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ENCYCLOPÆDIA BRITANNICA.

VOLUME XXXII (PRIBILOFF ISLANDS—STOWMARKET).

PRINCIPAL CONTENTS.

PREFATORY ESSAY.

THE FUNCTION OF SCIENCE IN THE MODERN STATE.[1]

By Karl Pearson.

I. *Science and the Structure of the Modern State.*

BEFORE the second half of the 19th century a true theory of the state was impossible. A sound idea of mankind as but one among many types of life, even if the highest type, had hardly entered men's minds—they were accustomed to contrast "nature" and "man." But had it entered, they knew so little about the laws governing any form of life, that they would not have gained much by extending the little known to man. Not till the publication of Darwin's epoch-making works was a real appreciation of man's position in the evolution of living forms possible, and with this appreciation all the old theories of the state became practically idle—landmarks only in the study, ever-interesting to man, of the history of human thoughts and theories. A complete revolution was wrought in the ideas of those who read and understood Darwin, both as to the nature of the state and as to its functions. The theory of the state could no longer be treated from either the philosophical or the purely logistic standpoint. The state was the product of an historical evolution; the nation was a unity evolved by the struggle of one living type under the same laws as applied to other phases of life. The theory of the state became biological: one of the most complex and difficult branches of biology no doubt; but still it was a great step to remove this theory from philosophy—or even from metaphysics, as in the case of Hegel—and transfer it to its true class.

Biological theory of the state.

It is little wonder, perhaps, that the first investigators in this new field went widely astray. They extended without due thought fascinating biological hypotheses to the case of man. They found the struggle of individual against individual in many vital fields, and they extended the survival of the fitter as a governing principle to all individual life within human communities; they did not stay to inquire why and how communities had themselves come into existence; they neglected the suggestions of the hive and the herd, and reached (as in the cases of both Spencer and Huxley) fallacious conclusions as to the functions of the state and the sources of social conduct. In short, they over-emphasized the intra-racial struggle, and under-emphasized the inter-racial contest, as factors producing and developing the political and moral characteristics in man. Other state theorists, again, accepted without qualification some doctrine like that of panmixia, unproven or even disproven for the lower types of life, and heedlessly applied it to civilized man. Nor were these over-hasty conclusions to be entirely condemned: by the discovery of the doctrine of evolution by natural selection, an absolutely new country had been thrown open, with endless possibilities for thought and action. What wonder if publicists, with no

[1] It must be understood that this is the briefest sketch of a vast and all-important subject, where the writer has not been able at every turn to develop detailed plans, but only to outline suggestion and criticism.

sound biological training, indeed no scientific training whatever, rushed in with jubilation to be among the early settlers? What wonder that biologists, with small historical knowledge, even without intimate acquaintance with the exact social history of any human community for the briefest of periods, extended at once great vital principles beyond their legitimate limits?

We can scarcely be surprised that some false views as to man and the state were propounded under the new impetus, or that some mistakes were made even in social legislation. Reaction was certain to come, and the cycle was completed, as usual, by a German professor demonstrating all Darwinian theory to be snare and delusion.

Darwinian theory and man.

Let us then at the present moment take stock and see where we actually stand. The main principle of evolution by natural selection is based upon four factors:—(*a*) That characters are variable. (*b*) That characters are inherited. (*c*) That there is a selective death-rate, *i.e.*, that individuals possessing characters or combinations of characters in a higher or less degree than other individuals die, on the whole, sooner or later than the latter. (*d*) That those individuals who die early leave fewer offspring than those who die late. How far are these factors demonstrable truths in the case of civilized man?

(*a*) This is beyond question for both physique and intelligence in man.

(*b*) This is absolutely certain for both the mental and physical characters in man. Both these are sensibly inherited at the same rate and, further, with such a degree of intensity that three, or at most four, generations of selection will suffice to establish a race in man which will breed true to itself under a stable environment.

(*c*) By observations on the death-rate of relatives—*i.e.*, of groups of individuals possessing like characters or combinations of characters—it has been demonstrated that 50 to 80 per cent. of the deaths among mankind are selective.

(*d*) This has been statistically demonstrated for both sexes in Great Britain, America, and Australia.

We are forced, then, to the conclusion that the Darwinian theory in the case of mankind is a law and not a "plausible hypothesis." It is a different problem to measure the rate at which evolution works. What sensible modifications can be made within 200, or even 8000, years in a human race by evolution? Recent craniological investigations seem to show that, even within the shorter of these periods, such changes can occur in the shape of the skull of a single race that 50,000 years or less would suffice to have modified the cranium from a type which any modern anatomist would hesitate to call human. The argument is not that the human skull has always gone forward at this rate, but that it could do so under apparently quite ordinary conditions. In other words, the biologist's demand for time must not be looked upon as indefinitely exceeding what the geologist is prepared to grant.

Such is our modern stock-taking—a possibility of the work done between 1890 and 1902—of the relation of the Darwinian theory to man.

The international struggle for existence.

But if we only apply the principle that all life progresses by the struggle of individual against individual to the history of man, we find half the facts of both social and political history wholly unintelligible. We have missed the great point, that man has largely progressed because he is gregarious; we cannot describe on such a basis the evolution of morality, the origins of tribal customs, tribal worship, national institutions, national religions, and, ultimately, of the modern state. We might as well attempt, on the basis of the survival of the fitter individual, a satisfactory explanation of why Sir Harry Johnston's African ant gave forth, when trodden on, a most appalling stench, so skunk-like that the destroyer fled from the spot. The welfare of the whole has controlled in this case, as in others, the development of the individual. The community in its entirety is struggling against its vital and physical environments. As soon as we interpret the facts of history in the light of progress by inter-racial struggle, and only in a secondary manner by intra-racial competition, those facts become deeply suggestive and significant for our guidance. We see both Roman and Hebrew nations arising from very small beginnings by successful variations in tribal custom and belief. We no longer mourn over the apparent waste of power in the continuous wars of the small Greek communities: we see in that strife the probable source of their rapid progress

in intelligence and physique. Nay, modern Europe itself at once becomes the stage whereon the drama of evolution is being played out amid the hum of factories, the clash of armaments, and the buzz of youth in the playing-field and the lecture-room. History has painted for us the ever-present strife of nations: in the lower stages we see the victory of brute-force and of cunning; in somewhat higher stages we find the dominance of strength, valour, and discipline; at the present the factors of mastery are possession of material sources and the skill to turn them to account,—the copious store of knowledge, the power to increase it at will, and the intelligence to apply it for the national profit. The struggle of nations is the commonplace of history; but the realization that this struggle is a factor in human development,—that big battalions or an armada are not sufficient insurance for success in it, but that organization and intelligence in every function of national life are requisite for victory,—this is the special truth that dawned upon us at the end of the 19th century. Formerly territory was blindly seized, trade routes and commercial markets blindly opened or controlled, manufacturing processes and means of transit developed or not, according as they might seem profitable or not to individuals. The bearing of these things and a multitude of others—such as the physique of the nation, the skill of its craftsmen, the intelligence of its trade-leaders, the activity of its educators, the organization and preservation of its material resources—was unrecognized in their relation to national fitness for the international struggle. The politician could tell the nation that it must have more ships or more rifles for the national safety, or he could emphasize the importance of the "open door" for national welfare, but he did not provide for the intelligent building of the ships, the intelligent sighting of the rifles, the intelligent training of the merchants who were to enter the open door amid the great international crush to get inside. He did not see that ultimately the training of even the apparently most insignificant workers in the community, the fitness for its purpose of the simplest manufacturing or agricultural process, may be vital to a nation in the evenly balanced contest of modern civilization. To stand still—for a moment to depend only on the possession of material resources, of the existing trade routes, or of means of transit—is to lose points in the game. Where all are pressing forward, not to advance is to fall behind.

Factors of national success.

Let us consider for a moment some of the factors of national welfare. First, the physical powers of the nation—*vital*: its numbers and effective fertility, its health and sanitation, the energy, vigour, and absolute strength of individuals; *material*: mineral wealth, sources of mechanical energy, coal, oil, water power, water and rail transit, docks, coaling stations; *equipment*: power to seize and power to hold. Secondly, the mental powers of a nation—power to carry out mechanical work quickly and effectively; power to discover and power to imagine, to incite and to stimulate:—*morale* and patriotism; power to resist long strain, to avoid epochs of national hysteria, to follow for years definite policies with only future profit in view, to govern effectively, or ultimately assimilate divergent racial groups. On examination, each one of these and other factors of national efficiency will be found to require intelligent handling: they demand training and knowledge—science in its broadest sense—if the stability of the state is to be maintained and increased, if the nation is to contribute its full share to the total progress of human activity.

Trained intelligence at the basis of national fitness.

The future is to the nations which not only realize the international struggle in all fields of activity, but consciously develop all the factors of national efficiency with this end in view. This is the theory of national life which presents itself at the beginning of the 20th century. It connotes an immense development of the functions of science in both legislature and executive. It should lead to new conceptions of, and new scope for, patriotism, and a revised attitude towards state action and state service. Brute force, strength and bravery, material wealth, have in turn been dominant in the state; to-morrow will be marked by the dominance of intelligence. The most intelligent nations will be victorious in the struggle; and it befits each state that would be great to-morrow as well as to-day to educate and organize itself, from the statesmen at the top to the ploughboys and factory hands at the basis. In the future it will not be possible either to organize and lead a nation or to make a cheese effectively without training—without a knowledge of what science has to say about men or milk.

The education of the nation, from statesman to dairymaid, is a task of great magnitude—more especially in old countries, where the institutions have developed historically, and often preserved features of earlier periods, when other factors than intelligence were dominant in national life. On the other hand, the older nations possess traditions and divisions which are not without service as rough results of experience. Caste and class may be exaggerated so much that they do far more harm than good, but to a certain extent they may serve for differentiating workers within the community. The nation stands equally in need of its ploughmen, its craftsmen, its traders, its brain-workers, and its leaders; and it is desirable to have some preliminary classification of what work an individual is best suited for. While, on the one hand, it is most important that all capacity which will be of special social service in performing a particular function shall find that function within its reach, it is, on the other hand, not only undesirable, but impossible, to subject every individual in the nation to a test of fitness for every possible calling. With rough practical efficiency a man's work in life is settled by his caste or class. This is not so undesirable as it might at first sight appear; it is a largely unconscious differentiation of the nation into workers of different types, who marry within their caste, and—if we remember how few generations are needful for a special human group to breed true—thus preserve to a large extent their special usefulness. We need a net which will be widely cast to drag upwards, and a similar net to drag *downwards,* but the meshes of neither of these nets should be too small. It is cruel to the individual, it serves no social purpose, to drag a man of only moderate intellectual power from the hand-working to the brain-working group; yet this seems too often the result of the present system. If there be a moderately capable worker, the state should strive, in the first place, that he should be trained to better craftsmanship. Do not let it assume that he will turn out a Faraday because he shows some relative capacity. In at least nine cases out of ten disappointment will be in store for the state if it does. Let there be a ladder from class to class, and occupation to occupation, but let it not be a very easy ladder to climb; great ability will get up, and that is all that is socially advantageous. We have to remember, for example, that the middle class in England, which stands there for intellectual culture and brain-work, is the product of generations of selection from other classes and of in-marriage. A hundred men of this class, quite apart from training and tradition, will provide a greater percentage of men capable of doing brain-work, than a hundred men from the farming class, or a hundred craftsmen.[1] These in their turn (if we do not regard training and tradition, though there is no reason why we should not) will produce a larger proportion of men suited for colonists or for the workshop than the former, and for precisely the same reasons—long selection and in-marriage. Again, we assert, the gradation of the body social is not a mere historical anomaly; it is largely the result of long-continued selection, economically differentiating the community into classes roughly fitted to certain types of work. And here we reach the first fundamental principle in the education of a community: the education must be specialized for each individual class of workers—all intelligence must not be driven through the same mill. The system under which local colleges ape universities, polytechnics ape local colleges, night-schools ape polytechnics, and all think it the highest merit to get their students stamped with a degree of one kind or another, is an utterly fallacious one; it is educational chaos, and has not the slightest approach to that harmonious system of education differentiated to class-function and class-intelligence, which must be at the basis of national fitness, *i.e.*, the readiness of each group in the community to do its specialized work efficiently. Let there be a ladder then, that indisputable capacity may climb to the place where it is most wanted, but the nation needs that the great bulk of its members shall work at the same tasks as their forefathers, only with increased intelligence and more highly developed craftsmanship.

Significance of class and caste.

[1] The cry for "an easy ladder" is a most mistaken one, especially as long as any false feeling of gentility attaches to one or another class of workers. During the last few years the writer has come largely in contact with a number of young men and women whom the county councils up and down the country are educating at the national expense. These county council scholars are on the average not up to the mean middle-class intelligence. It is very rarely that one could not pick out for any given post better, often many better, middle-class candidates. In this case the meshes of the net are far too small: ten per cent. of the scholarships would have sufficed to procure the really capable men and women whom it was of social value to educate for intellectual pursuits. The rest want either the originality, the power of self-assertion, or the physique which would enable them to force their way forward in a new sphere. The bitterness of failure is upon those, who, scholarships ended, sink to usherdom in small private schools, or to second-rate draughtsmen in engineering works. Taught in true craft-schools, they might well have been leaders in their own class, instead of failures in another.

Make it easy for the Michael Faradays to climb, but only for such as he was; the increase of the intellectual proletariat is a sign not of efficiency but of chaos in national education.

Need of specialization in education.

If national education at the present day be a *sine quâ non* of national fitness for success in the world-struggle, it must none the less be a specialized education suited to develop the intelligence of each caste and class. Training is essential to a nation, but it must be specialized to each social activity, if it is to perform its function. How is this truth to be brought home to the statesmen, the permanent officials, or the politicians, who alone can bring order into educational chaos? The statesmen of the old school, blamelessly ignorant of the laws of national development, were inclined to look upon race-progress as due to mighty forces beyond human control, and thus to believe that executive and legislature could do little to make or mar national welfare. But as we learn to understand better the laws ruling living organisms, our appreciation of the factors in human history changes: man cannot modify the law of gravitation, but he can make its effects subserve his own ends; and this is equally true of the laws which rule organic and inorganic material.

Training of the statesman.

Unfortunately the training of the statesman himself is often sadly defective; he rarely stands at the summit of the knowledge of his day, or has the instinct to select his subordinates for real organizing power. In a democratic state the process by which the statesman is chosen is at best a risky one. His requirements are, first, ample private resources; secondly, power to impress a possibly well-meaning but largely ignorant democratic electorate; and lastly, ready debating power and personal influence on the somewhat narrow group, chiefly of his own type, which is to be found in the average representative assembly. There is no security in these requisites for a training in statecraft. The race-leaders and potential empire-builders rarely find their way into representative assemblies. The men who could organize a great national department, or even organize the nation itself, devote their energies to the building up of world-wide commercial enterprises to their own profit, or to the profit of a narrow circle. And when such men have convinced the world of their business capacity, of the shrewdness with which they can appreciate new ideas and forestall the future, they are already beyond their prime. They have no longer the inclination to learn the complex routine of parliamentary life, or the power to stand its physical strain. One of the most difficult problems for the democratic state is to make state service in its highest branches a career for such men in their youth, and thus allow the nation to exploit at once and directly their power of initiation and organization. Still more difficult, perhaps, is the selection of statesmen in the case of an oligarchy. The nation which bred and trained a specialized class of men solely for statesmanship would undoubtedly be best governed under such a true aristocracy. But in practice the existing false aristocracies fall far short of serving any such state function. There is no security that the dominant caste represents either the intelligence or the organizing power of the community. Even if the caste be based on wealth-accumulating power or state-service of ancestry, there is no security for the brain-power indicated in past success being preserved by inheritance, unless the maintenance of family ability becomes a far more conscious guide in the arrangement of matrimonial alliances than it appears to be in any aristocracy of the present day. Further, little, if any, specialized training has hitherto been provided for such a class beyond the educative experience of men and manners—which may legitimately be considered a trifle narrow—to be gained in a parliamentary career and the earlier stages of executive life. Without proper selection or fitting training the statesmen of the oligarchy may forget inter-racial competition under the bias of class interest, and the intra-racial dominance of a caste become the chief object of a false statecraft.

A secure autocracy hardly affords a like foothold for intra-racial struggle weakening the effective response of a nation to its environment. But its success depends so entirely on a single throw of the dice—the discovery of a man with unique powers of selecting intelligence and organizing ability in his immediate subordinates—that it need hardly be considered as a practical form of government. The discovery of the ideal dictator is a problem which finds not even an approximate solution in elected presidents, still less in hereditary autocrats. It is true that revolutionary processes by which the really strong man comes to the top may occasionally aid a nation at a time of crisis, but they are too expensive in other ways to be aught but a counsel of despair. Historical evolution has left most civilized nations,

after a rough and tumble experience, with a democratic government more or less tempered by oligarchic and autocratic institutions. This may be the best practical solution of the problem in the present stage of national development, but such a system is terribly cumbersome in its processes for ensuring that the keenest brains and the best organizing power of individuals shall be secured as the brains and the organizing power of the nation at large. If the best trained, the most intelligent community is destined to be the surviving type of the present century, then the cry must not only be: Educate your democracy! but also: Select and train your aristocracy for statecraft!

If we may assume, and there is small doubt that we safely may assume, that all qualities in man are inherited, and inherited at such a rate that very few—two to four—generations suffice for selection to produce a class breeding true to itself, then the selection of an aristocracy even by the rough process of ennobling great ability or great wealth (acquired by the owner) is intelligible. But the continuous support by the nation of members of an oligarchic class who have ceased to be of service for aristocratic purposes is futile. In the fourth generation at latest such members should drop out, unless the stock has again proved its capacity by effective national service. The absence of such service will be a sure sign that the original ability was sporadic, that the stock has not bred true, has wasted its intellectual patrimony, or has neglected to train itself for its special functions. The net—meshes not too small, let us remember—must drag *downwards* as well as upwards.

Need for a school of statescraft.

The training of an oligarchic class in statecraft is the first and perhaps hardest task of the modern state. Much, very much no doubt, can be learnt from municipal, parliamentary, and minor executive experience by the man who from youth upwards has resources and leisure. But such a training alone is very narrow; it may be supplemented by leisurely travel, and the somewhat superficial knowledge thus gained of the men of other races, their institutions, aims, and modes of thought. As a preliminary, however, to both travel and political experience, a specialized academic training is really needed. There is a demand for a school of statecraft. The idea is not so absurd as it may at first sight appear; nor, on the other hand, are the chances of its success so great that every university, local college, and night school should rush to establish a lectureship in statecraft! Special schools are best localized at one or at most two centres; they should grow up naturally by the development in a definite direction of an existing educational centre, which to some extent already attracts the class of men to be catered for. We want a specialization and a modernization, in the light of current biological science, of some existing History School. There should be one school at least, where the political institutions of Germany and France are as well known as those of Greece and Rome; where the chief phases of Indian religious development are as closely appreciated as the theological currents of 16th-century Europe; where the 19th-century "discovery of Africa" would be discussed and interpreted in its relation to modern European politics, like Columbus's discovery of America has been dealt with as marking the end of the Middle Ages and the collapse of the mediæval system. There should be one school at least where colonial institutions, ambitions, and developments are studied and appreciated; where national customs, racial prejudices, the foreign press, its powers and limitations, are calmly, and apart from political intrigue, investigated and weighed in the balance; where the students' own nation, its comparative power and influence, its *morale*, and its policy are all dealt with in an atmosphere comparatively free from party strife, and at an age when the mental judgment has not had its roadway worn into ruts by the continual traffic of men and affairs. Sketchy as such a scheme must seem,—its realization could only be a growth,—yet the absence of such a school of statecraft is a partial, if not complete, excuse for ignorance on the part of the leisured and ruling class of more than one modern nation. A class of great ability and organizing power has not only to be gathered together by the drag-net cast over the other classes of the community, but once formed it must have a high tradition in its choice of mates, and a really effective training provided for its members.

The form of government, the right selection of statesmen, is far more important in its bearing upon the true function of science in the state than might at first sight appear. Unless we have the statesman of insight, who recognizes that every function of the state, every phase of national life, has a theory of its own; that there is a right and a wrong way of conducting all state business, whether it be concerned with the wealth, the physique, the intellectual efficiency, or the *morale* of a nation;—we cannot

place knowledge—science in its broadest and truest sense—in its rightful position of consultant alongside the executive. We must have stored knowledge, science theoretical or empirical, at the service of the state for the ordinary routine of every department of national activity; we must also have thinkers and discoverers ready to meet new needs and sudden emergencies; there must be in reserve trained brains and deft organizers both of material resources and of living workers, not only for the constant drain of progressive national development, but, above all, to give the community confidence and reasoned guidance in times of national crisis. The universal rivalry of nations at all points of the globe, the rapidity and ease of modern communications, do not give any nation time to wait for the right man for a particular task to turn up. He must be there fully trained and equipped, so that the executive, the commerce, or the commonality of the nation can seize and exploit him at once. If he is not immediately forthcoming, the fruit will drop into the mouth of the nation that had the luck or the foresight to have its man ready for the occasion. Readiness for pioneer-work is one of the best tests for efficiency in the modern state. The mineral wealth, the climate, the agricultural resources of a new territory are to be reported upon with a view to its incorporation or development: the men to do this effectively must be ready trained and at hand. A troublesome native tribe is to be tutored by the touch of the masterhand: the man who can guide them with experience, with knowledge of their language, of their religion and their customs, cannot be reared—he must be forthcoming on the spot. The trade-rivals of a nation discover a chemical process which threatens some national industry of a second: the chemical or agricultural experts of the latter must be immediately prepared with a process for cheaper manufacture or more intensive production. Another nation invents a smokeless powder or a submarine boat: no neighbouring state can afford to start *de novo* with years of experimental inquiry; its experts—if they have failed, as it is not creditable to have failed, to be first in the field—must be ready with an immediate and effective reply. No nation can nowadays risk being a single step behindhand in its offensive or defensive services, in its methods of production, of trade or of transit, or in the general education of its citizens, —their craftsmanship and their ingenuity,—or, again, in their average physique and reproductive power.

Statesmanship and science.

In the days of old the battle of life was won by the nation with physique, and intelligence enough to guide that physique. To-day victory is to the nation with intelligence, and physique enough to keep that intelligence in healthy activity. In past times the chief store of national power was manual labour: to-day it is the machine that does the work, and not the man; the important things are the brain which organizes and the intelligence which creates and guides the machine. Mineralogical, chemical, engineering knowledge achieve to-day what muscle and brain did a thousand years ago; the chief function of physique is now to maintain the brain in order, and not to act as a machine at the bidding of brain. The old order has changed; from statesman at the helm to craftsman in the shop, modern conditions demand special training, not haphazard selection. Here is the wide function of science in the state. How under existing conditions can science serve the state? How provide guidance in executive, reserves of knowledge, of discovering power, and quick response for emergencies; how train the craftsman, the agriculturalist, the engineer, to be one and all efficient for the international contest? To touch upon these things will be the object of the second section of this paper.

Survival of the most intelligent nation.

II. *Science as Educator.*

The subject of primary education is not one on which much can be profitably said here. Its thorny character arises partly from theological difficulties, and partly from the widespread delusion in the minds of those who have received a primary, or even a more advanced education, that this fact alone constitutes them educational experts. Neither aspect of the case is satisfactory from the crucial standpoint of national efficiency: both involve immense waste in time, energy, and *personnel*. Sooner or later the primary schools must fall absolutely into the hands of the state, and, free from direct local control, be managed by a single council of education and a minister responsible to the national assembly. Every other system is merely tinkering at best; there are not sufficient real educational experts in the country to provide the capacity which is needful on innumerable school boards, to say nothing of parish

Primary education.

committees and district councils. Local vigilance committees may well be organized to see that the national system is effectively carried out locally, but local bodies are not in the intellectual position to draft an efficient system; nor, if they could do so, are they able either to put it into practice economically, or to avoid the friction of local sectarian feeling. If intelligence be the keynote to national fitness for the international struggle, the organization of even the primary stages of the nation's training is as much a national affair as the equipment of the nation's forces for offence and defence: it cannot be left to local management, but must be removed to a higher plane of both criticism and executive organization.

But state control of primary schools is not only essential from this aspect, but also from the importance which must be attached to the nation having a complete and uniform record of the physical condition of its children. Is the stamina of the nation being not only maintained but strengthened? This is a question to which the statesman ought to be able to give at once a satisfactory answer. He ought to be in a position to tell us whether fifteen to twenty years hence we shall be as strong and active a nation as we have been in the past. We are too apt to forget the changes that have taken place not only in the nature of the food supplies, but in the very atmosphere our citizens are breathing. What are the effects of urban or suburban dwellings on increasing numbers of the population; of a frozen meat supply kept for months and possibly years; of foreign ground flour; and of innumerable articles of food and medicine prepared in factories, here or abroad, by processes not wholly scientific, and now sold over the whole country? Possibly but little knowledge of the direct effects of such new factors could be obtained by straightforward inquiry, but a systematic anthropometric record of the schools would tell us whether our children progress or not from generation to generation, and what is the nature of the special precautions, if any, to be taken with regard not only to individuals but to whole localities. Very little extension of the system of observation and measurement would teach the state the effect of particular trades on parentage; the districts where special diseases have to be combated; the localities where special physical or mental aptitudes are to be found; and where it is most desirable to establish secondary and craft schools of a specialized character. In Great Britain we have not only many local races, but many mixtures in diverse proportions of these races. How far are such groups particularly suited to specialized activities? It does not follow that because certain industries have sprung up in the neighbourhood of material resources or of means of transit, that the local population is best fitted to carry on these industries; the sorting and sifting of population, the creation of a local sub-race, suitable to a developing local industry, is by no means so rapid as it ought to be.[1] An effective record, made on a common system, of the physique and intelligence of the children of the nation would immensely assist the quest for suitable types of manual labour or of special intelligence.

Physical record of nation's children.

Or, again, at a time of national stress it may be important to answer a definite question, which could be at once answered from primary school records. We may be struck by some defect in our training, we may attribute want of intelligence in our officers or soldiers to the over-emphasis given in our school system to athletic sports. We may be stirred by ringing phrases like "the flannelled fool at the wicket" and "the muddied oaf at the goal," not to change the bat for the rifle, nor the pad for the pigskin, but to condemn sports in the school as lessening the training required for intellectual development. We may attempt to remedy wrongly an admitted national failure through ignorance as to its true source. Here, again, the schools can aid with a proper record. What are the characteristics with which we find the athletic tendency associated in the schoolboy? Science is now ready with an answer,[2] which would be far more definite and complete if we could draw our statistics from the wide material of a national record. Association between qualities is measured scientifically by the so-called *coefficient of correlation*, which is really a measure of the average relationship between two qualities—it can take every value between zero and unity. When it is zero, we say the qualities have no relation to each other; when it is unity, we consider the relationship perfect or

Relation of athletics to intelligence.

[1] The man who wants horses for a particular type of work, to go at a definite speed, or with a definite load, or on a particular type of metal, will generally be able to find a part of the country where horses suitable for his purpose are bred.

[2] The results given below are based upon measurements and observations of between 5000 to 6000 school children which have been taken for the writer during the last five or six years by the help of school teachers. The inquiry has been aided by a grant from the Royal Society Government Grant Committee.

causal.[1] When it is positive, the two qualities increase together; when it is negative, the one quality increases as the other decreases, and *vice versâ*. Premising so much, let us inquire in what degree our school record shows the athletic character to be increasingly related to admittedly desirable characteristics. We find, if we define the athletic group to consist of boys not only keen on games but proficient at them, that the relationship between the characters is expressed as follows:—

Athletics and good health	·46	Athletics and noise	·35
Athletics and intelligence	·21	Athletics and popularity	·33
Athletics and quick temper	·22	Athletics and self-consciousness	·08

Thus we see that the athletic lad has associated with this character in a very sensible degree: good health, quick temper, and intelligence. His ability in games makes him slightly self-conscious, comparatively noisy, and, as we might expect, popular. He is also rarely *sullen*. Nor is this character substantially the result of his having good health; for we find that the healthy, as distinct from the athletic, have less than half (·09) the association with intelligence, and a scarcely sensible correlation (·03) instead of a fairly high correlation with quick temper. Nor is it a matter of race; for soundness of health is very slightly related to *dark* eye (·07) and *dark* hair (·01) colours, but the *fair* are just sensibly the more athletic (·04). The athletic schoolboy who rejoices in cricket and football is distinctly neither "fool" nor "oaf," but the healthy, intelligent, rather quick-tempered lad who should make a good soldier. Clearly games and aptitude for games ought to be encouraged in the primary school. When and for what they should be laid aside as we approach the real work of life, with its national and industrial demands on the citizen, cannot be profitably studied until we have ample data of the above kind for youth both in the factory and at the university.

Aims of primary education.

To the observer of childhood playing and questioning are its natural functions, and the teacher in the primary school has to develop nascent intelligence on these lines. Playing skilfully means intelligent use of eye and hand,—it is the basis of efficient craftsmanship in the future. Questioning profitably as to the meaning of what is seen, is the basis of discovery by observation—it provides the *principia* of scientific training. To turn the ceaseless movements of the healthy child into the co-operative work of eye, hand, and leg, and its too often meaningless "why" into reasoned inquiry, is the first and most difficult task of the primary-school teacher. Organized games developing into the elements of craftsmanship, inquiry into things observed expanding as time goes on into a conception of the methods of science: these must be the essential features of the state primary schools of the future. Facts are to be secondary, methods of the first importance; the intelligent man knows where and how to find his facts, but he retains no more in his head than he finds economical for everyday practice.[2] His brain is an instrument for work, not a lumber-room. Hence when once the barest essentials of elementary knowledge—the power to read, to write, and to do simple calculations—have been attained,[3] let us adopt largely heuristic methods—collect facts only as aids to intelligent observation and inquiry, and use biology or mechanics, or history or physiography, according to the aptitude of the teacher and the environment of the school, as a means of training intelligence, and not as a store of facts worth remembering for their own sakes. Let the child come out of the primary school able to formulate its questions intelligibly; able to put eye, hand, and leg into co-operative action; able to read, write, and count;—and the first stage in the training of its intelligence to national ends has been attained.

[1] The following series indicates the closeness of correlation in various qualities for purposes of comparison:

High Correlation, 1 to ·75.		*Moderate Correlation*, ·5 to ·25.	
Right and left femurs in man	·96	Out-relief rates and pauperism	·48
Bone length, right and left little fingers in man	·90	Degree of foveation and severity of smallpox attack in vaccinated persons	·40
Stature and femur in man	·80	Coat colours of horse and grandsire	·30
Left middle finger and foot in man	·76	Winter barometric heights in Lisbon and Valentia	·25
Considerable Correlation, ·75 to ·5.		*Low Correlation*, ·25 to ·00.	
Stature and foot length in man	·74	Strength of pull and stature in women	·22
Weight and length of new-born infants	·63	Lengths of lives of mother and adult daughter	·15
Vaccination and recovery in cases of smallpox	·60	Sizes of family for mother and daughter	·11
Statures of father and son	·51	Size of head and ability in man	·06

[2] Not to know the capital of Servia, the tributaries of the Don, or the constituents of the atmosphere, is no sign of defective education. "Facts" change from generation to generation; but skill in manipulating facts is the fundamental sign of a trained intelligence, of a true education, which survives all modifications of its material.

[3] From the standpoint of economy a certain amount of rote teaching must be admitted in the case of the three R's. It is loss of time to apply the heuristic method to English spelling, or to *every* stage in the multiplication table. Nature-study—physical or biological—offers far more profitable material than adding nines to nines up to 108!

But let it realize in the simplest way that this development of intelligence is not for selfish ends. Bring before it from the earliest day the habits of the herd and the hive as illustrations of united work to a common end; let it see that man is lord of all life because he is the most intelligent *gregarious* animal; teach the child by practice and example the effect of combination, the struggle of the social group against its environment, and the progress man has made in effective resistance by co-operation. Let the child very gradually become conscious of the fact that man is fittest not as individual, but as society. In the broadest outline let it see evolution at work on man, and why the social is "right" and the anti-social "wrong." Let it realize that the strong nation is the intelligent nation; and let it early grasp school-teaching as the first stage to good citizenship, and that only the intelligent man can successfully perform the duties which society and the nation demand from each of their members. Here is a broad enough basis for primary schools in teaching the fundamentals of morality, which each sect may supplement in its own special manner. The state, as unsectarian, has first to inculcate the social duties: to emphasise the need of developing the physique, the intelligence, and the spirit of co-operative action as essentials of true patriotism.

Social action as a product of evolution.

From primary we may pass to secondary education, wherein we shall find that far greater changes will be needed in the future than seem at all to be anticipated to-day. For while the subject matter of primary education may well be the same for all classes in the nation, modern requirements urgently demand specialization in secondary education, and to a large extent a differentiation of groups, according to the nature of the work they are to undertake in life. This does not necessarily mean a differentiation of method, nor perhaps of location, but certainly of the subject and of the apparatus used to illustrate method. The great bulk of the population are already at fourteen employed in work or in seeking employment. For this portion, at any rate, there ought to be the elements of a secondary education specialized to their calling in life. Besides the state primary schools, there ought to be craft-schools, possibly separate for the two sexes, thickly strewn over the country. These schools, while largely under state control, ought to be subject to a much greater local influence than the primary schools, partly because theological problems will have been for the most part settled at an earlier stage, partly because the needs of local industries are often best appreciated in their immediate neighbourhood. In these craft-schools we do not want university graduates lecturing upon mechanics or chemistry as they have learnt those subjects in academic text-books or laboratories. We do not want the higher theory of agriculture or engineering such as may be given to the directors and leaders of labour in technical colleges. What is needed is an extension of the object-lesson method of the primary school to the basal forms of labour on which the social fabric ultimately rests. We want to give a system of secondary education to the great bulk of workers, which will make the individual worker an intelligent instrument for his allotted task; we do not require, in the first place, a system which leaves the majority untouched, but raises an artisan here and there to a higher caste. We need a system of education for the bulk of men, who follow, entirely independent of the system requisite for the minority, who organize and lead.

Secondary education.

Secondary craft-schools.

The craft-school, in the few years in which it can handle its material, must achieve two things, both tending to strengthen the national fitness for survival, namely, it must lay the basis (1) of good craftsmanship and (2) of good citizenship. Under the first heading no form of labour is to be considered beneath educational treatment. Taking first the rural craft-schools, no agricultural or horticultural process is or ought to be without a basis of scientific theory; hedging and ditching, ploughing, hay-making, harvesting, care and handling of horses, cattle, sheep, and pigs, all that falls to the lot of farm-labourer, shepherd, hind, and groom, can be treated intelligently. They can all be dealt with by the object-lesson method,—observation, and deduction from what is observed. On the girls' side, milk, butter, cheese, poultry, household work of every description, can be used in the same way as material for showing how to do things intelligently. Education is in no case to leave the feeling that it is finer to follow one trade than another, but is to develop the consciousness that it is a disgrace to follow any craft without intelligent appreciation of the why of its processes. The victory is to the intelligent nation; that nation is intelligent in which each member performs his allotted task with appreciation of how and why it is done.

Rural craft-schools.

The pure scientist still occasionally speaks with contempt of the technical side of education. If technical education be merely a knowledge of the facts and formulæ used in special industries, he is entirely in the right; if, on the other hand, technical education means the illustration of scientific method on the material and appliances used in a particular trade or craft, he is hopelessly wrong. It is as possible to give scientific instruction on the apparatus of a craft as upon the delicate toys of the academic physical laboratory. The horse and the pig, the growing crop and the vegetable garden, are as replete with lessons in scientific method as zoological or botanical laboratories with their microtomes and microscopes. The science of elasticity may be as effectively studied with the 60-ton testing machine on the materials of construction as with pound-weights on the rods and wires of the physical laboratory; thermodynamics is, perhaps, as instructive a science when illustrated on the steam- or gas-engine as when a diagrammatic air-engine appears on the lecture-room table; and there is a reality about the inertia of machinery in motion which illustrates momentum and energy in a somewhat more convincing way than the falling weights and the rolling balls of the academic mechanical laboratory.

Pure and technical science.

We have diverged here far beyond the humble limits of our craft-school, but it seemed necessary to insist once and for all on the great principle: that technical instruction can be scientific in the best and highest sense; scientific method can be inculcated and illustrated on the material and apparatus of any special craft or employment as well as with the costly buildings and delicate apparatus now demanded for academic purposes. If it be said that apprenticeship is the true craft-school, the argument is valid, so far as many facts and empirical rules have still to be learnt in the shop, on the farm, or at the bench. But our secondary craft-school is to be preliminary to work in field and factory, it is to inculcate what the master or fellow-workman has not the time, nor usually the power, to do, namely, to emphasize the importance of intelligently following out each craft-process. The secondary craft-school must inspire its pupils with a desire to know the reason for the rote which apprenticeship is sure to thrust upon them. The secondary craft-school is not to be too specialized—at least not in rural districts; its pupils must spend much of their time on the farm, in the local factory, in the carpenter's shop, and at the smithy. They should not be required to learn the elements of mechanics out of examination text-books; nor be pushed on to the extraction of cube roots, as if that were the crowning feat of mathematical instruction. Let the pupils measure a plot of garden ground intelligently, the capacity of a barn with reference to the size of crop it will hold, or the cubic feet of air in a stable or stall with reference to the air-space necessary for healthiness of cattle; the approximate amount of half-inch planking to be obtained from an unfelled tree (to be tested after it has passed through the local sawmill) —these and many other exercises will occur to the intelligent teacher. Let his or her work be supplemented, too, by occasional lessons from the highly-trained artisan, the carpenter or millwright, the head-gardener, the shepherd or the dairymaid, or from the workers in any other crafts which are locally available and offer craft-workers of experience. The intelligent craftsmen may be scarce at present, but as the secondary craft-schools pass more and more of their pupils into local activities, and possibly keep touch with them through the higher craft-schools, through continuation and night-schools, the material to draw upon for occasional lessons, and possibly for permanent teachers, will become more extensive and better.

Apprenticeship and craft-school.

In the town districts the secondary craft-schools ought to be more specialized; some of their work is already being done by so-called technical schools and polytechnics. But these places and their courses are largely chaotic at present. They have not settled whether it is their function to give secondary craft-education to boys and girls, to give higher craft-education to the non-commissioned officers of industry, to train the commissioned officers themselves—the proper work of the higher technical colleges,—or to provide cheaply a one-sided and, in nine cases out of ten, inferior academic education for young men and women who believe their success and standing in life will be assured if they are hall-marked with a university degree. It cannot be too emphatically asserted that absolute differentiation in function is essential for success in technical education, especially in urban districts. There must be secondary craft-schools which will supplement primary education, by illustration of scientific method on the elementary processes of most forms of labour. Boys and girls will leave these schools not later than thirteen to fifteen, roughly pre-

Urban craft-schools: present chaos.

pared to follow intelligently the lower grades of industry. There must be higher craft-schools, with much more specialized instruction, for the non-commissioned officers of industry. There must be technical colleges for the leaders of industry, and universities or university-colleges for pure science, literature, and other types of brain-work; these again must be supplemented by professional schools for medicine, law, actuarial training, &c. &c. There must be for the most capable pupils a possible passage from secondary to higher craft-school, and from the latter to the technical college, or in special cases, where pure scientific capacity is noted, a transition to the university. But the nation which fondly imagines that one class of teacher and one building will serve for all these diverse purposes, and calls it a polytechnic or a university-college, is only excelled in folly by the nation which clubs a dozen such hybrid institutions together and supposes that they form a working university! Such a nation has not learnt the *principia* of educational theory, and the sooner it learns from the nations that have, the better for its welfare if that depends upon industrial efficiency. The secondary craft-school, the higher craft-school, the technical college, and the university serve quite diverse functions, educate for different careers and occupations in life; if economy or convenience bring any two under one roof, then there should be a differentiation of teachers; if even this be not possible, there should be at the very least a differentiation of material and of plan of instruction.[1] Otherwise, there is the greatest danger that instead of intelligent workers in the ranks, the secondary schools turn out a superfluity of incompetent non-commissioned officers; the polytechnics provide non-commissioned officers who know only the duties of the subaltern, and the colleges subalterns with the making of pure scientists, but not of technical leaders.

Scope of secondary craft-schools.

In urban districts, from the higher grade or continuation board-schools, and from one side of the polytechnic teaching, must arise the perfectly distinct secondary craft-school, educating boys and girls to be intelligent workers in the ranks of specialized industry. It must go no further than the attempt to show that all forms of manual labour can be performed intelligently: its aim is the real, or at any rate the idealized, craftsman of the Middle Ages, the man who loved his work, because he realized the why of it, and its relation to a greater whole. There is no doubt that the highly-differentiated character of some branches of modern factory labour—by no means all—tells against intelligent craftsmanship. For this reason the secondary craft-school must not be too specialized, even in urban districts. The demand of the state for intelligent citizens is equally important with its demand for intelligent craftsmen. Hence it should be a *sine quâ non* of every craft-school, whether secondary or higher, that each pupil should study one branch of pure science, or one literature, or one historical period, apart from his technical studies, as a field for rational enjoyment in adult life. Let it be done as recreation, not as task; but let its effectiveness be a condition of any state or municipal support to a craft-school. It has been in the past such a noteworthy characteristic of the British race to produce amateurs, following professions, trades, or even handicrafts, who have done first-class historical or scientific work, that we may hope that the absolute need for differentiation in education and the specialization of the smallest branches of knowledge will not finally check this production. The encouragement in the craft-schools of a special recreative study might be of most material importance in this direction. If care be taken that not facts and formulæ, but the scientific method and spirit, are illustrated on the subject and appliances peculiar to the craft, very little time or energy will be expended in merely applying the notions of scientific observation and reasoning thus obtained to the recreative study. In the higher craft-schools and technical colleges, lecturers of the university-extension type would find a most useful field for their energy and enthusiasm in teaching recreative branches of literature or science, and above all in showing the pleasures of a library, apart from its value as a store for facts and formulæ, its most important function on the technical side. In the secondary craft-schools, also, the "citizenship" teaching should certainly be carried a stage further: both boys and girls should learn a little, if only a little be possible, of the reason for and history of the institutions—national, municipal, and social—which, as citizens, they will have to work under and develop.

[1] To give a man control of a higher craft-school because he has taken a brilliant university degree in pure science is a common illustration of the present chaos in technical education in England. It is hardly excelled by the offers of *teaching* posts which the high wrangler receives the day after the appearance of the class lists.

Lastly, in no secondary craft-school ought the need for athletic exercises to be disregarded. The anthropometric record of the primary schools should be continued, that it may serve as a control for comparative physical progress. But a certain portion of the time devoted to athletic exercises should now be applied to developing qualities which may hereafter be of service for national offence or defence. The rural lads should be taught the elements of drill, rough road-making, the ready use of pick and shovel, and the fun of scouting games; where possible, rifle practice should be introduced, and swimming and even riding be taught. For the lads of urban secondary schools some of these matters are difficult enough; but the plan of holiday camps in the summer may be widely extended,[1] rough map-making and scouting can often be practised on suburban heaths, and opportunities for drill and swimming, rough carpenter's, saddler's, or shoemaker's work can nearly always be found. In all these cases let it be recognized by the lads themselves that these things are not craft-training, but are taught to fit them for duties which a strong nation demands of all its citizens in one form or another. In the case of the girls the horizon must appear somewhat narrower, and it is, perhaps, only their teachers and elders who can realize the national importance of those forms of physical training which may aid them to be the healthy mothers of a strong race. Still it is highly important that they should realize that they belong to a larger whole: that they have a function in the state as well as a relation to individuals. Bandaging, first-aid, the elements of nursing, the care of infants—and of the aged—may all be taught as extensions of household economy, and the social value of such work inculcated. But they are not essentially outdoor physical exercises, and the latter, whatever be their real import, must bear for the girls the aspect of mere games, not of sports obviously directed to national ends.

Athletics in secondary schools.

To sum up, then, our conclusions as to the functions of the secondary craft-school: it is intended for the rank-and-file workers in all the industries and crafts of the country. It should provide: (i.) Training for the intelligence, by illustrating scientific method upon the material and appliances of every craft. As the elements only of the craft will be considered, many crafts will be combined in one school, but greater specialization may be possible in urban than in rural districts. (ii.) Recreative Studies, (iii.) Citizenship Course, and (iv.) Athletic Exercises. The bulk of the instruction will fall to the lot of the permanent teachers under (i.); subjects (ii.) and (iii.) may well be undertaken by a specially trained class of peripatetic teachers; while (iv.) might largely be aided by volunteer workers, whose labours should be guided and systematized by district advisers, who would travel from school to school, suggesting and organizing the service with a keen eye for local possibilities.

General functions of secondary craft-schools.

If from the secondary education of the rank-and-file workers we turn to that of the leaders, we have at once the differentiation into the two classes of non-commissioned officers or foremen, and of the commissioned officers, or the leaders of industry, the brain-workers, thinkers, and educators of the nation. Probably the first class will be largely drawn from those who have shown marked capacity in the secondary craft-schools; these should be passed on to the higher craft-schools, the work of which will be dealt with later. When we consider, however, the provision hitherto made for the nation's intellectual leaders in the matter of secondary education, one is surprised, not that the nation has gone relatively backward, but that it has survived at all in the keen competition of modern times. A nation needs organizers, leaders, thinkers, not only in commerce, but in manufactures, the technical arts, transit, colonization and exploitation, pure science, professional and literary pursuits. Up to the immediate present hardly any secondary education at all has been provided suitable in the least degree for a college training in any one of these matters except the last. Our commercial and technical leaders have rarely had any scientific training at all; they have grown up without it, and held their own owing to the political and economic conditions of their country relative to its rivals. Such will be an absolute impossibility in the future, now that the equal or superior sources of power of our rivals are being worked, and the plant is created and the labour trained which is requisite for production. Granted that resources and machinery are alike,—they are now far from being in our favour,—it is only

Secondary education of middle classes.

[1] The camp-holiday system, which has flourished a good deal under voluntary effort during the last few years, ought not only to be developed and widely extended, but supplemented, if possible, by short summer cruises on training brigs, where the lads would receive a different kind of drill and learn a little, if the veriest little, of what the sea means.

the most highly trained intelligence which can turn the balance to our side, or even equalize it. Yet what has happened? The movement for technical education has led to the establishment of a number of technical colleges, where a more or less efficient technical higher education can be obtained, but it has not provided the essential stepping-stones to this education: namely, secondary schools up and down the country specializing in commercial, technical, and scientific instruction. Occasionally the modern side of a large school may be found doing good work, but its existence at all is an exception, and it is an exception among exceptions if it gives a training useful for technical purposes. A Cambridge wrangler, who teaches to an occasional student an arid text-book on the calculus, with a view of his getting a scholarship; academic laboratory work of a physical or biological character, boiled down and sterilized to suit the youthful digestion; formulæ from algebra, facts from mechanics: all these exist. But in nine cases out of ten no direct and conscious training in scientific method, no teaching to observe, classify, and reason on facts collected by the lads themselves.[1] No specialization by *trained* teachers for commercial, technical, and scientific pursuits is in the majority of cases thought of; and since it would largely have to be provided by men not educated in the ruts of the older academic methods, there is small doubt that both teachers and taught would be looked down upon as of a lower caste. Desirable as it is to associate lads who are about to follow very diverse callings in life, there is small hope of efficient secondary education, specialized for commercial, technical, and scientific pursuits, being provided in the majority of our great public schools, with their traditions and systems centuries old. These modern schools will have to be founded *de novo*, or developed out of the large day-schools of urban districts, or the decadent rural grammar schools, which up and down the country may be found, atrophied under a system which was, perhaps, a vigorous reform in the second half of the 16th century, but supplies no urgent national need of to-day. Let there be no doubt, however, about the nature even of the commercial education we are considering; it is not intended to turn out commercial travellers and clerks, who fall into the class we have termed non-commissioned officers. For these the secondary and higher craft schools should provide. The scheme is intended for the leaders of industry, for the men who will be manufacturers, merchants, shippers, engineers, the organizers and thinkers. These are the men who will pass on to the technical colleges and the commercial universities of the future. As the German technical universities[2] draw their students from the *Realschulen* and not the *Gymnasien*, so our technical colleges need an effective technical and scientific secondary education antecedent to their work. We have the German experience to draw from and to learn from, and we ought to be able to create schools which will turn out a lad with all the healthy traditions of English public-school life, but who has replaced its classical education by an effective training in the methods, not the results, of scientific inquiry.

Need for modern schools.

To the general outline of these schools much that we have said of the secondary craft-schools will apply. The teaching will have to a considerable extent to be specialized—commercial, technical, and purely scientific departments being provided with different teachers and methods. In each case the primary object will not be to give the lad information useful to him in his future calling, but to develop his intelligence by the application of scientific method to the material and processes with which he will later be concerned.[3] Again, to prevent narrowness we must have the recreative study; and to strengthen social stability, the citizenship lessons. Athletic exercises, culminating in some knowledge useful for purposes of national offence or defence, must not of course be omitted. But as the secondary education of the classes we are considering will last at least two or three years longer, the extent of these secondary studies can be considerably increased. Thus the ground-

Functions of modern secondary schools.

[1] Every teacher in a technical college knows well the average public-school lad: personally delightful, athletic, popular, he cannot draw, his geometry is a rapidly disappearing acquaintance with Euclid I. to III., his algebra a formula for quadratics, and his arithmetical accuracy sadly inferior to that of a shilling slide-rule. His secondary education has to be undertaken over again, and even then he will probably end in the South African Constabulary.

[2] The German *Polytechnikum, technische Hochschule*, is not for the moment to be confused with our polytechnic, which ought to be a higher craft-school and is a hotch-potch of a dozen stages of education. It corresponds more to our technical college, but is ten times as complete. It usually represents the complete technical university, and by government decree its teachers and students are placed on an academic footing.

[3] One man may learn how to use his reasoning powers from a teacher who adopts Greek grammar as his medium, another from a teacher whose material is provided by the hedgerow, and the powers gained in either way may be turned from one to another subject; but there are obvious advantages in selecting for the object-lesson material at least akin to what the reason is ultimately to deal with.

work of a true culture—the superstructure of which must always be self-culture—can be laid in the technical college or science school. An important addition, however, should be made to the teaching of such modern secondary schools, not as part of the recreative but as part of the bread studies,—a reading knowledge of one, and a speaking knowledge of a second language should be insisted upon. The doorway into another race's scientific laboratory, its methods of work and of expression, is as important an opening for the mind as the doorway provided by a knowledge of its language into its institutions, literature, and folk-feelings. To grasp how a great investigator works needs presence at his lectures or in his laboratory, or at least the study of his papers,—it is an education which can never be obtained from text-books. In any specialized branch of science there are rarely at any given epoch more than two or three master-minds, and these are diverse in country and in tongue. To follow these personally or in the written word is an impossibility without linguistic knowledge, and science-abstracts and text-books are a deadening and nigh worthless substitute for direct contact with a master-mind. We shall insist later on the national importance of the *Wanderjahre*, but to profit by such years the young apprentice must have received in his secondary school the groundwork of at least one language, and maintained and developed that knowledge at college. The pure scientist or the professional engineer who cannot directly study the work of contemporary foreign investigators is most heavily handicapped, and in many cases a tenth of the time and energy he will spend in finding out how to do things already done would have given him a reading knowledge of foreign literature. The speaking knowledge of a language serves a different purpose: it is essential to the pioneer in commerce, exploitation, and transit.[1] Started in the secondary school, it may be completed in the *Wanderjahre*; it is a practical instrument of a man's calling—like the multiplication table, he requires to be sure of it, but he will not, like the philologist, make it a means, in the first place, of intellectual training.

It would be out of place here to give even outline curricula for the secondary modern schools we have in view. If the curriculum of the secondary classical school has only been crystallized out in the course of many generations, no new scheme for science schools will in itself be wholly satisfactory, or work without initial difficulties and friction. In the first place, the teachers, to do the work effectively, have largely to be made. In the next place, parents have to be convinced that the secondary modern school is not going to provide knowledge useful in professional life. It is going, like the classical school, to develop the intellectual powers, but it will take as its material not the dead languages, but the living sciences which bear most closely on commercial or professional work. There will be, undoubtedly, specialization and differentiation. The biologist and the physicist receive their intellectual education in observing and reasoning on a certain class of facts—they need mathematics as an instrument of investigation. The mathematician who insists that they shall have it as an intellectual education only is going beyond his legitimate sphere. In the same way, the engineer receives his intellectual training in a field very unfamiliar to most physicists and mathematicians, and the teachers of mathematics and physics who insist upon these subjects being taught to him as intellectual exercises from the pure-science standpoint are the bane of technical education. Secondary schools, like the higher craft-schools, will do little to improve technical instruction if this point be not kept in view: the teachers of pure science required for the technical side must be men trained in a technical college, and having touch with the needs of practical life. Such men ought to be distinct from the teachers of pure science on the science side, who ought to be men who have been through research schools and laboratories, and whose first aim will be pure science as an education, not as an instrument.

Nature of teachers.

Lastly, if we consider the secondary education given in the public and large day-schools as they at present exist, in many ways well fitted, perhaps, for professional and literary careers, we can only hope that the opening up of large secondary modern schools, turning out pupils of equal intelligence and better fitted for modern commercial, mercantile, and technical pursuits, will serve as a stimulus to quicken and, above all, humanize their activities. They will certainly decrease in

Secondary classical schools.

[1] While French and German for the English-speaking races are the more valuable languages for the storehouses of method and knowledge they throw open, Spanish and Dutch are perhaps at present most useful for pioneering. But it is nationally important to have a great range of choice in the spoken languages among workers in both the commercial and technical fields.

number, but this does not necessarily mean in efficiency; and where the endowment allows of a complete duplication of staff and educational apparatus, the running of modern and classical schools side by side would have all the advantage which the admixture of men of different callings, modes of thought, and social standpoint provides in after-life. Before the renascence, teachers of the old monastic learning would have denied that it was possible to improve their methods, or to change with advantage the subjects taught. Yet within fifty years the Humanists reconstructed the school-education of all Europe. They achieved it by raising an enthusiasm in youth, which demanded that instruction should be for both teachers and taught a vitalizing process and not a drudgery. A small minority of teachers with the new ideas, and a wide-spread rebellion of the taught, swept the old system and its professors swiftly and forever away. The abuses of to-day do not perhaps justify, nor the tutelage under which young people now stand[1] permit, of quite such a drastic reformation. Yet the pressure of competing modern schools ought assuredly to modernize classical and philological studies. We want to train the intelligence of each future citizen to observe and reason about facts, and this power can never be fully developed when the material dealt with is isolated from all relationship with present experience or living modes of thought. The scholar has to realize that he is merely a unit in a living nation, which is one among many nations, each with a history of its own. The study of a special literature or language may be very harmful if it is not seen in perspective. It leads to the spirit which supposes that philosophy was summed up in Aristotle, that style culminated in Cicero, that there is only one great religious work, and that Euclid provided once and for all what is needful for geometrical instruction. Comparative history, folk-lore, and custom,—the discrimination of what is peculiar and what is universal in the institutions of the special people studied,—are all needed if the scholar is to be saved from narrowness. The *Odyssey* is not only a great epic, it is intensely exciting as an object-lesson in the early stages of civilization, in the growth of mankind from boyhood to adolescence. The institutions of early Rome are unintelligible without comparison with Teutonic, Slavonic, and even African folk-customs and religious practices. Style and taste are never to be despised; but what we want the cultured lad of to-day to understand is what man now is and how he has come to be what he is. The over-emphasis of one period, one literature, one art or language, may be dangerous if it tends to obscure the fundamental principle that man is the product of an evolution, under vital forces of which science knows something and is daily learning more. No nation was ever without rivals, moulding and modifying its development; no literature without a growth; no art or craft without an historic evolution; no human product, judged from either the artistic or intellectual standpoint, final. The schoolmaster who forgets these things is not truly preparing lads to be thinkers and leaders for the nation; the academic teacher who does not make them the thread of his exegesis will aid little towards the much-needed humanization of the older forms of study. Neither religious thought nor educational theories can stand aloof from the growth of scientific knowledge. One and all react upon each other. We cannot stand now where Virchow did in 1877: the pressure of foreign commercial competition has been a conclusive object-lesson in the survival of the fitter. We must base national education on the need for national reaction against a changing environment; we must consciously prepare for the struggle, and by an intelligent study of human evolution arouse the patriotism and race pride of the young to assist directly in developing their intelligence for national ends.

Higher craft-schools.

Before we pass to the specialized college education, a word ought to be said of the higher craft-schools, which should supplement secondary craft-schools in the preparation of the non-commissioned officers of industry. Hitherto these schools have either been wholly wanting or supplied by private enterprise bent on personal profit. The keynote to such a school should be intelligent instruction in a craft suitable to lads of fourteen to seventeen who hope to be foremen workers. It should lay more stress on technical knowledge than the secondary craft-school, where the development of the intelligence is the first requisite; but it must, like all true education, appeal to the reason as a guide. It must also be far more specialized. We need higher craft-schools in plumbing,

[1] In mediæval times the lad of fourteen to seventeen might wander across Europe seeking for the school reputed for its methods, or attracted by the vigorous teacher. The *Wanderjahre* for the schoolboy are, perhaps, wisely abolished; they will, let us hope, be reinstituted for the undergraduate.

farriery, cabinet-making, textile industries, metal-plate work, and a dozen other different things. As usual, we began with the wrong end—establishing examinations in these subjects, rather than model schools. Nor have the so-called polytechnics and technical schools of the county councils—good although the work has been in *some* cases—wholly made up the leeway. The technical school or polytechnic, instead of throwing itself body and soul into a special branch of craft or industry, has aped the university. It prided itself on getting a few students labelled B.Sc., or on producing a small piece of pure-science research having no bearing whatever on the national industries. It aimed at turning out second-rate engineers, rather than first-rate machinists. The result has not been, and cannot be, that great increase of craft efficiency which we might expect from the amount of money expended on technical education. The polytechnic may become a centre for a mild form of general instruction and amusement, or it may become a specialized higher craft-school. It cannot effectively fulfil both functions. In the first case it will probably fail, as the mechanics' institutes of last century have failed; in the second case it will become not only of local but of national importance. Let one technical school devote itself to smith's work, another to the printing and lithographic arts, a third to the glass industries, a fourth to bookbinding, and so on,[1] not duplicating their work and teaching many things superficially.

Need for local specialization.

Some large towns may maintain a considerable variety of specialized schools, but it is the student who ought to wander; repetition of staff and teaching material at a dozen centres means waste and inefficiency. If Birmingham founds a higher craft-school for electroplating work, Wolverhampton may reply with a metal-plate-work school; if the Whitechapel higher craft-school specializes in cabinet-making, Clerkenwell may find a wide enough sphere in the glass trades. The bane of technical, indeed of all education of an advanced kind in England, is the unreasonable overlapping of institutions, teachers, spheres, and methods. The higher craft-school has nothing to do with academic training, therefore we appoint academic scientists to teach in it, and place them on university faculties; the technical college has a separate but coequal function with the university, therefore we mix them up, thinking one method of teaching and one teacher will serve for both. We send peripatetic teachers out to fulfil the all-important function of raising the general culture of the people: we fancy it academic extension, and demand that it shall lead to a university degree. Nay, a degree having come to be looked upon as a mark of caste or gentility, the branding-iron is, in the true democratic state, to be brought to every man's chamber. At the basis of every science are real philosophical and intellectual difficulties; in its structure, endless lessons in observation and in method; at its summit, the prospect into still untrodden lands. Not one of these things can be indicated by an examination schedule; they are scarcely touched by any text-book which follows such a schedule. They are appreciated only when the student comes into personal contact with the creator of knowledge, and sees how he observes and reasons. Here is the field of true academic work; no branding-iron brought to a man's chamber can testify that he has been in contact with this vivifying atmosphere. Nor can we bring science and learning in their highest expression to each student's door. He must go out on his *Wanderjahre* in pursuit of the master-teacher, or of the school which has specialized in his chosen study. What is true of the university is equally true of the higher craft-school: the student must seek the specialized teacher and the specialized school, and not trust a local polytechnic to be an effective educational *omnium gatherum.*

Higher commercial schools.

Besides schools for the more mechanical crafts, we need higher schools for the lower ranks of head-workers, for the lower branches of civil and municipal employ, for shorthand and clerks' work, for postal, telegraph, and railway service. Some of these employments—where students will pay to be got through an examination—are at present provided for by private enterprise. But such schools want organizing as a comprehensive system, and should not be based on the question of immediate profits derivable from some small section of the work. To such schools the government, the municipality, companies, and private employers would very soon learn to turn for a specially-trained class of employee, and we might hope that in the first instance they would ultimately replace the Chinese system of selecting by examination.

[1] To some extent this has been begun with the textile schools in the North of England, and the photographic and optical instrument schools in London, but these are the merest beginnings only.

We now turn to the highest forms of education, which, whatever we may hope for in a distant future, can at present only be organized for the brain-workers of the community—for its thinkers and leaders.

Higher education. Here we find much the same educational chaos as we have had to note lower down in the scale. With as great, if not greater, need for it, there is even less organization and specialization. As a first classification, we may consider our subject under four headings: (i.) the university proper; (ii.) the technical college; (iii.) professional schools; (iv.) the commercial university. How far these four phases of advanced education can be advantageously united into a single university system is not easily determined. In Great Britain the advantages of union are: first, that as education becomes more specialized, the larger funds accumulated during many generations for the university proper may be shared by the younger branches of study;[1] secondly, it is of immense gain that both students and teachers of specialized studies should mingle together, and share traditions common to all. This is what must take place in later life, and the joint university provides, from student to professor, an excellent training in toleration,—a characteristic as important in science as in theology. On the other hand, the union of the four schools in one locality and institution is likely to disguise the absolute need for entirely independent staffs, and for completely specialized methods of study. The doctor and the engineer require mechanics and chemistry, but to teach medical and engineering students in the pure-science laboratories of these subjects is an evil only sanctioned by absolute want of funds, and solely due to the haphazard growth of British systems of education. Look at the specialized staff of one of the great German polytechnics,—a dozen professors and double as many more lecturers and assistants,—and then compare such staff with the roll presented by any university or technical college in Great Britain! Nine out of ten of these colleges think it sufficient to provide a so-called professor of engineering, and send their students to pick up what mathematics, what physics, what chemistry they can under teachers who have had no special technical training, who have never studied the special needs of engineering students, nor published a single memoir dealing with technical problems. The result of such a system is manifest: we have no research in the sciences preliminary to engineering; not even first-class text-books, for the preliminary science teachers in the engineering schools are, if not overdone with teaching, workers in pure science. It is very little better in the matter of engineering research pure and simple. The professors are not able to specialize, partly because they have to teach too many subjects, owing to want of colleagues and of the fitting secondary and preliminary scientific training in their students, and partly because they have not been themselves educated in an atmosphere of research. We do not think there is exaggeration in this statement of the case; we have not overlooked certain text-books on the strength of materials, machine-design, or the steam-engine. Rather these illustrate our text: they show that want of knowledge of the modern theory of elasticity, of kinematics, or even of foreign contemporary work, which indicates how pressing the need of an effective research training may be in even the highest places under our present system.

We are undoubtedly far better off now than we were a generation ago; the technical schools up and down the country are doing good work, but they are not in any case comparable with a German polytechnic, nor with the technical university which we must hope to see ultimately established here.

Technical colleges. The University of London, for example, comprises three or four engineering schools, each duplicating much preliminary work; combine their staffs, specialize their individual teachers, give them leisure and laboratories suitable for research, and there would be only the foundations of one real technical university. Yet no other university or technical college in the country could produce as much. We have started again on the wrong system—multiplication of little centres, doing their individual best no doubt, but not what is best for the nation. Three or four technical universities would suffice for the whole nation, but we have established fifteen or twenty technical colleges, on the theory that knowledge, like milk, must be delivered at each man's door. The result is that all the schools are, broadly speaking, doing the same elementary work, and there is no specialization. No one school devotes itself entirely to civil engineering, naval engineering, hydraulics, municipal work, gas, electric lighting, or haulage, &c. &c. The elements of many

[1] Thus it is satisfactory to hear of College fellowships at Cambridge being given to engineering students for technical dissertations.

things are touched on, but the higher teaching and the atmosphere of research are largely absent. What then is needed?

The technical university.

The development of three or four only of the technical colleges of the country into technical universities, with specialized departments of mechanical, civil, electrical, &c. engineering and of chemical industry. The remaining schools should disappear or be converted into higher craft-schools. Use their staff or buildings, where possible, for special departments of the university, but recognize once and for all that under the stress of modern competition these are matters of national importance; and that to bring our technical intelligence up to the level of that of our neighbours, we do not want local engineering professors, or local colleges, but national technical universities, each with ten or more complete laboratories, a score of special technical professors, and with equipment and funds comparable only with those of the whole of the pure-science faculty of a first-class modern university. Such universities would train not only the nation's industrial leaders, but the teachers for the secondary and higher craft-schools; and by bringing both classes into touch with actual knowledge-making, indicate on the one hand how the problems of practical life, on the other the problems of craft education, may be met and solved.

The university and its future.

If we pass from the technical university to the university proper, by which we are to understand the corporation of teachers which deals with training in pure science or scholarship, without regard to the needs of special industries or professions, its work in the future seems likely to become more specialized. There will always be minds for which the best intellectual training, independent of future calling, will be an end in itself. Senior Wranglers may make good judges; senior classics, excellent doctors; and double-firsts, capable statesmen. But in the case of modern nations specialization of the individual appears to be a progressive feature, and as soon as it becomes a recognized principle that the intelligence can be trained and developed by observation, and reasoning on observation, applied to technical or professional subjects, much of the monopoly value of pure academic studies will disappear. The study of yeasts may be as good an intellectual training as that of the gases of the atmosphere; bacteria are as mentally exciting as snails; the vibrations of a bridge lead to more aspects of physical science than those of the tuning-fork, and examples may be multiplied to show that technical or professional education is not one-sided or intellectually inadequate. It seems likely, therefore, that academic studies, whether purely scientific, literary, linguistic, historical, or philosophical, will tend to be recognized more and more as a training for specialized careers, namely, for statesmen, scientists, historians, literary men, educators, and makers of all forms of knowledge,—in short, for the intellectual leaders of the nation. With this recognition, academic studies will become more intense and definite in character. Above all, the research training will more and more supplant the examination training. In actual life it is the problem which comes to us; stores of facts are accessible—we want the training which enables us to apply these facts and solve the problem.

Reformation of academic studies.

The recognition of this fundamental fact is the reformation which must take place in academic studies. Examination is by no means the best process for testing the power to observe, classify, and reason on observation. The known itself may be made the subject of a formally new inquiry, and a monograph may be written showing data, classification, and deduction;—the method is equally applicable in physics, biology, or history. It forms the basis on which the capable instructor can point out the sources of information, the proper method of arranging it, the logical results which flow from it. Scientific method, the true spirit of inquiry, is better learnt by criticism and suggestion applied to two or three such monographs by the master-investigator, than by months of labour devoted to learning the known for examination purposes. We cannot too often repeat that for the purposes of education what we need is a training in method, and not, in the first place, a mere knowledge of facts, nor even of the laws under which these facts may be classified. It is so easy to provide facts and formulæ, so difficult to give insight into method, that text-books, degree schedules, and examination papers invariably turn to the former; and the latter, to be learnt only from direct touch with the investigator or from the classical memoir of the master, is thrust ruthlessly aside. Treat the known as unknown, to be rediscovered, or bring the student rapidly to the real unknown on the confines of the

discovered, then true training in method becomes a possibility. Every nation is daily being confronted with new problems; they may be material, or they may be social, or they may be intellectual. Admit progressive evolution, and this statement is an obvious truth. The nation's brain-workers, whether their rôle be great or small, have to be prepared to meet and answer these new problems. Training for examination is but feeble equipment, certificate of examination success very one-sided evidence of competence for this essential function in a nation's thinkers. Nor is the reader to suppose these remarks apply only to the training of master-investigators in any branch of human knowledge; the academic training is that upon which the great majority of secondary educators depends, and their present failure to apply, or rightly apply, heuristic methods is largely due to the examination system not having brought them into close touch with the methods of research. Nay, our professional and commercial classes suffer in international competition from much the same want—definite training in observing and reasoning upon facts. The university of the future will bring its undergraduates, not into touch with an army of tutors and "coaches," nor with their impedimenta of examination schedules and text-books, but directly into the field, the library, the laboratory, where the material of knowledge is accumulated and classified, and into personal touch with the men who make it.

The professional college.

The problem of the professional college or school of academic rank and its relation to the university is one of considerable complexity, and can hardly be dealt with at length here. Specialization is the most emphatic note of modern national development; it has to be met, not by protest, but by providing for training in *method*, even when a special or somewhat narrow class of facts is dealt with. The establishment of technical colleges for engineering, metallurgy, chemical industries, navigation, agriculture, and forestry [1] indicates to some extent the direction in which the older academic faculties of law, theology, and medicine must develop. It is fundamental that the preliminary linguistic or scientific studies should be, as in the case of the technical colleges, in the hands of a special staff, distinct from that of the pure academic studies.[2]

The law school.

It is difficult to understand why great law schools do not thrive in this country. No other nation can present such living object-lessons in comparative law: it rules in different parts of the world under nearly every present or past legal system, and by innumerable forms of folk-custom, which exhibit legal institutions in almost each stage of progressive evolution. Yet comparative and historical knowledge is very largely lacking in our practical lawyers; but few of them are acquainted with the French, Dutch, or German codes, or have gained insight by a study of the development of the early Teutonic and mediæval systems. The result is a want of imagination in our own domestic legislation, and too little sympathy in dealing with the legal institutions of subject or assimilated races. The law schools have thus partially failed to create the class of men needed by the nation for its legal work in all corners of the globe. The broad idea of satisfying a national want has not been a primary consideration, and to this extent they urgently require that humanization which is demanded in the history school, if it is to become a school of statecraft.

The medical school.

Perhaps in the case of the professional schools the most complete chaos in educational matters is to be found on the medical side. In the first place, it cannot be doubted that the hospital system itself must soon suffer a profound modification. It is impossible that the present system of support by fluctuating charity can permanently continue. Alongside the public charities have arisen infirmaries, fever hospitals, and asylums supported by public funds, and in

[1] In the last three cases the colleges should be for the scientific experts, not for mariners, farmers, and foresters, who require, in the first place, higher craft-colleges. What might be achieved in the science of navigation at present by an expert school can be well realized by a study of the first fifty years of Gresham College, London. The merchants and traders of London, in the first flush of new-world discovery, turned to Sir Thomas Gresham's professors for their instruments of, and treatises on, navigation.

[2] It is not to be inferred that mechanics or biology is to be taught by medical men waiting for a chance to get on to the clinical staff of a hospital school. On the contrary, we want a specialized class of teachers, who devote their leisure to research in biophysics and kindred subjects. The mechanism of the jaw is quite as good an object-lesson in the fundamental principles of mechanics as the screw and the systems of pullies, while the principle of energy and the laws of elasticity are subject to variations in living forms which are apt to be overlooked by the pure physicist. The range of linguistic studies required for canon and mediæval law, for *Weisthümer* and folk-custom, are scarcely those of the academic classical scholar or the Teutonic philologist. Nor does the university philosopher find anything profitable between Aristotle and Descartes,—although it was the age of fathers and schoolmen, who directly or indirectly gave rise to all modern European philosophico-theological systems.

many cases but little used for clinical instruction. The medical schools thrive or not according to the success of their hospitals in attracting charitable subscriptions, and this again depends indirectly on skilful advertisement. The result is overlapping, rivalry, want of specialization, and the predominance of pecuniary instead of purely scientific interests. General municipal control of the whole hospital system must sooner or later be the rule, and with the wider clinical material thus placed at the disposal of medical instruction must come a diminution in the dominance of individual medical schools over individual hospital management. The overlapping of the preliminary teaching, and of much of the more theoretical and scientific branches of medicine and surgery, must be avoided. The direct and sufficient payment of all forms of medical teaching must attach men to academic work and experimental medical research as a profession, and such teaching not be undertaken as a step to a consulting practice. The competition of the medical faculties of different universities, and of the medical schools of the same university, would be perfectly healthy if it depended solely upon the reputation of the teachers; but it depends largely on the flow of public subscriptions to individual hospitals, the success with which the school may be used as a step towards a professional reputation, and the skill of one or two men in effective advertisement of the special wants of their individual hospital, or its special fitness to deal with a disease for the time looming large in the popular mind. The municipal control of the hospitals, the utilization of all clinical material, the wider separation of the academic teaching of medicine from its purely professional pursuit—these are the points which arise in the mind of one who views the present chaos from an outside standpoint. But if the observer be an outsider, he is a sympathetic one, who believes largely in the academic future of experimental and scientific medicine. Yet here the very instruments of knowledge (such as vivisection) and of experiment (like inoculation) demand the most careful and diplomatic procedure. The storms of the past in these matters are as nothing compared with what we may experience in the near future; and if sure progress is to be made, there must be no hasty adoption of tentative treatments, when no strong scientific arguments in their favour are adducible; there must be no "fishing" inquiries on living forms; in other words, each experiment sanctioned must be directed to answering a definite question, which in the opinion of scientifically trained minds there is reasonable hope might be answered by the investigation proposed, and, if answered, would be of substantial service to medical or surgical treatment. Lastly, a greater knowledge of the nature of scientific method and of scientific proof must in some manner be provided for by academic medical training.[1] Medicine, and even surgery, must to a large extent be, and remain, empirical; but it is just the empirical sciences in which, for example, an accurate theory of statistics is of most importance. It is not too much to say that medical statistics are at present in a most rudimentary condition; definite conclusions are over and over again drawn from short series of cases, where the trained statistician realizes that the emphasized differences are well within the limits of random sampling; or, again, A and C are found statistically to be associated with B, and it is argued that A and C must be themselves associated. The recent vaccination legislation has produced most instructive object-lessons in this direction. It has very unfortunately created a large class of men with pecuniary interests in the maintenance of vaccination. These men have had, in the press and at public meetings, to face a strong opposition, partly sceptical, largely fanatic. It is not too much to say that from the standpoint of science the medical defendants' handling of statistics has been excelled in inadequacy only by that of their opponents'. Much of the strength of proof in medical science depends entirely on statistics; copious raw material can be obtained from hospital practice, but this is rather too largely drawn from special classes of the community. The bulk of data from all classes either escapes written record, or remains "unstandardized" in case-books; here it is monopolized as "experience," when by co-operative action it might be statistically generalized into proof. The quantitative value of the correlation between environment, age, or physical characters and the special features or virulence of any disease is probably unknown at the present day in a single instance; and yet it is hard to conceive that clinical prognosis

Need for scientific method in medicine.

[1] In the course of the past twenty years the writer has received a scarcely intermitted flow of papers and letters from pseudo-scientists, circle-squarers, perpetual-motion mongers, heredity-theorists, neo-Darwinists, and others. The common feature of all these productions is the failure to grasp the elements of a real scientific *proof*. If the authors were classified by profession, the general medical practitioner would lead in numbers, the engineer being second, and the theologian a comparatively poor third.

would not be greatly advanced, especially among the younger members of the profession, by a quantitative knowledge of this kind. An authoritative body standardizing records, collecting individual experience and reducing it by adequate statistical theory, seems almost a necessity for medical progress at the present day. An elementary training in the handling of statistics and an insistance on the nature of scientific reasoning and statistical proof seems an urgent need, which ought to be, but is not, provided for in the preliminary scientific education of the medical profession.

Passing from professional schools[1] to the commercial university, we see at the present moment a great experiment being made in this direction. Birmingham has wisely entered on an unoccupied field.

The commercial university.

It may be desirable that one or, at most, two large centres should follow its lead, but it is most sincerely to be hoped that every university and university-college in the kingdom will not now appoint a professor of commerce and advertise a commercial department because they think it will pay. They have neither the funds nor the experience requisite for success. What is needed, from the national standpoint, is at most two or three perfectly efficient, fully manned, and fully equipped commercial universities, attracting students from the whole area of the empire. There are plenty of unoccupied fields for other institutions and colleges to specialize in, to the national profit, without the creation of innumerable small rivals in a new sphere. This is, of course, on the supposition that those who have first taken the work in hand will do it thoroughly, even if their progress be gradual and tentative at stages. Let it be remembered that it is not a mere professor of commerce that is required, but ultimately a staff of ten or a dozen such, with a large auxiliary force of lecturers and assistants. The man who can effectively deal with preferential tariffs and the general fiscal policy of the empire is not necessarily the man who has special knowledge of commercial interests and transit possibilities in China. A fundamental rule of the commercial university ought to be the "third free year" of the Russian academic system, and this means that only two-thirds of the senior staff will at any given time be actually engaged in teaching. The "third free year" is only free from teaching work; the lecturer is expected to travel for the purposes of research.[2] Especially, owing to the rapidly altering, ever contracting and developing, processes of commerce, will it be needful for the teacher to keep in touch with current progress and methods. Nor can a man rear men to be pioneers unless he has done pioneering work himself. It is a big task which the commercial university sets before itself, full of difficulties and, possibly, pitfalls, but one of essential national importance to-day, when our commercial leadership has been more than threatened. We have to rear a new type of worker, who will see in trade not only a source of individual profit, but a patriotic duty. Developing commerce on the Yangtse, or struggling against fever in West Africa, or starting new industrial enterprises in the Argentine, the trader must realize the relation of his efforts and those of his colleagues to thousands of handworkers at home, whose bread must come from over the sea by exchange. He must recognize that on his intelligence, on his linguistic and local knowledge, on his readiness to adapt goods and transit to environment, depends, to a far larger extent than has been dreamt of in the past, the national fitness to survive. The leeway of the nation has to be made up by increased intelligence, first in production and then both in distribution and exchange; the former need has to be met by higher craft-schools and improved technical colleges; the latter, by the creation of commercial universities. Can any training help the nation to the skilful merchant and the fully-equipped pioneer? Those who believe in education and modern scientific methods can only reply: Yes, if you train the intelligence by the heuristic method, and exercise it on the materials of its future work. It is a great task which Birmingham has set itself; let us hope that it realizes its magnitude and difficulty—above all, that it understands that failure, from want of efficient staff or of equipment, or from lack of internal or external enthusiasm, would be little short of a national disaster. It would discredit for years, if not indefinitely, the systematic training of intelligence in one of the most important fields of national activity.

[1] The range of professional schools wants considerable widening. One profession certainly ripe for a great professional science school is that of the actuaries, and a little study of official reports will show that a school for government statists is a necessity of a not distant future.

[2] Started in the commercial university, we might hope that this wise custom would extend to the pure-science, medicine, and engineering faculties, where it is as important to seek new material, test foreign methods, and critically examine current practice as in commerce.

Commercial universities, again, suggest the great importance of further extending the *Wanderjahre* custom. We have already discussed the need for local colleges, schools, and universities to specialize, and the advantage of the student wandering in search of his subject and the master-teacher. To the commercial university a relatively considerable number of studentships should be attached, the holders of which should be compelled to travel and report on foreign and colonial commercial methods and possibilities. These reports should in the first place be looked upon as exercises, but selected reports might well deserve publication as monographs of commercial research. Past holders of such scholarships, the pick of academic training, with their minds freed from insular method and local custom by the insight of travel, would undoubtedly be in constant demand for pioneer work. They would form a class such as is being rapidly formed in pure science[1] by the 1851 Exhibition scholars, men compelled to wander in search of research training. A percentage of failures there has been, and probably must be, but the next generation of physicists and chemists will undoubtedly show how markedly advantageous has been the system. The *Wanderjahre* with the research studentship must be widely extended to all fields of work. Any Oxford or Cambridge college which insists on its fellowships being held only on *Wanderjahre* research conditions will quickly realize the profit which must flow from the increased reputation of its members and the broadened views and activity of its fellowship-lecturers. The older universities can distribute their fellowships without the special limitations set in the case of the 1851 studentships to which we have already referred: they could yearly send out men to study the flora and fauna of almost untouched districts; to learn the native languages, religions, and customary laws of British and other possessions; to study under the masters of pure science, history, or philosophy who exist outside their own walls; and to return, as the American travelling fellows have done from the European universities, to develop their home institutions and widen their educational system by leaps and bounds. Without such *Wanderjahre* training, no academic post ought to be open to the teacher of the future.

The Wanderjahre.

III. *Science in the Direct Service of the State.*

A slender sketch like the present does not permit of our dealing at length with another class of science school of vital importance to the state, namely, *Government Schools* training directly for special branches of state service. Here the maximum efficiency possible both in staff and equipment is absolutely essential for national safety, and yet the routine, almost a necessity, of official institutions is excessively apt to check just the very variations of individuality and the genius on which discovery in science and progress in its practical applications almost invariably depend. For this reason it is very desirable that the government schools should be limited to those branches of instruction which are needed only for the national service. For example, schools of offence and defence—naval colleges, staff colleges, artillery and military engineering colleges; to these ought probably to be added, schools for home and imperial civil service—for consuls, native state residents, and the lower branches of the diplomatic service. It seems, but for the historic evolution,[2] a curiously anomalous process to select for many of the latter services men who have obtained examination distinction in classics and pure science, often taught by crammers, and with no special relation to the future work of the taught. It would probably be a great advantage to place these colleges, where feasible, near to one or other university. Thus while specialization in training and study should be insisted upon, both teachers and taught would have the widening influence of contact with other forms of work and play. The want of this "touch" undoubtedly tells on the efficiency of certain service colleges: their professors are too isolated; and necessary as is specialization, and valuable as is *esprit de corps*, the creation of a caste among the students, with caste habits and amusements, is far from an unmixed good. Without rivalry, and free from comparison with

Government schools.

[1] Comparatively few of these scholarships appear now to be given for essentially technical research,—which was possibly the original intention.

[2] The origin of the all-pervading state-examination system in the United Kingdom was the desire to check nepotism in government appointments; to hinder one type of inefficient is not equivalent to selecting the fittest and training them effectively for their specialized work. Even the examination system has probably been adapted, by artificial "adjustment of marks," to pass into the service not individuals, but types of men who appear best suited for the work in the eyes of certain commissioners. In other words, we are trusting very considerably to *personal* judgment as to a fit type; and this fact, be it good or bad, is screened behind a complex system of examination-marking.

any but foreign schools, the government service school is liable to run in grooves; in many cases the staff does not appear to be numerous enough or sufficiently specialized to have leisure or inclination to study new problems or foreign methods. The pay of a government professor and the honour of the position should be such as to attract the highest teaching and organizing talent to the state service, and the leisure at present sometimes devoted to external teaching and examination work should be monopolized for specialized research work in the national service.

Relation of government schools to technical colleges.

Lastly, the government schools should be confined to those branches of the service where the specialized training required by government servants is not already being provided on an adequate scale by other educational bodies. A government civil engineering college, for example, may be perfectly efficient in its own line, but the men it turns out see only one group of teachers and one form of instruction. The whole service may thus run far too much in one groove, which would be impossible if its members were the picked students of the various technical schools and universities. The same criticism applies, if to a less extent, to naval engineering and architecture. The Admiralty, which occasionally does draw on external supplies, rarely gets the best students of the technical colleges, because it draws by an examination schedule which none of the more efficient engineering schools would be likely to adopt for its curriculum; and if they did, it would be, under present arrangements, devoting their energies to a small and very uncertain class of student. It would be an interesting experiment—and we believe a successful one—if the government gave for a trial number of years a limited number of engineering appointments to the pick of the technical college students, and compared their work with that of the men reared in their own schools. We believe that the wider field of selection would lead to a greater variety in capacity, talent, and training being made available for the government service.

Government research institutes.

From government schools we naturally pass to government research institutions, and the position of science as consultant in the modern state. The position accorded to science in the past in this respect has been a very defective one. The state needs quite as much scientific as legal advisers; indeed, under present circumstances, they are perhaps even more essential. Not only problems in offence and defence, but in development, transit, industry, disease, sanitation, reproduction and medico-legal matters arise daily, and the government wants not only to know where to turn for immediate advice, but to be sure that it will get what for the great bulk of cases is *sound* advice. Beyond this, the progressive state ought always to be on the look-out for and seeking to encourage discoveries or inventions which will increase national efficiency either for war or in peace. Something of this latter function may be fulfilled by permanent government research institutions and consultative scientists. But not only is the incentive to discovery greatest in the young man with his future to make, but the power to discover great things rapidly diminishes with age. There is the born scientist, who researches for the keen intellectual pleasure of the work, and would go on, whatever his income or post; and there is the man for whom research or science is a means to a living and a position. He pursues it to a competency and his D.Sc., to his F.R.S. or to his K.C.B., as the desire impels. He retires on his laurels, spending his life on committees, emphasizing the needs of pure science, the importance of technical education, and scaring us with the German bogie.[1] It would be unreasonable to condemn this man; for he belongs to the type which forms the bulk of humanity, whether occupied with science or any other pursuit. He has probably done good work, and his experience is of value for consultative, if no longer for research, purposes. We have only to remember that science has and can have no high priests, for it is always progressive and advancing. It is hardly too much to say that the moment a scientist reaches celebrity as a man, he has ceased to be a discoverer. For he can hardly attain fame before middle life, and already the younger man is on his shoulders reaching higher, for he starts with his elder's knowledge and with the unspent energy of youth. One of the greatest dangers of science, and especially science in the consultative service of the state, is the possible creation of a scientific

The two scientific types.

[1] All honour to Germany's scientific work! Her specialist has organized his science and made research a trade, yet his product lacks too often the real insight, the lucidity, the touch of genius characteristic of the best French work; rarely, too, does the German break entirely novel ground, as was done by the three great scientists of the English type—Newton, Faraday, and Darwin.

hierarchy, resting on past achievement and believing itself at the summit of scientific knowledge. As soon as a man ceases to research, he has fallen behindhand; his tools grow rusty, and he ceases to grasp new methods and new possibilities. Hence one of the greatest problems of the state is how to draw into its service not only those who have achieved as consultants, but those who are achieving as discoverers. Possibly an extension to our country of the French system of substantial pecuniary prizes, with not too-closely defined limitations, would turn more of the research work of the country to national ends. A prize every two or three years of four or five thousand pounds for a markedly useful contribution to the country's means of naval defence; a like sum for the most valuable work tending to develop the chemical industries of the country, or to improve its sea or land transit; or, again, equally substantial prizes for medical or sanitary discoveries—these would draw the energy of many youthful scientists into channels of national value. A yearly government offer, not necessarily an expenditure, of £10,000 to £20,000 in such prizes would be no extravagant sum, and might well have enabled this country to lead in at least some of the recent fields of discovery, such as smokeless powders, submarine boats, motor cars, wireless telegraphy, &c. &c. Such prizes and research should be independent of national laboratories and government consultants, to whom more specialized problems and routine difficulties should be submitted for solution or advice. In the one case the appeal is made to the energy of the youthful scientist, in the other to the experience of the consultant, to the store of current knowledge.

Prize system.

Considering more closely science institutions in the direct service of the state, it will be found that the ideas of men on this point are at present somewhat chaotic. Such institutions as exist have arisen partly from the immediate exigencies of executive, and partly from the outside pressure of pure scientists, asking for government assistance, or for public support on the ground of a private institution fulfilling a crying national need. This haphazard origin accounts for the want of organization and specialization; private institutions are partially doing national work, and national institutions which should be doing specialized industrial work have fallen to some extent into the hands of pure scientists. Here, as in other fields, a differentiation of pure and applied science is necessary. It is perfectly true that none can tell how soon a result of pure science will be applicable to industry; but the type of mind that can apply such results is rare, and the bulk of applied science problems are first formulated, and afterwards the extension of pure science which leads to their solution worked out.[1] In the first place, therefore, a nation needs laboratories for its industries—for standardizing the implements, testing the materials, and distributing knowledge with regard to the processes of its manufactures. There must be institutions which, free of every bias, will test and compare the products of all manufacturers seeking government contracts, or will advise Boards of Trade and state or municipal authorities as to regulations for factories, transit, food, and sanitation. These needs stretch far beyond any existing institution, and cannot be satisfactorily dealt with except by technical specialists having control of independent laboratories.

State science institutes.

Thus the nation's wants comprise: (i.) *National Engineering Laboratory.* — This must be subdivided into mechanical, civil, and naval departments. The first would test materials and machinery for government use, or apply standard tests in the case of corporations or private individuals. It should keep a hold on the industries of the country by reports on the quality of materials of construction bought in the open market, and their quality relative to foreign productions. It should undertake engine and other tests for manufacturers, and report to them on the relative efficiency of British and foreign machinery. In fact, in every way within its sphere it should apply and circulate current knowledge. The second, or civil engineering department should deal in a like manner with docks, railways and general transit, water and sewerage, &c. It should be prepared to advise the government or municipalities on the conditions to be satisfied in bridge structure, to criticize development plans from the national and from local standpoints, to provide tests for dam efficiency, data for the flow of fluids, and a multitude of other matters which come daily before civil and municipal engineers. The naval depart-

National engineering laboratory.

[1] Of course this rule is not universal, but it is strikingly illustrated in pure and applied mathematics. Developments of pure analysis are now and then of occasional use, but pure mathematics has over and over again been enriched by analysis directly invented for the solution of special physical or even technical problems.

ment should lay down the conditions for testing the machinery of ships, the strength of their plating and riveting, and keep shipbuilders in constant touch with foreign developments, as well as help to maintain a high standard of efficiency in home work. It should assist indirectly or directly in the registration or classification of ships. Of course much of all this is done at present by various government inspectors or departments, by private corporations like the two Institutions of Engineers and Lloyd's. But it is not done in a systematic manner. When a pressing need arises, a commission is appointed, which investigates or experiments for a time on iron, boilers, or bridges. It has to do this in a more or less haphazard sort of way, with a temporary staff, and without a properly equipped centre, or even without direct experiment by comparing the conflicting evidence of too often interested witnesses. These defects of existing procedure result in grave delays, much expense, and general inefficiency. A trained staff accustomed to experiment, with apparatus and locus provided, ought to be at the constant service of such commissions; in many cases such a staff would be already prepared with the unbiassed information necessary for a judgment, and would be the centre from which government and private individuals could at once ascertain what was known here or abroad on the problems ever arising in progressive construction.

Electro-technical laboratory.

(ii.) In close touch with the Engineering Laboratory should be a *Laboratory for Electro-Technical Industries.* This is especially needful in the case of electric transit. But electro-technology opens up such an immense field of activity in transit, lighting, telegraphy, telephony, power, and the smaller arts, that the laboratory ought to be differentiated from that for engineering proper. Here there is at present such a wide amount of work necessary in standardization, testing, regulation, and control for public safety, that the early establishment of such a laboratory is almost more urgent than that of any other.

National chemical laboratory.

(iii.) It seems almost unnecessary to discuss the importance of a *National Chemical Laboratory.* This is to some extent already provided for in separate government departments. What is needed is centralization, departmental differentiation, and complete and efficient equipment. It must be in no sense an institute for research in pure science, but it has to answer the innumerable chemical problems of the state, both on the organic and inorganic sides. It must do for the chemical industries what the engineering laboratory does in its own field—standardize, test purity, report, and watch foreign rivals; deal with colonial produce, poisons, adulteration of food, and an infinity of other problems, which suggest many sub-departments, and ultimately differentiation into separate national institutes.

National institute for the smaller industries.

(iv.) There must be at least one institute to deal with those smaller industries which demand a high standard of scientific efficiency. The work done in the old Kew Laboratory was excellent of its kind, and kept fairly in view the industrial factor; the testing of watches, chronometers, barometers, and thermometers must be supplemented by work on microscopes, theodolites, telescopes, and a multitude of optical instruments used in pure or applied scientific work. The Admiralty or War Office should know at once where to turn for a report on telescopes or telemeters, and upon the reliability of instrument makers, here or abroad. Nor does the above list by any means complete the round of important smaller industries where scientific control, standardizing, testing, or advice is desirable. As the scientific training of the nation, from the handworkers to the organizing leaders of each specialized industry goes on, the need for national institutes, as centres for collecting information, for maintaining high standards of production and controlling the relations of industry to the state, will grow more and more pressing, and the differentiation of the above institutes and the foundation of new ones must be taken in hand. It will be clear that it is not possible to deal satisfactorily, from the industrial side, with such consultant bodies as we have sketched when they are merely sub-departments of a National Physical Laboratory. They must be placed in the hands of leading and independent *technical* authorities.

(v.) *National Astronomical Observatory.*

(vi.) *National Meteorological Office.*

(vii.) *National Geographical and Geological Survey Office.*

The institutes comprised under (v.), (vi.), and (vii.) have been for years in effective existence, but perhaps have hardly been developed on a sufficiently wide or imperial basis. The link between the central

home observatories and those in the colonies and dependencies has hardly been strong enough, nor the whole chain of institutes systematized; and this is particularly the case in the meteorological service. There is no central authority for collecting and storing the meteorological data of the empire. In some cases records are taken at scientifically important stations, but no returns are made, still less printed. Often months or years of record will be omitted. In other cases returns are made by the naval authorities, by the army medical service, by colonial botanical superintendents, &c. &c., and returns have to be sought for at the Admiralty, Netley, Kew, or vainly at the Colonial Office. Colonial data, unless printed, rarely reach this country, which from the imperial standpoint is far behind Portugal in the systematization of its meteorological service. It must never be forgotten that the meteorological condition of the world at any given time is a complex unity, and the state of the atmosphere in Northern Norway is correlated with the contemporary conditions even of St Helena and the Cape. The world-wide extent of the British Empire presents opportunities in this direction which are far from utilized at the present time, and the extension and "imperialization" of all three of the institutes just referred to must be an important task for the immediate future.

Further national institutes of science.

Meteorological service.

Thus far we have dealt chiefly with the inorganic or physical sciences *applied* to the service of the state. In several of these sciences there have been, and undoubtedly will in future be, demands for state institutions for research in pure science. Now although the boundaries of pure and applied science are in some cases ill-defined, yet we believe a working distinction can be made, especially if we remember that the first, if not, however, the whole function of a national institute is to collect data and apply existing knowledge. It is to the academic bodies that we should look for real advance in pure science, and this will become the more feasible the sooner it is recognized that it is the function of these bodies to teach by research, and that the members of their staff who merely teach and do not research are not teaching in the proper manner. Hence any cry for national laboratories for pure science must weaken the legitimate demand of the universities for effective municipal and state support for their laboratories. The university laboratories for research and post-graduate students are, and ought to be, the true national laboratories for pure science. Of course they want, especially on the biological side, wide extension and development.

The state and pure-science institutes.

Turning now to the organic side, we see at once the fundamental importance of: (viii.) *National Institute for Preventive Medicine* and (ix.) *National Institute for Sanitary Science.*—Here again there are innumerable questions to which municipalities, or home and colonial governments, need answers, and definite and prompt answers. It is little good, after an army has been decimated by enteric, to appoint a commission to inquire into the causes of it: advice and control on the point should have been provided before the army started. Pollution of rivers, provision of vaccine and antitoxin, the treatment of malarial districts, are not topics to be left on one side until public attention forces the government to action; they and many other matters are not effectively dealt with by private corporations, individual research, or hurriedly constituted commissions; the staff of government institutes should have been steadily pegging away at them, collecting data and experimenting, so as to be ripe with information when the state demands aid, or popular interest, tardily excited, calls for expert opinion.

Medical and sanitary institutes.

(x.) *National Institute for Anthropology.*—With possibly more races under the British flag than under any other imperial symbol since the days of the Roman eagle, we have yet entirely failed to systematize and nationalize our study of those races. There is no national museum or institute where one may learn the cranial, anthropometric, and physical characters of the various races under our sway, still less something of their languages, folk-customs, industries, and religions. An institute carrying out a complete anthropological survey of the empire is as necessary from the imperial standpoint as those dealing with the geographical or geological surveys. The Americans have recognized this, and their anthropological reports and museums under state supervision will soon be a model for such work everywhere.

National institute for anthropology.

(xi.) *National Institute for Botany.*—The importance of this has been long recognized, and Kew with its associated botanical gardens in the colonies and dependencies forms a great organization which

better security for the publication of first-class work than can be provided even by a strong editorial committee in a specialized branch of science.

Need for specialization in scientific journals.

If we demand for scientific journals and societies permanent endowment, we must also demand from them increased specialization, and in many cases a higher standard of publication. At present memoirs of a given class may appear in perhaps a dozen different journals or proceedings. We may hope in the future that national journals may assume a more international character, and then specialization would become more and more feasible.[1] Such specialization is needful, not only for the efficiency of editorial committees, and for the facility of reference, but would ultimately extend circulation. A specialist will take in one or two journals devoted to his own branch of science, but he cannot afford a round of publications which partially and intermittently touch his special field. He trusts to the library rather than to the study shelves, and thus the total number of subscribers to scientific literature is permanently reduced.

Co-ordination of existing learned societies.

The progressive specialization and differentiation of learned societies are of course familiar to every student of the formal history of science, and it becomes a grave question how long national academies and royal societies can maintain their old lines of publication or constitution. Under the present arrangement the most highly specialized and, perhaps, the best work does not reach these societies at all; and the leading specialists may be far more interested in the work and executive of special societies or journals for astronomy, biology, or geology, than in those of the academy or society which is supposed to be the representative of national science. It weakens the reputation of the leading society to publish special memoirs distinctly inferior to those issued by a specialized society or journal;[2] it is undesirable, on the other hand, that the leading society should skim the cream of special journals and transactions, if indeed it lie in its power to do so. The co-ordination of learned societies and the organization to a common end of their publications is a matter of some difficulty, but of a pressing character. It may be doubted whether a central society, discussing and publishing communications bearing on almost every field of knowledge, is fitted to survive in the highly specialized science of the future. Rather such a central society needs differentiation into astronomical, mathematical, physical, biological, geological, physiological, and other sections, each of which is now more or less effectively provided for by one or more special societies. In our own case we might render the whole work of science much more effective if the publications of these societies—proceedings and transactions—were rendered uniform in format, and the first stage to publication[3] by the Royal Society, or to its membership, were through these specialized or co-ordinated societies. In this way a much higher standard of publication and of membership might be reached, especially if the executive of the central society were a body fully representative of the executives of the co-ordinated societies. Thus the Royal Society's *Transactions* and *Proceedings*, off-printed from the sectional publications, would embody the best and most representative scientific work of the nation; this selection, embracing most of originality and progress in the year's scientific work, would be offered as an incentive in style and matter to individual workers, and as a résumé of the best in national work for international criticism and exchange. Whatever direction reform of the Royal Society and co-ordination of existing scientific bodies may take, it is hardly possible that by the middle of this century the Royal Society can remain with its present *olla podrida* in publication and membership, and yet maintain its reputation or influence.

V. *State Recognition of Science.*

We have already referred to a more or less fundamental distinction that exists between the two types of scientific workers,—those who adopt science and research as a profession, and those who are impelled to

[1] There are, for example, perhaps a dozen journals of mathematical research, of which at least five or six are of the first class. But each one covers the enormous range of pure and applied mathematics, and a mathematical paper may have to be hunted for not only in these, but in twice as many more proceedings or transactions. Both pure and applied sides require to-day in publication (as in teaching) wide-reaching differentiation, and a specialization of mathematical journals on international lines would be a great gain.

[2] The mixed character of the papers communicated, even at a single sitting, to a national academy or society makes a really valuable discussion, such as may well arise in a specialized society, rarely possible.

[3] It would be needful to maintain a general publication, co-ordinate with those of the specialized societies, for work in new fields—often the most important type of work—not yet recognized as a part of any differentiated section.

investigate by an uncontrollable curiosity, to which in our higher flights we are tempted to give grandiloquent names. As in other callings, so in science the bulk of men, from forces of external circumstance and of internal character, must belong to the first class, and the usual incentives of endowment and state recognition are needful as spurs. The state of the future, the welfare of which will so largely depend on science, must provide such rewards of this kind as seem necessary. In this respect the institution of a particular grade, say that of State Science Counsel, with a patent like that of the existing King's Counsel, might serve to mark the field in which distinction had been gained, and so differentiate scientists as a class from provincial mayors and successful financiers. The whole body of State Science Counsellors might form the State Science Council. This would consist of the directors of the national institutes, of the most distinguished pure science professors in the universities, of the leading teachers in the principal technical and government schools, and of any other persons of great scientific achievement. It would form the chief scientific consultant body to which government or any public authorities could appeal in cases of difficulty. Out of the members of such a council, investigating and advising commissions might be nominated by ministers of state. It would probably be undesirable to summon such a Science Council as a whole, or give it officers or corporate existence. Many of its members at any given time might be beyond active scientific work, but, as in the case of other state councils, selected members only might be summoned for special committees and special types of work. It would provide a body from which men far better able to advise the state could be drawn, than the council of any existing society. For it would involve specialists in all branches of pure and applied science, having the instruments of research at their disposal, and would be essentially practical and national in its character. But in the selection of the right type of man to aid the state in a particular function, we come back to the point from which we started—to a knowledge wholly different from scientific knowledge. Science in the end, if it is to be of the highest national service, must be subject to a different type of knowledge—to that experience of men, that power of selecting the fit man for the fitting task, which is summed up in statecraft. We need men in every department of state who have insight into character, who can judge the man who is capable of achieving, without having studied his creative work or knowing the "ropes" of his special science. Herein the position of science in both Germany and France is better than in Great Britain, for there is a closer association of the scientific and governing castes; we do not want an increase in the number of parliamentary scientists, for in deserting science they have not become statesmen. It is a matter where closer personal knowledge and a more intimate contact of men of diverse pursuits have to be brought about. Such considerations lead us again to the training of statesmen; it seems far easier to develop the scientific knowledge of a nation than to increase its store of statecraft. Educate intelligently the craftsmen who form the basis of social life and the bulk of the electorate; then, perhaps, the politician who appeals to them will need to reach a higher standard; he, in his turn, will demand graver qualities and more weighty capacity in his leaders than at present: power of organization, insight into character, true executive ability, will weigh more than ready repartee, mere force in verbal criticism, or the other special aptitudes developed by a parliamentary training. But it is a long way up from nature-study in the village schools, and the heuristic method in craft-schools, to this; it may sound paradoxical to some, and a counsel of perfection to many. Yet the nation, from the bottom to the top, has yet to learn that trained intelligence in all functions is the factor which makes for victory in the modern international struggle. It may be a lesson taught by the wisdom of statesmen, or bitterly by the stress of defeat and famine. We have by one or other process to learn the national importance of science: to realise that science in the broadest sense, as educator and discoverer, is the mainspring of modern national life; that the future is to the scientifically trained nation which reproduces itself, maintains its health, develops its institutions, controls its production, organizes its distribution, extends its territory, governs its subject races, and prepares its offensive and defensive services with scientific foresight and insight—

State science counsel.

Science and statecraft.

> In the reproof of chance
> Lies the true proof of men—

and, we may add, the true proof of nations.

ENCYCLOPÆDIA BRITANNICA.

NEW VOLUMES.

Pribiloff Islands, often called the Fur Seal Islands, a part of the U.S. territory of Alaska, lying in Bering Sea in about 56° 50′ N. and 170° W. They were first sighted in 1767 by Synde, but visited by Gerasim Pribiloff in 1786, who discovered the fur seal rookeries for which they became famous. Between 1786 and 1890 it is estimated that 6,500,000 seal-skins were taken on the islands; and during the period of the first lease by the Government of the United States (1870–90) the lessees paid to the Treasury $5,956,565. There are two principal islands, St Paul and St George, about 30 miles apart, and Otter and Walrus islets near St Paul. The Aleuts employed in the fishery number about 400, and only agents of the United States or employés of the lessees are permitted on the islands. The islands are hilly and volcanic, without harbours, with abundant herbage, a mean annual temperature of 35·7° F., and a rainfall of about 35 inches. The total area of the group is about 50 square miles.

Příbram, town and capital of a district of the same name, Bohemia, Austria, 29 miles east by south of Pilsen. It is the most important silver-mining town in Austria, the rich Adalbert vein having been worked continuously since 1778 and now reaching a depth of over 3300 feet, becoming richer with the depth. Population (1890), 13,412, or, including the adjoining township of Birkenberk, 18,536; (1900), 19,119, almost exclusively Catholic and Czech.

Price, Bartholomew (1818–1898), English mathematician and educationist, was born at Coln St Denis, Gloucestershire, in 1818. After a private early education he matriculated at Pembroke College, Oxford, of which college (after taking a first class in mathematics in 1840 and gaining the University mathematical scholarship in 1842) he became fellow in 1844 and tutor and mathematical lecturer in 1845. He at once took a leading position in the mathematical teaching of the University, and published treatises on the *Differential Calculus* (in 1848) and the *Infinitesimal Calculus* (4 vols., 1852–60), which for long were the recognized text-books there. In 1853 he was appointed Sedleian professor of natural philosophy, a post which he filled for forty-five years, resigning it in June 1898. His chief public activity at Oxford was in connexion with the Hebdomadal Council, in which he was very prominent, and the Clarendon Press, of which he was for many years secretary. He was a man of remarkable business ability as well as great diligence, the result of this being that he became largely responsible for the conduct of the affairs of the University in various directions. He was also a curator of the Bodleian Library, an honorary fellow of Queen's College, a governor of Winchester College, and a visitor of Greenwich Observatory. In 1891 he was elected Master of Pembroke College, which dignity carried with it a canonry of Gloucester Cathedral. He died on 29th December 1898. (R. F. S.)

Price, Bonamy (1807–1888), political economist, was born at St Peter's Port, Guernsey, on 22nd May 1807. He was educated privately, and then entered at Worcester College, Oxford, in 1825, where he took a double first in 1829. From 1830 to 1832 he was mathematical master, and from 1832 to 1850 a classical master, at Rugby. After resigning his position there, he lived for some years in London, and was appointed, both then and later, to serve on various Royal Commissions. He married in 1864. In 1868 he was elected Drummond professor of political economy at Oxford, and, proving himself an excellent lecturer, was thrice re-elected to the post, which he held till his death. In 1883 he was elected an honorary fellow of his college. He died in London on 8th January 1888. His principal economic publications, exclusive of pamphlets, were: *The Principles of Currency* (1869), *Currency and Banking* (1876), *Chapters on Practical Political Economy* (1878).

Priego de Cordoba, a town of Spain, in the province of Cordoba, in a plain bounded on the south by the sierra of the same name and by Rute. The surrounding

districts send to the market large droves of cattle and mules, and agricultural products, especially wine and oil. The local industries, tanning and manufactures of esparto grass, rugs, and cotton goods, are on the increase. The streets and squares are well built and mostly modern. The parish church was built in the 13th century and subsequently restored; it has a fine chapel. There are several other churches and convents. The town-hall, theatre, and public promenades are modern. There are ruins of an old castle—Priego having been a fortified city of the Moors, and twice retaken by the Christians in 1226 and 1407. Population (1897), 14,434.

Priluki, a district town of Russia, in the government and 145 miles north-west of the town of Poltava. It is an old town, and is mentioned in the will of Vladimir Monomakh. It belonged for some time to the Poles, but was definitively annexed to Russia in 1781. It has an agricultural society and two steam flour-mills, and carries on trade in grain and flour. Population (1897), 19,055.

Primrose League, The, an organization for spreading Conservative principles amongst the British democracy. The primrose is associated with the name of the late Lord Beaconsfield (*q.v.*), as being preferred by him to other flowers. In a letter to his private secretary, Mr Montague Corry, afterwards Lord Rowton, he once wrote: "Primroses are beginning to show themselves at Hughenden, 'sweet harbingers of Spring.'" On a card affixed to the wreath of primroses plucked in the Isle of Wight, and sent by Queen Victoria to be placed upon his coffin by Prince Leopold, there were written in Her Majesty's own handwriting the following words: "His favourite flowers: from Osborne: a tribute of affectionate regard from Queen Victoria." On the day of the unveiling of Lord Beaconsfield's statue, Sir Henry Drummond Wolff, coming late, found all the members of the Conservative party in the House of Commons decorated with the primrose. A small group had for some time discussed the means for obtaining for Conservative principles the support of the people. He therefore said to Lord Randolph Churchill, "Let us found a primrose league." The idea was accepted by several gentlemen in the habit of working together, and a meeting was held at the Carlton Club shortly afterwards, consisting of Lord Randolph Churchill, Sir H. Drummond Wolff, Mr (afterwards Sir John) Gorst, Mr Percy Mitford, Col. Fred Burnaby, and some others, to whom were subsequently added Mr Satchell Hopkins, Mr J. B. Stone, Mr Rowlands, and some Birmingham supporters of Col. Fred Burnaby, who also wished to return Lord Randolph Churchill as a Conservative member for that city. These gentlemen were of great service in remodelling the original statutes first drawn up by Sir H. Drummond Wolff. The latter had for some years perceived the influence exercised in benefit societies by badges and titular appellations, and he further endeavoured to devise some quaint phraseology which would be attractive to the working classes. The title of Knight Harbinger was taken from an office no longer existing in the Royal Household, and a regular gradation was instituted for the honorific titles and decorations assigned to members. This idea, though at first ridiculed, has been greatly developed since the foundation of the Order; and new distinctions and decorations have been founded, also contributing to the attractions of the League. The League was partially copied from the organization of the Orange Society in Ireland, which does not include either Roman Catholics or Jews, who had then recently proclaimed their support of the Conservative party. Thus it was considered that the Primrose League, embracing all creeds and classes, would have much influence in organizing public opinion. In lieu of calling the different subsidiary associations by the ordinary term "Lodges," the name was given of "Habitations," which could be constituted with thirteen members. These were intended as a substitute for the paid canvassers, about to be abolished by Mr Gladstone's Reform Bill. It was thought that thirteen in the habit of working together would be sufficient to undertake the registration and canvassing of a district. The principles of the League are best explained in the declaration which every member is asked to sign: "I declare on my honour and faith that I will devote my best ability to the maintenance of religion, of the estates of the realm, and of the imperial ascendancy of the British Empire; and that, consistently with my allegiance to the Sovereign of these realms, I will promote with discretion and fidelity the above objects, being those of the Primrose League." The motto was "Imperium et libertas"; the seal, three primroses; and the badge, a monogram containing the letters PL, surrounded by primroses. Many other badges and various articles of jewellery have since been designed, with this flower as an emblem.

A small office was first taken on a second floor in Essex Street, Strand; but this had soon to be abandoned, as the dimensions of the League rapidly increased. Ladies were generally included in the first organization of the League, but subsequently a separate Ladies' Branch and Grand Council were formed. The founder of the Ladies' Grand Council was Lady Borthwick (afterwards Lady Glenesk), and the first meeting of the committee took place at her house in Piccadilly, on the 2nd March 1885. The ladies who formed the first committee were: Lady Borthwick, the Dowager-Duchess of Marlborough (first lady president), Lady Wimborne, Lady Randolph Churchill, Lady Charles Beresford, the Dowager-Marchioness of Waterford, Julia Marchioness of Tweeddale, Julia Countess of Jersey, Mrs (subsequently Lady) Hardman, Lady Dorothy Nevill, the Honourable Lady Campbell (later Lady Blythswood), the Honourable Mrs Armitage, Mrs Bischoffsheim, Miss Meresia Nevill (the first secretary of the Ladies' Council). Miss Nevill soon achieved a considerable reputation by her activity and her oratorical gifts. The work of the ladies' branch consists principally in the distribution of literature, the organization of social entertainments with an admixture of politics, and in constant assistance as district visitors both in registration and in canvassing during elections.

When the League had become a success, it was joined by Lord Salisbury and Sir Stafford Northcote, who were elected Grand Masters. Since the first formation the numbers have increased to a marvellous extent, and the following table shows the annual progress:—

Year.	Knights.	Dames.	Associates.	Total.	Habitations.
1884 . .	747	153	57	957	46
1885 . .	8,071	1,381	1,914	11,366	169
1886 . .	32,645	23,381	181,257	237,283	1200
1887 . .	50,258	39,215	476,388	565,861	1724
1888 . .	54,580	42,791	575,235	672,606	1877
1889 . .	58,180	46,216	705,832	810,228	1980
1890 . .	60,795	48,796	801,261	910,852	2081
1891 . .	63,251	50,973	887,068	1,001,292	2143
1892 . .	65,149	52,914	957,180	1,075,248	2188
1893 . .	66,570	54,623	1,010,628	1,131,821	2233
1894 . .	67,896	56,147	1,074,388	1,198,431	2275
1895 . .	69,167	57,632	1,133,009	1,259,808	2296
1896 . .	70,475	59,117	1,185,536	1,315,128	2326
1897 . .	71,563	60,484	1,244,381	1,376,428	2346
1898 . .	72,590	61,817	1,295,612	1,430,019	2360
1899 . .	73,566	62,942	1,338,844	1,475,352	2371
1900 . .	74,461	64,003	1,380,097	1,518,561	2380
1901 . .	75,260	64,906	1,416,473	1,556,639	2392

The Primrose League has undoubtedly exercised considerable influence on elections. Much information may be found in an article in a review called *The Albemarle* of January 1892, written by Miss Meresia Nevill; and in the *Primrose League Manual*, published at the offices at Westminster. The latter publication shows that the League wishes for the dissemination of its three great principles, independently of party politics, and it contains at length the statutes and general instructions, with the gradation of honours and the financial arrangements. It is interesting as a history of the organization. (H. D. W.)

Prince Edward Island, a province of the Dominion of Canada, lies between 45° 58′ and 47° 5′ N. and 62° and 64° 27′ W. The rocks consist of soft red micaceous sandstone and shales, with interstratified but irregular beds of brownish-red conglomerates containing pebbles of white quartz and other rocks. There are also beds of hard dark-red sandstone with the shales. Bands of moderately hard reddish-brown conglomerate, the pebbles being of red shale and containing white calcite, are seen at many points; and then greenish-grey irregular patches occur in the red beds, due to the bleaching out of the red colours by the action of the organic matter of plants. Fossil plants are abundant at many places. These characteristics are persistent over the whole island, and the rocks have been assigned to the Permian age, but it is probable that outliers of Triassic rocks also occur. North of Summerside the land nowhere rises more than 175 feet above sea-level; but a considerable area lying between Summerside and Charlottetown, especially near North Wiltshire, is hilly, rising in places nearly 400 feet and containing the highest land on the island. From Charlottetown eastwards the land is comparatively low and level. The average mean temperature for 1899 was 43° F., the lowest being 10° and the highest 86°; the average rainfall for twenty-seven years (1874–1902) was 31·7 inches, and the snowfall for the same time was 92·7 inches. The area of the island is 2184 square miles. The population in 1871 was 94,021; in 1881, 108,891; in 1891, 109,078; and in 1901, 103,259, giving a density of 47·2 inhabitants to the square mile. In 1901 there were 18,746 families, with an average number of 5·5 persons per family. There were 51,959 males and 51,300 females. In 1901 the origin of the people was—Scots, 41,753; English, 24,043; Irish, 21,992; French, 13,867; all other nationalities, 1604. Of the whole population 103,126 were either born in Canada or became naturalized citizens.

Constitution and Government.—In 1892 the Legislative Council was abolished. The present Legislative Assembly consists of 30 members, who sit and vote together, though divided into 15 councillors and 15 assemblymen. The latter are elected by manhood suffrage, and the former by voters who own real estate valued at $325 or over. The province is represented in the Dominion House of Commons by 5 members instead of 6, as formerly.

Religion.—The principal religious denominations and the number of their adherents were as follows (1901):—Church of England, 5976; Church of Rome, 45,796; Presbyterians, 30,750; Methodists, 13,402; Baptists, 5905.

Education.—In 1901 there were 475 schools conducted by 589 teachers; pupils enrolled, 20,779; percentage of attendance, 59·34. The total amount expended for education was $164,935, the cost per pupil enrolled being $7.93.

Finance.—The ordinary revenue in 1901 was $284,431, and the ordinary expenditure $315,326. In 1901 the gross debt was $642,178, and the assets $181,953.

Defence.—The active militia consists of one regiment of garrison artillery, one company of engineers, one battalion of infantry, and a squadron of Canadian mounted rifles—a total of 58 officers and 713 non-commissioned officers and men, and No. 8 Field Hospital Medical Corps.

Agriculture.—Within the last ten years of the 19th century a great impetus was given to the manufacture of butter and cheese by the introduction of the co-operative plan. In 1899 there were 34 cheese factories and 30 creameries, which produced 3,746,168 ℔ of cheese valued at $376,060, and 722,614 ℔ of butter valued at $139,056. The rapid development of this industry will be seen from the fact that in 1892 there was only one factory, producing 63,018 ℔ of cheese valued at $7872; and in 1894 only 2 creameries, producing 44,512 ℔ of butter, valued at $7872. The island is famous for the excellent quality of its dairy products. In 1891 the crops raised were wheat, 613,364 bushels; barley, 147,880; oats, 2,922,552; rye, 221; peas and beans, 7180; buckwheat, 84,460; corn, 2651; potatoes, 7,071,308; turnips, 2,005,453; grass and clover seed, 12,417; and hay, 132,959 tons. The total number of occupiers of land was 15,137; of these, 14,295 were owners, 813 tenants, and 29 employés. There were 1,214,248 acres occupied, 718,092 improved, 536,175 under crop, 178,072 in pasture, 496,156 in woodland and forest, and 3845 in gardens and orchards. In the same year there were animals and their products: horses, 37,392; milch cows, 45,849; other horned cattle, 45,730; sheep, 147,372; swine, 42,629; domestic fowls, 534,962; cheese, 123,708 ℔; butter, 1,969,213 ℔; wool, 528,273 ℔.

Fisheries.—The Dominion Government distributes annually $160,000 among the fishermen and fishing vessels of Canada; of this amount Prince Edward Island received $10,589 in 1900, distributed among 29 vessels of 737 tons and 1140 boats with 2198 men. In the same year the total number of vessels employed in the fisheries was 29 of 750 tons and 2330 boats manned by 4895 men. The value of vessels, boats, nets, lobster canneries, &c., used in the whole province was $442,120. The total value of the fisheries was $1,059,194, of which lobsters amounted to $445,417, herring to $147,347, oysters to $71,300, and cod to $155,038.

Manufactures.—Factories have been established for the manufacture of tobacco, boots and shoes, cream cheese, condensed milk, and pork-packing. In 1891 there were 2679 industrial establishments: capital invested, $2,911,963; hands employed, 7910; wages paid, $1,101,620; value of raw material, $2,092,067; value of articles produced, $4,345,910. The volume of trade during the last quarter of the 19th century is shown in the following table:—

Year.	Exports.	Imports.	Entered for Consumption.	Duty.
	$	$	$	$
1875 . . .	1,308,461	1,960,997	1,983,419	317,163
1885 . . .	1,494,469	780,141	778,444	187,642
1895 . . .	1,039,493	524,133	530,713	136,136
1900 . . .	1,349,529	502,565	506,374	143,402
1901 . . .	681,403	526,617	543,130	148,258

Shipping.—The registry books of the Dominion for 1900 showed that Prince Edward Island owned 176 sailing ships and steamers, net tonnage, 14,251; of these 21 were steamers, gross tonnage, 3966. During the same year there were 3 vessels built, net tonnage, 106.

Communication.—Two specially constructed boats ply between Georgetown and Pictou, and, with slight interruptions in extremely cold weather, make regular trips. The mail is now carried in this way instead of by ice-boats, as formerly. During the winter of 1901–02 experiments with one of these steamers were carried on between Cape Tormentine, N.B., and Prince Edward Island ports. These experiments showed that communication can be kept up the whole winter. A complete telephone system extends over the island, connecting all the towns, villages, and the more populous country districts. In 1901 there were 209 miles of railway in operation.

Roads and Railways.—Good waggon roads intersect each other everywhere, and the Prince Edward Island branch of the Intercolonial Railway runs the whole length of the island, with branches to Georgetown, Charlottetown, and Cape Traverse. The Murray Harbour Branch Railway, under construction, will connect Charlottetown with Murray Harbour.

The chief towns are Charlottetown, the capital (12,080 in 1901), Summerside (2875), Georgetown (about 1060), Montague, Souris, Alberton, Kensington, and Tignish.

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Prince of Wales Island, the official name of the island commonly called Penang by Europeans, and Pûlau Pînang (*i.e.*, Areca Nut Island) by the Malays, situated in 5° 24′ N. and 100° 21′ E., and distant about 2½ miles from the west coast of the Malay Peninsula. The island is about 15½ miles long by 10½

miles wide at its broadest point. Its area is something over 107 square miles. The town, which is built on a promontory at a point nearest to the mainland, is by no means imposing. It is largely occupied by Chinese and Tamils, though the Malays are also well represented. Behind the town, Penang Hill rises to a height of some 2700 feet, and upon it are built several Government and private bungalows, which are much used both as health and pleasure resorts. The town possesses a fine European club, a racecourse, and good golf-links. Cocoanuts are grown in considerable quantities along the seashore, and rice is cultivated at Bâlek Pûlau and in parts of the interior of the island, but for the rest the jungle still spreads over wide areas. Penang forms, after Singapore, the most important settlement in the Crown colony of the Straits. It has an excellent harbour, and is much used by shipping; but in this respect it has suffered from its proximity to the more important port of Singapore. There are a Church of England and a Roman Catholic church in the town, and a training college under the Roman Catholic missionaries of the Société des Missions Étrangères at Pûlau Tîkus, a few miles outside the town.

History.—Penang was founded on 17th July 1786, having been ceded to the East India Company by the Sultan of Kĕdah in 1785 by virtue of an agreement entered into by him with Captain Light, in consideration of the payment of a sum of $10,000 for a period of eight years. In 1791 the subsidy was changed to $6000, to be paid annually in perpetuity; but some years later this was raised to $10,000, which amount is still annually paid to the Sultan of Kĕdah. This final addition was made when the strip of mainland now called Province Wellesley was purchased by the East India Company for $2000 in 1798. At the time of the cession Penang was almost uninhabited. In 1796 it was made a penal settlement, and 700 convicts were transferred thither from the Andaman Islands. In 1805 Penang was made a separate presidency, ranking with Bombay and Madras; and when in 1826 Singapore and Malacca were incorporated with it, Penang continued to be the seat of Government. In 1829 Penang was reduced from the rank of a presidency, and eight years later the town of Singapore was made the capital of the Settlements. In 1867 the Straits Settlements were created a Crown colony, in which Penang was included. Since then it has been under the administrative control of a resident councillor, who is responsible to the Governor of the Straits. He is aided in his duties by officers of the Straits Civil Service.

Population.—The estimated population of Penang in 1898, exclusive of Province Wellesley, amounted to 154,850 souls. The population is divided into the following nationalities: Europeans, 1173; Eurasians, 1814; Chinese, 80,511; Malays, 44,790; Indians, 24,893; other nationalities, 1669. The number of births registered in Penang in 1898 numbered 1178 males and 1058 females, a total of 2236, giving a ratio of 14·44 per thousand of the population of the island. The number of deaths registered was 3364 males, 1142 females, a total of 4506, being a ratio of 29·10 per thousand of the population. From this it will be seen that in Penang, as in other parts of the Straits Settlements, the deaths annually far exceed the births, this being due to the disproportionate smallness of the female as compared with the male population. None the less the population of Penang yearly increases, owing to immigration from China and the mainland of India.

Shipping.—The number of ships which entered and left the port of Penang during 1898 was 5114, with an aggregate tonnage of 3,761,094. Of these, 4412 were British, with an aggregate tonnage of 2,847,301.

Finance and Trade.—The revenue of Penang, including that of Province Wellesley, amounted in 1898 to $1,653,767, of which $1,084,839 was derived from the revenue farms for the collection of import duties on opium, spirits, &c.; $102,909 from land revenue, $120,987 from stamps, and $65,000 from postal revenue. The expenditure for 1898 amounted to $1,211,267, of which $844,719 was spent on the administrative establishments, $103,028 on the upkeep of existing public works, $69,604 on the construction of works and buildings, and $87,780 on the construction of roads, streets, &c. The revenue in 1900 amounted to $1,736,130.

The imports in 1899 were valued at $69,078,371, the exports at $61,424,108, making the total value of the trade of the year up to $130,502,479. Of the imports in 1898 the value of $6,339,203 came from Great Britain, and $25,075,737 from British possessions. The exports to the United Kingdom were valued at $10,299,968, and those to British possessions at $10,920,735. The principal exports were pepper, tin, rice, and sugar; but all these things were brought from the mainland, none being produced on the island itself in any quantities.

See *Straits Settlements Blue Book containing Annual Reports for 1898*, Singapore, 1898. *Straits Directory for 1900*, Singapore.

H. CL.

Princes' Islands, the ancient *Demonesi*; Byzantine, *Papadonisia*; Turk, *Kizil Adalar*, or "Red Islands," from the ruddy colour of the rocks, a cluster of nine islands in the Sea of Marmora, which forms a kaza of the prefecture of Constantinople. Four of the islands are inhabited, and noted for the mildness and salubrity of their climate—Prinkipo (*Pityusa*), altitude 655 feet; Khalki (*Chalcitis*; Turk, *Heibeli*), altitude 445 feet; Prote (Turk, *Kinali*), altitude 375 feet; and Antigone (*Panormus*; Turk, *Burgaz Adasi*), altitude 500 feet. The others are Oxeia, a marble rock 300 feet high; Plate, Pyti, Antirobitho, and Neandro. The buildings on all the islands were injured by the earthquake of 1894, especially the naval college, and monastery of St George on Khalki, and the monastery of Christ on Prinkipo. Population about 10,000, of whom more than half are Greeks. On Prote were the monasteries to which Bardanes, Michael I. Rangabe, Romanus I. Lecapenus, and Romanus IV. Diogenes were banished.

Princeton, a city of Indiana, U.S.A., capital of Gibson county. It is at the intersection of the Evansville and Terre Haute and the Louisville, Evansville, and St Louis (Southern) Railways, in the south-western part of the state. Population (1890), 3076; (1900), 6041, of whom 198 were foreign-born and 628 negroes.

Princeton, a borough of Mercer county, New Jersey, U.S.A., on high ground between the Millstone river and Stony brook, at an altitude of 209 feet. It is on the Delaware and Raritan canal, and on a short branch from the main line of the Pennsylvania Railroad, between Philadelphia and New York. It is chiefly known as the seat of Princeton University (which see). Population (1890), 3422; (1900), 3899, of whom 508 were foreign-born and 899 negroes.

Princeton University, situated in Princeton, New Jersey, U.S.A., originally named The College of New Jersey. It was founded in 1746, in Elizabethtown, N.J., but was removed to Newark, N.J., and finally, in 1754–55, the first college building, Nassau Hall, was erected at Princeton. During the period before the American Revolution it graduated many men of distinction, among them Richard Stockton and Dr Benjamin Rush, who, with John Witherspoon, president of the College, were signers of the Declaration of Independence; James Madison, fourth president of the United States; twenty-two members of the Continental Congress, and nine members of the Convention which framed the United States Constitution. It has since maintained its place among the leading American colleges. In 1896, responding to the general movement towards advanced instruction and special research, it was incorporated as a university, although, unlike many American universities, it has no law school and no medical school. It is governed by a president and a self-perpetuating board of twenty-six trustees, and five other trustees elected by the alumni, and is independent of state or denominational control. There were, in 1901, 760 undergraduates in the academic or classical department, pursuing courses leading to the degree of Bachelor of Arts, and 477 undergraduates in the John C. Green School of Science, divided among the departments of electrical engineering, civil engineering, and general science. The graduate students, who constitute the university element proper, numbered 138. The higher degrees conferred are Master of Arts, Master of

Science, Doctor of Philosophy, Doctor of Science, and Bachelor of Divinity. There were 46 professors, 19 assistant professors, 40 instructors, assistants, and lecturers, and 16 fellows.

Pringsheim, Nathanael (1823–1894), German botanist, was born at Wziesko in Silesia, on 30th November 1823. He studied at the universities of Breslau, Leipzig, and Berlin successively. Though at one time intended for the medical profession, his tastes were always for pure science, and it was as doctor of philosophy that he graduated in 1848, with the thesis *De formâ et incremento stratorum crassiorum in plantarum cellulâ*. From that time onwards his life was devoted to botanical research, and he rapidly became a leader in the great botanical renaissance of the 19th century. Until Pringsheim was over fifty his work was entirely on the morphological side of the science, and in this direction his great triumphs were won; during the last twenty years of his life he turned his attention to physiological questions, but with less marked success. His contributions to scientific algology were of striking interest. Pringsheim was among the very first to demonstrate the occurrence of a sexual process in this class of plants, and he drew from his observations weighty conclusions as to the nature of sexuality. Together with the French investigators Thuret and Bornet, Pringsheim ranks as the founder of our scientific knowledge of the Algæ. Among his researches in this field may be mentioned those on *Vaucheria*, 1855, the Œdogoniaceæ, 1855–58, the Coleochætcæ, 1860, *Hydrodictyon*, 1861, and *Pandorina*, 1869; the last-mentioned memoir bore the title *Beobachtungen über die Paarung der Zoosporen*. This was a discovery of fundamental importance; the conjugation of zoospores was regarded by Pringsheim, with good reason, as the primitive form of sexual reproduction. A work on the course of morphological differentiation in the Sphacelariaceæ (1873), a family of marine Algæ, is of great interest, inasmuch as it treats of evolutionary questions; the author's point of view is that of Naegeli rather than Darwin. Closely connected with Pringsheim's algological work was his long-continued investigation of the Saprolegniaceæ, a family of algoid Fungi, some of which have become notorious as the causes of disease in fish. Pringsheim's work was by no means limited to Thallophytes; among his contributions to our knowledge of the higher plants, his exhaustive monograph on the curious genus of Water-Ferns, *Savinia*, deserves special mention. His career as a morphologist culminated in 1876 with the publication of a memoir on the alternation of generations in Thallophytes and Mosses; his theory will always hold its own as a brilliant attempt to solve the greatest problem of morphological botany. From 1874 to the close of his life Pringsheim's activity was chiefly directed to physiological questions: he published, in a long series of memoirs, a theory of the carbon-assimilation of green plants, the central point of which is the conception of the chlorophyll-pigment as a screen, with the main function of protecting the protoplasm from light-rays which would neutralize its assimilative activity by stimulating too active respiration. This view, though it no doubt contains an element of truth, has not been accepted as offering an adequate explanation of the phenomena. Pringsheim founded in 1858, and edited till his death, the classical *Jahrbuch für wissenschaftliche Botanik*, which still bears his name. He was also founder, in 1882, and first president, of the German Botanical Society. His work was for the most part carried on in his private laboratory in Berlin; he had little taste for professorial duties, and only held a teaching post of importance for four years, 1864–68, when he was professor at Jena. In early life he was a keen politician on the Liberal side, and even took part in the street fighting in Berlin during the "Annus Mirabilis." That adventure, however, appears to have finally extinguished his active interest in politics. He died in Berlin on the 6th of October 1894.

A fuller account of Pringsheim's career will be found in *Nature*, vol. li., 1895, and in the *Berichte der deutschen botanischen Gesellschaft*, vol. xiii., 1895. The latter is by his friend and colleague, Ferdinand Cohn. (D. H. S.)

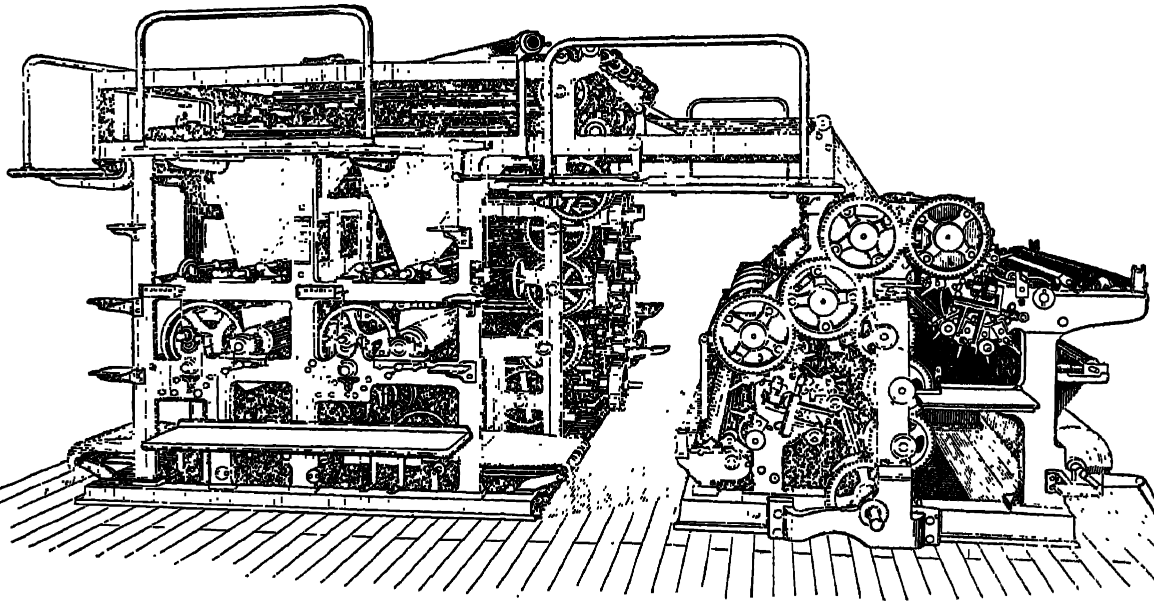
Printing, Book: See Book Printing.

Printing Presses.—Improvements in newspaper printing machinery are now sought in the direction of greater compactness and simplicity. The Goss Rotary of Chicago, also known as the straight-line machine, from that peculiarity in its construction, is an illustration of this tendency. The larger part of this machine is in four sections, apparently exactly alike, each section at times independent of other sections. Four webs of paper, four impression and four plate cylinders are in a vertical line. In the process of printing from four rolls, the sheets from each roll move in a horizontal line until they near the end of the machine, in which position they are folded, conjoined, and thrown out ready for delivery. As each section is independent, one section only, which prints 4 pages, can be used, and the other sections thrown out of gear. When combined, two sections will print 8 pages, three sections 12, and four sections 16 pages.

As rotary machines for the rapid printing of newspapers in two or more colours always require for each colour a separate ink-fountain and rollers, and usually a separate plate cylinder and impression cylinder, their production is not so great as the machine of same size made for black ink only. A successful form of colour machine, made by Marinoni, of Paris, is used for printing in six colours more than 1,000,000 copies on each edition of the weekly illustrated supplement of *Le Petit Journal*. Colour machines of American design are used by a few papers of New York for their Sunday and holiday editions. A machine recently made in that city is intended to produce 48,000 papers, cut and folded, with an inset sheet, and a cover in four colours. All the colour presses now made register with perfect accuracy, but much has yet to be learned about the making and management of the paper and the inks adapted to colour work. Rotary machines printing from a continuous roll have their limitations. They are constructed usually so that they can print one size only of paper, and that size must be in length the exact circumference of the impression cylinder.

Machines for printing books and jobs are of simpler construction and of slower speed. The *drum cylinder*, so called from the large size of the cylinder, makes one revolution for each impression; but as the width of the bed containing the type is about one-third the circumference of the cylinder, the actual printing of the sheet takes up but one-third of the time the cylinder is rotating. During two-thirds of its rotation no printing can be done. On the smaller sizes of drum cylinder, 1800 impressions an hour can be had; on the larger, about 1000. The *two-revolution cylinder*, which makes two revolutions to each impression, and can be made to produce 1500 or more impressions on a large sheet in one hour, is preferred for its compactness and its somewhat greater speed. The *stop-cylinder* (invented by Dutartre, of France, in 1852) is a little inferior to the two-revolution cylinder in performance, but it has marked merit in greater strength and accuracy of movement, and is largely used for the printing of woodcuts and the best colour work. In this machine the cylinder stops after every impression and allows the feeder to place properly the sheet to be

printed. The bed containing the type is moved to and from impression by steady wheel motion. The ink is distributed upon a table as well as by vibrating rollers. The *Perfecting Press* of two cylinders prints from a flat type bed the outer and inner side of the same sheet by the same operation. It is a form of cylinder machine once largely used abroad, but is not approved in the United States, and is declining in favour in France. Its product is greater than that of the simple cylinder, but not more than that of two single cylinders, nor is it so easily managed. The *Rotary Art Press* (first made by R. Hoe & Co. for the printing of the illustrated formes



Quadruple Perfecting Printing Machine and Folder.

of the *Century Magazine*) is simpler and more manageable. Sixty-four electrotyped plates, curved and attached to a cylinder about 30 inches in diameter, are inked by 16 rollers. Impression is made against a cylinder of similar size which revolves at the same rate of speed. The sheets are fed by hand. Unlike all other hand-fed cylinders, this machine has no lost motion, for printing is continuous. Although it does four times the work of the stop-cylinder, the rotation of the cylinder is no faster, and the quality of the press work is really superior. For printing the plain type pages and advertising pages of this magazine a simpler form of web press is used, which is not so rapid as the web press of newspapers; but it performs more operations and does more accurate work. At every revolution it puts on the delivery-table 64 pages in exact register, truly cut, folded, and ready for the binder. Small cylinder machines are also made for printing cards, numbered railway tickets, pamphlets, stock and market reports, proofs for proof-readers, matrixes for stereotype plates, and for aluminium plates to be printed by lithographic process. Improvements in cylinders for book work have been made by several European mechanicians. At the Paris Exposition of 1900 Marinoni exhibited a perfecting cylinder which printed at one revolution at a rapid rate two colours on either side of the sheet. Alauzet and Voirin, of Paris, Rochstrop and Schneider-Nachf, of Dresden, König and Bauer, of Oberzell, and Schelter and Giesecke are makers of approved book and job printing machines.

Methods of printing have been as greatly changed as the styles of presses. Before 1870 nearly all the books and newspapers made in the United States were printed on damped paper. For the printing of types, damping was of advantage in aiding the quicker production of bold and black impressions, but for the printing of the finest engravings, dry paper of smooth surface was needed to show the delicacy of the finer lines. To attain this desired smoothness, paper-makers extended the application of calendering rollers for the quality now known as super-calendered paper, which is still largely used for the printing of ordinary illustrations. It is not possible, however, to give by calendering to the fibres of paper the smoothness of surface needed for the finest engravings. To produce perfect smoothness, the web of paper must be covered with a thin coat of whiting, which closes up all the pits in the fibre, and after calendering leaves it with a surface as smooth as polished metal. Paper so coated, when properly printed, will show a velvety black in the shadows of a cut and a paleness of grey in sky tints unattainable on pure paper fibre. The development in 1875 of photo-engraving by the Meisenbach process brought with it finer engraving with very shallow counters, and compelled a greater use of coated paper, which had to be printed dry. In 1880 the new process was so greatly improved that the so-called half-tone engravings began to supplant woodcuts in the magazines. As some of these half-tones were made behind screens of two hundred or more lines to the inch, the counters were unavoidably shallow, and printable only on the smoothest coated paper. Damping of paper was generally abandoned, not only for coated but for ordinary paper. This, in turn, compelled new methods of press-work. Woollen blankets and indiarubber impression-resists were supplanted by hard cardboard, which, as it pressed upon the face only of the cut, did not thicken its hair-lines. Much more time had to be given by the pressman to overlays and the exact graduation of impression for different tints on every illustration. Although the new method of hard-surface impression improved the appearance of the illustrations, it was wearing to the types, making them relatively deficient in boldness and blackness. The old-time boldness and blackness of type-printing have been appreciably sacrificed for the preservation of the higher delicacy of engraving.

All the old processes of stereotyping in plaster, or in clay, or in paper, were ineffective in book-printing, in that they could not fairly reproduce the fine work of a woodcut or an actinic plate. The more recently developed art of electrotyping is now used by all book printers for

types as well as for cuts, and even daily newspapers have to use it for issues containing illustrations of high merit. As first practised, the battery required about twelve hours for the making of the shell for an electrotype plate, but now, by the aid of the dynamo-electric machine, a fair shell can be produced in one or two hours. (See also TYPE-SETTING MACHINES, ENGRAVING, ELECTRO-METALLURGY, NEWSPAPERS, BOOK PRINTING.) (T. L. DE V.)

Prishtina, PRICHTINA, or PRISTINA, the chief town of a sanjak in the vilayet of Kossovo, European Turkey, situated on the Sitnítza, an affluent of the Ibar, 3 miles east of the station on the Salonica–Metrovitza Railway, 60 miles north-east of Prizren. It is the seat of a governor-general and of a general of division, and possesses seventeen mosques, a military hospital, and a higher class school. The trade is considerable, the imports including sugar, coffee, hardware, iron and steel, &c., and the exports chrome, wheat, maize, barley, skins, and wine. The Prishtina valley was the scene of the final combat between the Turks and Servians, which led to the establishment of the Ottoman Empire in the Balkan Peninsula. Population, 21,000.

Prison Discipline.—Great changes were introduced into the methods of enforcing penal discipline during the latter decades of the 19th century, and there has been a steady progress towards milder and more enlightened methods of prison treatment. Some new and remarkable experiments have been tried, especially beyond the Atlantic, and everywhere much attention has been paid to penal problems. This has shown itself abroad by the almost universal adoption—at least in theory—of principles hitherto accepted as paramount in Great Britain. The prison cell, which in effect typifies the modern system, has been long an established British institution. The separation, more or less strict and prolonged, of prison inmates has been esteemed an essential part of penal treatment, and of late years all civilized nations without exception have built or started building new prisons to carry out this form of treatment. France has shown much progress in this direction. Great additions have been made to La Santé in Paris, and an entirely new building on the very latest plan has been constructed at Fresnes-lès-Rungis to replace the once famous but somewhat obsolete gaol of Mazas and other prisons of the Seine. Germany has taken up the question of penitentiary reform, and new establishments on the cellular system have been erected; while Austria, Russia, Spain, Portugal, Holland, Denmark, Norway and Sweden, Switzerland, even Japan, all have been busy in providing separate cells for their prisoners. In Italy a comprehensive scheme has been drawn up, so that cellular imprisonment may become a general rule. In Belgium, where penal administration has received the closest attention for a number of years, the *régime* of cellular imprisonment has been long carried to its farthest limits, and solitary confinement ranging over ten years, and in some cases much more, has been strictly enforced. Of late years, however, a new school has arisen in Belgium which dissents from the hitherto accepted principle, and expresses strong doubts of the wisdom or efficacy of prolonged cellular confinement. In England, moreover, which if not the first to adopt separation in principle, certainly gave the largest effect to it in practice, continuous cellular confinement for short terms is ceasing to be the universal inevitable rule. A growing dislike to it has been manifested by both experts and philanthropists; the terms for which it could be inflicted have been constantly diminished; and although it is still retained in cases of penal servitude for the first six months, it was in 1899 practically abandoned for lesser sentences, and all prisoners after the first month work together in association under surveillance. This is neither more nor less than the adoption of the old-fashioned Auburn system, which in old days held the ground against the solitary system of Pennsylvania. The bias of modern practice, in short, is towards milder methods, not only in prison treatment, but in those anticipatory processes which if successful may render imprisonment unnecessary.

It has been well said that criminals are such by accident or inclination, and that under a perfect system of government they should be spared the one and cured of the other. Consistent attempts have been made to follow out this principle. When prevention ends reformation begins. The first includes child rescue, the general raising of the moral standard by education; the second, painstaking efforts to improve the character of all subjected to the chastening influences of imprisonment. Very beneficial results have been obtained by the care devoted to juveniles, who from inherited disposition, the neglect of parents, vicious surroundings, evil advice and example, might lapse into misconduct. The recruitment of the vast army of crime is cut off at its source. Great forbearance is shown to the less hardened offenders for whom there is reasonable hope of recovery. The law is loth to appeal at once to repressive measures, and does not necessarily apply the *ultima ratio* of the gaol. Several important Acts have been passed, having for their object the more merciful treatment of first or venial offenders. The punishment of such as are charged with anything less than the most heinous crimes may be held over pending good behaviour. The Probation of First Offenders Act discharges provisionally and practically pardons those who have not committed any previous offence, and some 5000 of these have annually escaped imprisonment since 1893. Moreover, the Summary Jurisdiction Act, 1879, by affording time for the payment of fines, keeps numbers of offenders out of gaol. Quite 46,000 were thus suffered to remain at large and seek funds for the discharge of their fines during 1899. A careful examination of the sentences now inflicted will show that they have steadily decreased in severity; for those who are still condemned to pass the gaol gates considerable modifications in penal treatment have been devised. Continuous cellular seclusion is no longer the rule. The older harsher forms of penal labour have been abolished; the crank which ground only air has all but disappeared, and if the treadwheel is still retained, it is made to fulfil the useful purpose of water-raising or grinding wheat. The 39 treadwheels and 29 cranks still in operation in 1895 had dwindled down in 1901 to 13 and 5 respectively, and they also will shortly be abolished. Attention is as far as possible concentrated on industrial labour, and great pains are employed to instruct prisoners in handicrafts and the manufacture of useful articles, which can be carried on as wage-earning trades in freedom. In deference to popular demand, great additions were made to prison dietaries, and these, if not actually excessive, compare favourably with the food issued in workhouses and with the general allowance of the poorer classes. The privilege of correspondence with friends outside and of receiving visits has been enlarged; additions have been made to prison libraries, which now contain works of fiction and other entertaining literature; the rule of silence during hours of association is relaxed for certain classes of prisoners. The use of tobacco, which is permitted in many prisons on the Continent and in the United States, but has been prohibited in the United Kingdom, is recommended by some reformers, who have also urged that lectures and other entertainments should be provided, and that, following

the example of some American prisons, the forbidding character of the gaol as a place of durance and punishment should largely be made to disappear.

So far these more extravagant views have not been generally accepted. But the pendulum has always oscillated between severity and mildness, and the recent movement has been in the latter direction. The new departure dates from a report of a departmental committee in 1895, which had been appointed by Mr Asquith to review the existing system of treatment of prisoners, and suggest changes in prison administration. The inquiry admitted that the centralization of authority in 1878 had been a complete success, as shown by increased economy in working and by the enforcement of uniformity in prison discipline. The committee was, however, dissatisfied with the moral results achieved, and thought that more attention should be paid to reformatory processes. They believed that "few inmates left prison better than they came in." Recommittals were frequent, and "recidivism"—or repeated reconviction of the same individual—was increasing. To make imprisonment more deterrent on the one hand to the habitual criminal class, and on the other hand more improving to the hopeful and less hardened offenders, was the aim of any good system, and the committee's recommendations dealt mainly with the latter aspect. They were accepted by Mr Asquith, then Home Secretary, as indicating the line which reform should take. The more academic and somewhat visionary theories of increasing the staff of chaplains and schoolmasters, and the calling in of outside exhortation, whereby each individual might be dealt with personally, have not borne much fruit. But the more minute classification of prisoners has worked well. Not only are the convicted and unconvicted kept apart, but the juvenile and first offenders are strictly separated from habitual criminals. The principle of the "star class," so successfully tried since 1879 in the convict prisons, has been extended to the local prisons; a prisoner never previously convicted is designated as a "star," and absolutely segregated from his fellows at chapel, labour, exercise, and quarters occupied. The salutary results of this system have been proved by prison statistics. Between 1879 and 1899, 2435 convicts were placed in the "star" class, of whom no more than 1·2 per cent. have been sent back to penal servitude under fresh sentences, and only 1·3 per cent. have forfeited their tickets of leave. The same results are shown in a lesser degree in the local prisons; in the four years 1897–1900, out of 29,195 males and 5823 females placed in the "star" class, 7·1 per cent. only of the former and 11·7 of the latter have been relegated to prison. Great emphasis was laid by the committee upon the development of agencies for the assistance and rehabilitation of the released, and the excellent work already done by private societies for the aid of discharged prisoners has been systematized and their functions enlarged. The help thus given is of the most useful kind, and tends to encourage good resolutions formed in gaol by keeping the weak or friendless, on their first reappearance in public, away from the evil influences of former associates. Reformatory institutions have also been opened to others than juveniles. One rule which restricted admission to youths below 16 has been modified to take in adults at 16 and retain them till they were 21, and the creation of a large penal reformatory for all such was mooted by the committee of 1895 and adopted in 1901, when a "juvenile-adult reformatory" was opened at Borstal, near Rochester, by the conversion of a part of the existing convict prison. It has been shown by undoubted figures that there is a "criminal age," a period ranging between 16 and 30, when more than 50 per cent. of the total indictable offences are committed; and it is held by expert authority that much might be done in this way to prevent lapses into crime at the most susceptible period. The principle has found practical illustration in the United States, where the reformatory system, as applied to adults and to full grown men (not children and juveniles), has reached an extraordinary development. Elmira, in the state of New York, and Concord, in Massachusetts, are typical establishments, whose methods deserve to be detailed. Their principal aim is to substitute complete moral regeneration for punishment. There is supposed to be nothing vindictive in the treatment. They are prisons in reality, but not in name, and those committed to them are called inmates, not prisoners. The offender is to be pitied, not punished, and it is held to be the duty of the public as well as its best safeguard to make another man of him. With this object in view he is handed over to be dealt with under an elaborate system of physical, intellectual, and industrial training, with no specific sentence, but for such period, with certain limits, as may be found necessary by the agent who is to carry out the desired change. These processes depend upon gymnastic and military exercises, upon a wide curriculum of instruction, and upon apprenticeship in some handicraft or technical trade. Much importance is attached to physical agencies; the Turkish bath is in constant use, and the frame is strengthened and its normal healthful functions highly developed. At Elmira there is a newspaper, written, edited, and printed by the inmates, and prison journalism of this kind is not at all uncommon in the States. The inmates are also formed into battalions of infantry, carefully drilled to manœuvre and march to the strains of an excellent band. Admission to these state reformatories is by the order of a high tribunal, the ages of offenders selected ranging between 15 and 35. The crimes committed are such as robberies, forgeries, manslaughter, embezzlement, receiving, and others of lighter character. The course of treatment is carefully prescribed, and each inmate passes through progressive stages, promotion from grade to grade being dependent upon application and good conduct. The discipline is more severe than the system would imply, and is enforced by ingenious penalties and the use of the "paddle" or stick. Considerable results are claimed for the treatment, but they are based upon presumption rather than upon positive fact, for the supervision that follows "parole" or conditional discharge covers no more than one year, and is chiefly exercised through relations and employers. According to the reports received, the Elmira pupils who do well amount to 78 per cent. of the total. No doubt they have much encouragement, not only in the acquisition gratis of a high-class education—which is denied to those who have never offended—but in the care bestowed upon them on release. No inmate leaves Elmira until a situation has been found for him, adapted to his abilities and recent training. It is not easy to strike the balance between excessive care bestowed on unworthy objects and the value to the community in the reclamation of delinquents by such extravagant means. More positive and more tangible results are hoped for from the less ambitious methods to be pursued at Borstal. Reliance will be placed upon a strict discipline and useful instruction in wage-earning trades, while all cases will be carefully watched on discharge by an association of kindly workers, ever ready to give advice and assistance to the well-intentioned. The character and scale of these may in a measure be judged by the following particulars concerning the former:—

The Elmira Reformatory, the buildings of which are large and thoroughly equipped, was opened in 1876. Only male felons who have not hitherto been convicted of felony are sentenced to the reformatory. They are com-

mitted there for a period not to exceed the maximum term provided by law for their particular offence had they been sentenced to a state prison instead. This indeterminate sentence, as well as the process of training and reformation in place of the ordinary punishment, distinguishes the reformatory from an ordinary prison. (Besides those sentenced to an indefinite term, there are a few—about one-tenth of the total number—sentenced to a definite period, but the board of managers has strongly recommended that these "definites" should no longer be received.)

On admission a man is assigned to the intermediate of the three grades in the institution, and from this grade he is promoted or degraded according to his conduct. He is at once set to learn a trade, if he does not already possess one, and he works at this half the day, the other half being spent in work connected with the institution. Three evenings each week every inmate attends school. After six perfect months in the medium grade he is eligible for promotion to the highest grade, and after six perfect months in this grade he may be paroled, at the discretion of the management, on condition that he has employment awaiting him and that he report to the management every month for six months. At the end of this third six months he may receive an absolute discharge. Certain privileges, especially in regard to food, dress, and letters, depend on the grade of the inmate. The men receive definite wages, 55 cents per day in the highest grade and 45 cents in the others. Out of their wages they must pay for their board, clothes (apart from the outfit given them on entrance), and also pay the fines imposed upon them for offences in demeanour and failures in trade or school. A monthly account is kept with each man, and he cannot be promoted unless he has a credit balance, nor paroled until he has saved enough to take him to his future place of employment. The discipline and daily life of the institution are largely of a military character. The men are organized into a regiment, are thoroughly drilled, and dress parade is held daily. Flogging has been abolished.

The number in the institution on the 30th September 1901 was 1276, the average number during the preceding twelve months being 1338. The total net cost of maintenance for the year was $205,021, or an average cost of 42 cents per inmate per day. Although no persons are sentenced to the reformatory who have previously been convicted of a felony, still a large proportion have been previously imprisoned for less serious offences. Of the 1276 inmates above mentioned, 559 had previously been confined in gaols, reformatory schools, penitentiaries, &c.

The total number of inmates received from the opening of the institution to the end of September 1901 was 11,046, of whom 10,540 had been sentenced for indefinite terms. The average age of inmates has been 21 years. Of the 10,540 "indefinites" received, 7010 have been released on parole. Of this number 508 were returned to the institution, of whom 257 were ultimately re-paroled, 209 were otherwise discharged (through expiration of maximum sentence, transfer to other prisons, &c.) or died, and 42 were still at the reformatory. Of the remaining 3530 "indefinites" not paroled the following statistics are given: absolutely released without parole, 27; maximum sentences expired, 935; pardoned, 33; escaped, 29; died, 199; transferred to other prisons, state hospitals, &c., 1137; now remaining in the institution, 1170.

It has been often debated whether or not prison discipline reacts upon the criminality of a country; whether, in other words, severity of treatment deters, while milder methods encourage the wrong-doers to despise the penalties imposed by the law. Evidence for and against the theory is drawn from the whole civilized world. In France crime increases by leaps and bounds (especially in the most serious forms—murder, parricide, poisoning), yet in French prisons of late years the rule of strict cellular confinement has obtained, while banishment to the uttermost ends of the earth is in force as a grievous punishment for a people so attached to the soil. There is the same very marked increase in the United States, in spite of the reformatory systems described. On the other hand, in Belgium a steady diminution is to be noted in the numbers committed to prisons in which that most irksome of all restraints, unbroken solitude for years, is inflicted. In Great Britain the whole tendency of legislation and administration has been towards leniency, and a steady decrease in crime has been long in progress—a fact combated by some critics, but based upon indisputable official figures. Taking England and Wales for illustration, although the same results are still more marked in Scotland and Ireland during the period 1860–1900, the total number of penal servitude sentences per annum has decreased from 2589 in 1859 to 728 in 1900, in spite of the growth of the population. The readiest method of contrast is by comparing the number of persons sentenced per 100,000 of the general population, and this works out at 13·4 in 1859, with successive reductions to 9·1 in 1869, 6·6 in 1879, 3·3 in 1889, and 2·3 in 1900. It has been urged that this diminution means no more than a reluctance in the various jurisdictions to impose the heaviest penalties, even for serious offences, but in that case a proportionate increase would be shown in the population of local prisons, in which sentences less than penal servitude are carried out. Yet taking these "local" prisons from 1878, the year in which they were brought under direct Government control, the same strongly marked decrease is (with some few fluctuations) to be observed. Thus at the date of the change in administration the total number of convicted prisoners in custody in the gaols was 20,833; this fell by 1000 within a year, and the move has since been generally downwards. In 1888 the total had sunk to 14,536, in 1892 to 12,663; in 1899 it had risen slightly to 14,957, and in 1901 it had again decreased to 14,739. The decrease may be better appreciated by taking the figures relatively with population. Thus for the quinquennial period ending 31st March 1885 the yearly average imprisoned for indictable offences was 37·8 per 100,000 of the population in England and Wales; for the next five years it was 32·7; the next, 28·0; for the five years ending 1900 it had fallen to 25·0, and for 1901 it was no more than 22. Consideration must be had to the character of the offences for which imprisonment was meted out. The more serious of those dealt with by indictment has continuously decreased; the increase has followed summary convictions for minor offences, many of which are no more than infractions of police rules, such as the order to muzzle dogs, or to prevent annoyance by the improper use of bicycles or motor-cars.

Satisfactory as the facts on the whole appear with regard to the decrease of the numbers incarcerated in England, it cannot be concluded that crime is distinctly on the wane. There may be fewer heinous offences compared to population, but they are more persistently repeated by the same persons. The gravest feature in modern penology is the vitality of "recidivism"—to adopt the term of French origin which expresses the persistent, reiterated lapses of the same individual into wrong-doing. Rather more than half the whole number of serious crimes are the work of the "habituals." A few figures will show this most clearly. In the official year ending 31st March 1899 there were in

Recidivism.

all 113,182 males and 45,288 females committed to prison on conviction of crimes. Rather more than half the males and nearly two-thirds of the females had been previously convicted, not merely once, but twice, thrice, up to twenty times and more. Some of the figures are most extraordinary. There were 19,313 males and 6062 females with one previous conviction; with four previous convictions the numbers were 3891 males and 2013 females; from six to ten times, 8558 males and 5269 females; from eleven to twenty times, 6079 and 5393; above twenty times, 4182 and 6639. It will be noted that by far the largest proportion of recidivists were females, but men and women alike offered themselves perpetually for reimprisonment. We have thus a grand army constantly on the march through prison, subjected all of them to the various processes known to and tried by penal administration, and yet undeterred by the treatment. Nothing has availed to check or cure them—neither the most irksome restraints on the one hand, nor the most philanthropic efforts of moral and educational persuasion on the other. It is the criminal residuum, the essence of the criminality of a country, a contingent ever at war with society, persistently defying the law and refusing to abide by the rules of conduct accepted by others. The State retaliates as best it can; it takes the criminal red-handed, punishes him, secludes him, exhorts, cautions, assists him when he is once more free, but it still largely fails to transform him into an honest, law-abiding citizen. Call them what we will—born criminals in the phraseology of the Lombroso school, the product of an imperfect social system, criminals by predestination, uncontrollable tendency, mere accident or neglect—criminals a large proportion will continue to be to the end of the chapter. Their path is chosen and will be trodden while they live; they are a terror and a danger to society while at large, incorrigible while in custody, intractable—at least to any methods hitherto applied. This failure to cope with habitual crime has led to the invention of the "indefinite sentence," adopted beyond the Atlantic. It means a system of indeterminate imprisonment, under which the hardened offender would be kept from doing more harm until there was reasonable hope that he was weaned from his evil ways. But the scheme bristles with difficulties. The reluctance of judges to sentence even the most abandoned offenders to nearly interminable periods of detention has to be overcome.

The progress made in prison treatment will be best realized by a brief survey of penal institutions in the principal countries of the world. It will be convenient to take them alphabetically.

1. *Austria-Hungary.*—The *régime* of cellular confinement has not been universally adopted; only six prisons are built on that principle, and no more than 15 per cent. of the whole number of prisoners can be subjected to the system. Cellular separation is not inflicted for long periods, the minimum being six months and the maximum three years. The bulk of the prisoners live and labour in common. A great feature has been the execution of public works by prisoners in a state of semi-liberty beyond prison walls—the practical adoption of the so-called "Irish" or intermediate prison—and good results are seen in road-making and the improvement of river-beds. The reformatory at Aszod was built by convict labour, and also the fine prison of Marburg on the Drave. New prisons have been constructed at Pilsen, Prague, Stanislau, Budapest, Streu, and Wiener Neudorf, all on the best lines and with liberal expenditure, but older establishments are still to be found—convents, monasteries, and castles—being appropriated to service. A number of societies (35) exist to aid discharged prisoners. Recidivism is very constant, and the existing discipline does not sufficiently restrain the habitual criminals, as is shown by a serious *émeute* in the prison of Garsten in 1890. In the new prison at Rozsahegy, in Hungary, the inmates are chiefly engaged in agriculture.

2. *Belgium.*—This country has spared no pains and no money in carrying out penal processes, and the Belgian prisons are examples of the cellular system prolonged to the utmost limits of human endurance. There is a minimum of ten years, but the individual may elect to continue in separation, or be transferred to partial association. Many, it is said, still prefer the living death of the cell, and cases are known of prisoners who have passed fifteen, twenty, even twenty-three years in unbroken solitude. Great results are claimed for the system, and judged by the test of diminishing crime it appears to have succeeded, though it fails to prepare those who endure it for the struggles of everyday life. The treatment is especially recommended for recidivists, whom no doubt it removes more or less entirely from the theatre of crime. A new school of Belgian criminologists has been headed by M. Prins, the chief of the department, who has protested that any hope that the vicious, hardened offender after a long detention, "surrounded with every attention, soaked with good counsel, will leave his cell regenerated," is a Utopian dream. Some of the Belgian prisons are magnificent edifices; that of St Gilles in Brussels is of imposing architecture, and was built regardless of cost; modern establishments, such as those of Louvain, Merxplas, and the new quarter at Ghent, are built on an excellent plan, and all of them are cellular.

3. *British Empire.*—The principle of cellular separation was accepted as far back as 1836, and the model prison of Pentonville, opened in 1842, has since been copied throughout the civilized world. The cellular system has been adopted in all British colonies with various modifications, and prisons built on modern principles are to be found in Canada, Australia, New Zealand, and the Cape of Good Hope. India retains association as the system most suitable for its criminal classes, with other methods generally abandoned by Great Britain, such as the employment of well-conducted prisoners as auxiliaries in prison discipline and service. Deportation is still the penalty for the worst offences, and is carried out on a large scale and with satisfactory results in the Andaman Islands. In Egypt since the establishment of British control a very marked change has been introduced in prison affairs under the active and enlightened initiative of Dr Crookshank Pasha. The great public works prison of Tourah, near Cairo, employs a large number of convicts in the neighbouring quarries; parties of them accompanied the Anglo-Egyptian advance into the Sudan, and assisted greatly in railway extension, in loading and unloading stores, and other "fatigue" duties. Although the cellular system has made no great progress, the new and improved prisons at Alexandria, Gizeh, Assiut, and elsewhere are well and carefully managed.

4. *Denmark.*—In Denmark all convicted prisoners pass through several stages, from cellular treatment to the intermediate prison and conditional liberty. Two new prisons on the latest model have been erected at Copenhagen, one for males and the other for females. The smaller gaols for short times are mostly on the cellular plan.

5. *France.*—France has devoted very considerable attention to prison matters, and is now practising the two extremes of treatment, the strict cellular isolation of the Belgian system, and the penal exile or transportation which was long the English rule. The conversion of her numerous provincial prisons into cellular has not yet been possible, but a splendid prison for Paris, replacing the obsolete Mazas, St Pélagie, and La Roquette, has been built in the suburbs at Fresnes-lès-Rungis, near Bercy, on the Seine. It contains 1780 cells, and embodies all the latest ideas and appliances in prison construction, douche baths, electric light, iron bedsteads. The cells have varnished walls, perfect ventilation, and the best hygienic services. There is also a quarter for 400 prisoners in association, so that the total prison population will exceed 2000. The old prison of La Santé in Paris has also been transformed into a cellular prison, with the same liberal provision of modern improvements, and contains now 1150 cells. Much is hoped from these new methods both in deterrence and reformation, but recidivism is steadily on the increase in France, and has resisted all treatment. The law of "relegation," which prescribed that all habitual offenders should be sent back to the penal colonies, has not worked well. The results of deportation generally have been most unsatisfactory. In Cayenne, in French Guiana, which has a climate deadly alike to convicts and their guardians, the hoped-for colonial development has proved disappointing. Even in New Caledonia, to which upwards of 30,000 convicts have been sent, and where the conditions are far more favourable to colonization, since it possesses a fruitful soil, a splendid climate, and unlimited mineral wealth, little substantial advance has been made. Some miles of road open for wheel traffic, a few thousand acres brought under cultivation, and one or two mediocre public buildings in the capital, Noumea, sum up the achievements of this vast amount of labour provided gratis for the improvement of the colony. France is encountering all the objections that led to the abandonment of deportation by Great Britain. It has been inordinately costly, unequal in incidence, and barren of substantial results in the rehabilitation of the criminal exiles, who, as free immigration has increased, have become more and more distasteful to their fellow colonists. The climax will come when the free settlers outnumber the liberated, and the colony refuses to be further contaminated.

6. *Germany.*—The unified German empire has not as yet adopted one system of prison treatment, and its various component kingdoms still retain independence in views and practice.

Baden has a well-known cellular prison at Bruchsal, but separation is not imposed for more than four years, and associated labour is carried out in another quarter of the prison.

Bavaria has four cellular prisons, the chief being at Munich and Nuremberg, but the collective system also obtains.

Prussia having declared for the cellular system and constructed the well-known Moabit prison in Berlin, those of Ratibor in Silesia, of Herford in Westphalia, and of Graudenz, Breslau, Werden, and Cologne have been added since. Frankfort has a good prison on the Pentonville (London) plan; so has Hamburg; and new buildings have been erected at Wohlau, Siegburg, Breslau, and Munster. Separate cells in Prussia had increased in 1896 from 3247 to 6573. The cellular *régime* is applicable to prisoners between 18 and 30, and to first offenders of 50 years of age, the term being fixed by the governor of the gaol, but never exceeding three years.

Saxony established a penitentiary at Zwickau in 1850, and in its earlier management exhibited exaggerated kindness to its inmates. Both the cellular and the associated systems obtain.

Würtemberg has accepted the cellular system. There are prisons for females at Heilbronn, and for males at Ludwigsburg and Stuttgart; in Würtemberg itself the *régime* is collective.

7. *Holland* has followed her nearest neighbour Belgium, and has now at command separate cells sufficient to receive the whole number of her prison population. The system of unbroken seclusion, prolonged to five years, is maintained with strictness. The prisons of Alkmaar and Breda have been enlarged, and the new buildings exhibit all the most recent improvements: the cells are lighted with electricity, perfectly ventilated and warmed, and furnished with every convenience. Prison labour embraces all kinds of handicrafts, and the prisoners' earnings are divided into three portions—one of which goes to the State, a second is at the disposal of the prisoner while incarcerated, or of his family outside, a third is paid him on discharge. This system obtains throughout the Dutch prisons at The Hague, Rotterdam, and elsewhere.

8. *Italy.*—Although accepting the principle of cellular imprisonment, Italy has not adopted it largely, partly from want of funds, and not a little because the current of thought has set against it, one leading criminologist, Enrico Ferri, having stigmatized the separate cell as "the greatest crime of the 19th century." In the 188 central prisons appropriated to accused persons and those sentenced to quite short terms there are only 13 on the cellular plan, and three others have a cellular quarter. The same applies in the smaller local prisons known as *i mandamentali.* The really penal establishments are 77 in number, the great *ergastolo* of San Stefano being one. Agricultural labour for convicts has been tried in colonies of *coatti* (or those provisionally released) planted out in the islands of the Italian archipelago. There are three of some importance upon Pianosa, Gorgona, and Capraja, one also on Monte Cristo and in Sardinia, several at Castiadas near Cagliari, at Bitti and Tre Fontane. These colonies are said to have been largely self-supporting, to have raised wine, cereals, and stock, and to have added to the development of the country by road-making, land reclamation, the building of breakwaters and river dams. Another view is that these colonies of *coatti* are a curse to the country, that their denizens live for the most part in idleness, that they set discipline at defiance, and terrorize their neighbourhoods. A marked feature in Italian criminality is the steady increase of recidivism, traceable by some to the faulty and demoralizing prison system of the country; others blame the practice of imposing sentences too short to be deterrent or to admit of the improvement of the offenders. A later experiment in the coercion of the recidivist, whereby the most determined were exiled as *coatti* to Assab in Abyssinia, where they were subjected to a very rigorous *régime*, lasted only eight months, as the whole number within that time had died or were invalided. Many Italian prisons, especially those of Naples, Venice, Parma, Mantua, Cagliari, and other large towns, are said to be of a most unsatisfactory character, and the penitentiary of Civita Vecchia is still more strongly condemned as a hotbed of vice.

9. *Norway and Sweden.*—Prince Oscar of Sweden was one of the earliest adherents of cellular imprisonment, and at his urgent representation penitentiary reform was warmly espoused in 1841. His influence is still felt, and the system in force in Norway and Sweden is progressive from strict separation to work outside the cell. There is a good prison at Christiania, another at Bodsfaengslet, and a fortress prison on the associated principle at Akershus for life-prisoners and recidivists. Serious crime in Norway tends to diminish, but the lesser offences have increased considerably, while reconvictions are very numerous, and the percentage of recidivists is for thefts alone from 34 to 35. Sweden, which adopted the cellular system in 1842, has now cells sufficient for prisoners sentenced to two years and less. There are three principal central prisons, one at Langholm near Stockholm, a second at Malmö, and the third at Nya Varfet near Gothenburg. In these as well as in the departmental and local prisons the system is one of complete isolation by day and night, but for sentences of more than four years the rule is associated work in the open air, with night separation. The cellular system is being extended to the prisons of Norrkoping and Gothenburg. In no case does the rule of cellular separation last beyond three years. It is claimed that the number of convictions is on the decrease in Sweden, but recidivism is frequent, amounting to 30 per cent. of the whole. A very substantial growth of juvenile crime is officially recorded in Sweden. One excellent agricultural colony for youthful offenders exists at Hall.

10. *Portugal.*—There are three or more cellular prisons at Lisbon, Coimbra, and Santarem, and the system of strict separation when first adopted in 1884 was expected both to amend and deter. These hopes have proved illusory, although the imprisonment has been prolonged to eight years for most serious offences. Deportation is a penalty always included in the Portuguese code, and it is still practised under the plea that it will regenerate the individual and develop colonization, but the results are unsatisfactory. There are now three penal colonies on the west coast of Africa—Mossico, Nana Candongo, and Caznengo in the province of Angola; and liberated convicts there are granted concessions of land. Depôts of exiled convicts exist also at Loanda and Benguela. Transportation has been decreed for recidivists, the *relegués* of the French law, but no very sanguine hopes are held of the success of the system.

11. *Russia.*—The subject of penal discipline in Russia covers a wide area, owing to the inclusion of political with purely criminal offences, the enormous number for whom prisons are needed under existing laws, and the severe character of the penalty most largely inflicted. The total prison population for whom accommodation is required amounts to 100,000 males and 13,000 females, a total which does not include children who accommpany their parents. For these vast numbers 883 prisons exist, nearly all of them till quite lately disgracefully bad and terribly overcrowded. Drastic reform was imperative, and between 1885 and 1891 eleven millions of roubles were spent on new buildings and the improvement of the old. The new cellular prison, "the Central," of St Petersburg, is a model of construction, with all the latest appliances; but the Belgian cellular *régime* is enforced with uncompromising severity. For some 300 years Russia has employed Siberian exile as almost the only method of secondary punishment, but at last sentiment has declared against a system which has inflicted countless sufferings upon hundreds of thousands, and by transporting some 30,000 souls annually has added 50 per cent. of the criminal class to the population of Siberia. But the Government would not surrender the principle of deportation, and as a later experiment has directed the stream of exiles by sea upon the semi-arctic island of Saghalien, with the object of creating a new great penal colony upon its inhospitable shores. The attempt appears to have been a failure. The island has proved quite unsuitable, owing to the rigours of the climate, the poverty of the soil, and the scarcity of food. Great administrative errors were made, the wrong sites for settlement chosen, the wrong persons—the aged and weakly—too largely selected as colonists. The moral and social condition of the convict population is reported to be abominable—drink, gambling, and the worst vices being everywhere prevalent. A high Russian official has thus summarized the situation: "The life led by the convict exiles at Saghalien is a frightful nightmare. It is a medley of debauchery, insolence, and impudence, coexistent with true suffering and indescribable privations." The general conclusion arrived at by competent authorities is that Saghalien is "a ghastly failure." The day cannot be far distant when a more intelligent system will replace all these costly and fruitless experiments.

12. *Spain.*—After many abortive attempts and long years of neglect, Spain took up penitentiary reform seriously in 1876, in which year a new cellular prison to accommodate 1000 souls was decreed for Madrid. Since then eighteen cellular prisons have been built and others designed. *Presidios*, or prisons for long terms, akin to the British convict establishments, exist throughout Spain. In them a harsh, merciless system prevailed, and prisoners' labour was leased out to contractors. *Presidios* beyond the confines of the kingdom have been maintained for long years, as at Melilla and notably at Ceuta. The system varies between great severity and excessive leniency. At Ceuta there is an average of 2500 inmates sentenced for life or long terms (*cadena perpetual* or *cadena temporal*). At first they are kept in close confinement, and then granted liberty, at first conditional, but afterwards complete, except for having to remain in Ceuta.

13. *Switzerland.*—The cantonal constitution of Switzerland has produced great variety in penal methods. Some are quite abreast of the best modern ideas. Cellular imprisonment is very generally the rule. There are excellent prisons at Geneva, Zürich, Neuchatel, Basel, Lausanne, and Lensburg. In the canton of Bern

the progressive system is the rule, with strict separation in the first stage, followed by labour at large and intermediate prisons. In the canton of Ticino there is a good cellular prison at Bellinzona, and the longest term of strict separation is for three years.

14. *United States.*—The penal system of the United States is perhaps the most advanced and also the most backward in the world. At one end are the numerous bad county gaols, and the horrors of the convict lease system in the Southern states, now nearly extinct; at the other the modern and well-equipped reformatories such as Elmira and Concord. The worst feature is the indiscriminate association sometimes seen of all inmates, bond and free, the convicted and accused; even witnesses against whom there is no shadow of a charge are sometimes imprisoned among felons. Nor is it only in distant corners of the great continent that this criticism applies. The local gaol in the city of New York, "the Tombs," a house of detention for prisoners awaiting trial, was described only a few years ago in an official report to the state Legislature as "a disgrace. . . . It is defective in every modern appliance. It is dark, damp, and ill-ventilated . . . . worst of all is the hideous system of keeping two or three men in a cell . . . . a means of indescribable torture to a decent man, and a prolific source of vice and crime to a criminal. Such treatment of dogs would be gross cruelty." This building has since been pulled down, a new and better one taking its place, and at least the worse features referred to in the official report have been done away with. The administration of prisons rests mainly with the state authorities, and there is no federal or general system which would introduce uniformity of treatment. Some of the state prisons are models of cleanliness and good order, built on the best and most imposing lines, with large, comfortable cells and an abundance of light and air. The earnest desire of most prison administrations is to develop industrial training and trade profits side by side with mildness of treatment. The latter sometimes lapses into methods which are not usually thought compatible with prison discipline, such as the permission to play on musical instruments, the holding of concerts, the privilege of smoking and chewing tobacco, of receiving baskets of provisions, novels, and newspapers from friends outside. The actual effect of prison treatment upon crime is doubtful. (A. G.)

Pritchard, Charles (1808–1893), British astronomer, was born at Brixton on 28th February 1808. At the age of 16 he was taken away from school and left practically to his own resources. Two years later he was enrolled as a sizar at St John's College, Cambridge, where he graduated in 1830 as fourth Wrangler. In 1832 he was elected fellow of his college, and in the following year he was ordained, and became headmaster of a private school at Stockwell, a post which he resigned in 1834 to undertake the headmastership of Clapham Grammar School, which he held till 1862, when he retired to Freshwater, in the Isle of Wight. For the next seven years he took an active interest in the affairs of the Royal Astronomical Society, of which he became honorary secretary in 1862 and president in 1866. His career as a professional astronomer began in 1870, when he was elected Savilian professor of astronomy at Oxford. At an age when most persons would have been looking forward to relief from the labours of an active life, he not only embarked with enthusiasm upon his professorial duties, but set himself vigorously to the task of original investigation. At his request the University determined to erect a fine equatorial telescope for the instruction of his class and for the purpose of original research, a scheme which, in consequence of Warren de la Rue's munificent gift of several valuable instruments from his private observatory at Cranford, expanded into the establishment of the new University Observatory. At de la Rue's suggestion the first research undertaken by Pritchard was a determination of the physical libration of the moon, or the nutation of its axis, an investigation in which the photographic method seemed to offer conspicuous advantages. Some thousands of photographs were taken and measured; but although important conclusions bearing on the applicability of photography to accurate astronomical measurements were deduced in the course of the work, the final results with regard to the moon's libration were never published. In 1882 Pritchard commenced a systematic study of stellar photometry, a branch of astronomy in which up to that time very little had been done (see PICKERING). For this purpose he employed an instrument known as the *wedge photometer* (see PHOTOMETRY, STELLAR, and *Mem. R.A.S.* vol. xlvii. p. 353). In his *Uranometria Nova Oxoniensis*, published in 1885 at the Clarendon Press, this work was extended so as to include the stars of Argelander's Uranometria Nova from the North Pole to about − 10° declination. It is thus confined to stars not fainter than the sixth magnitude, and includes in all 2784 different objects. In recognition of this important contribution to stellar photometry he was awarded the gold medal of the Royal Astronomical Society in 1886, conjointly with Professor Pickering. On the completion of this research he determined, for the first time in the history of astronomy, to apply the photographic method to the determination of stellar parallax. With the object of testing the capabilities of the method, he took for his first essay the well-known star 61 Cygni, whose parallax had already been attacked by several investigators employing other methods; and although the accuracy of his results was afterwards seriously called in question, they agreed so well with those of previous investigators that he was encouraged to undertake the systematic determination of the parallaxes of stars of the second magnitude, the results of which are contained in the third and fourth volumes of the Publications of the Oxford University Observatory. Apart altogether from the value of the actual parallaxes obtained, this work must be considered an important contribution to astronomy, as showing the possibility of employing photography in such delicate investigations. When the great scheme of an international survey of the heavens was projected, he undertook a share in it. The zone between 25° and 31° north declination was allotted to him, and at the time of his death some progress in the work had been made. Pritchard became a fellow of New College, Oxford, in 1883, and an honorary fellow of St John's College, Cambridge, in 1886. He was elected a fellow of the Royal Society in 1840, and in 1892 was awarded one of the Royal Medals for his work on photometry and stellar parallax. His death took place on 28th May 1893. (A. A. R*.)

Prittlewell, a parish in the South-Eastern parliamentary division of Essex, England; the village is 1½ mile north-north-west of Southend. The railway station is on the Great Eastern Railway. Population (1881), 7979; (1891), 12,333; (1901), 27,181.

Privas, chief town of department Ardèche, France, 378 miles south-south-east of Paris, with terminal station on branch line from Le Pouzin on the railway from Lyons to Nîmes. It is situated near the Orwèze, here joined by the Mezayon and Chazalon. A college, normal schools, library of 5000 volumes, mineralogical museum, hospital, and lunatic asylum for the departments of Ardèche and Drome are the principal local institutions. Manufacturing establishments include several silk-mills, forges, and foundries. The rearing of silk-worms and the cultivation of the mulberry are widespread industries. The important mining concession of Lac yields some of the finest iron ore in France. There is much commerce in silk, tanned leather, game, chestnuts, and fruit preserves. Population (1881), 4203; (1891), 4012; (1901), 7561.

Privas, one of the strongholds of the Reformed faith, suffered terribly during the wars of religion. Ineffectually besieged by Montpensier in 1574, it passed in 1619 into the possession of a Roman Catholic noble. A general rising followed, and in 1629 it was besieged and taken by Louis XIII. and Richelieu. In revenge for its resistance the captors reduced it to ruins, and the king decreed that it should not be again inhabited. A few years later, however, some of the townspeople crept back, and it was again repeopled. Some ancient Gothic-fronted houses, which escaped the general destruction, are still standing.

Prizren, Prizrendi, Prezdra, or Perzerin, chief town of a sanjak in the vilayet of Kossovo, European Turkey, situated on the Bistrìtza, near its junction with the White Drin, 60 miles east of Scutari. Among the mosques is the ancient Servian cathedral of Sveta-Petka. The old royal castle has been restored. Besides a manufactory of firearms, the town has an active general trade. Population, about 35,000, almost entirely Albanian, and chiefly Mussulman.

Prjevalsk (Przewalsk), formerly Karakol, a district town of Russian Turkestan, in the province Semiryechensk, 8 miles from the southern coast of Lake Issyk-kul. Prjevalsky, the Russian explorer in Central Asia, died here, and a monument has been erected to his memory. It is a growing town, and had in 1897 a population of 7987.

Prjevalsky, Nikolai Mikhailovich (1839–1888), Russian traveller, born at Kimbory, in the government of Smolensk, on 31st March 1839, was descended from a noble Cossack family. He was educated at the Smolensk gymnasium, and in 1855 entered an infantry regiment as a subaltern. In November 1856 he became an officer, and four years later he entered the academy of the general staff. From 1864 to 1866 he taught geography at the military school at Warsaw, and in 1867 he was admitted to the general staff and sent to Irkutsk, where he started to explore the highlands on the banks of the Usuri, the great southern tributary of the Amur. This occupied him until 1869, when he published a book on the Usuri region, partly ethnographical in character. Between November 1870 and September 1873, accompanied by only three men and with ridiculously small pecuniary resources, he crossed the Gobi, reached Peking, and, pushing westwards and south-westwards, explored the Ordos and the Ala-shan, as well as the upper part of the Yang-tse-kiang. By this remarkable journey he proved that, for resolute and enduring men, travelling in the Central Asian plateaux was easier than had been supposed. The Russian Geographical Society presented him with the great Constantine medal, and from all parts of Europe he received medals and honorary diplomas. The work in which he embodied his researches was immediately translated into all civilized languages, the English version, *Mongolia, the Tangut Country, and the Solitudes of Northern Tibet* (1876), being edited by Sir Henry Yule. On his second journey in 1877, while endeavouring to reach Lhasa through east Turkestan, he discovered the great lake Lob-nor (*q.v.*), which had not been visited by any European since Marco Polo. On his third expedition in 1879–80 he penetrated, by Hami, the Tsa-i-dam, and the great valley of the Tibetan river Kara-usu, to the vicinity of Lhasa, when he was turned back by order of the Dalai-lama. In 1883–85 he undertook a fourth journey of exploration in the wild mountain regions between Mongolia and Tibet. On these four expeditions he made collections of plants and animals of inestimable value, including nearly twenty thousand zoological and sixteen thousand botanical specimens. Among other remarkable discoveries were those of the wild camel, ancestor of the domesticated species, and of the ancestor of the modern horse (*Equus prjewalskii*), which some two hundred years ago inhabited Russia and Poland. Prjevalsky's account of his second journey, *From Kulja, across the Tian-Shan, to Lob-nor*, was translated into English in 1879. In September 1888 he started on a fifth expedition, intending to reach Lhasa, but on 20th October he died at Karakol, on Lake Issyk-kul. A monument was erected to his memory on the shores of the lake, and the Russian Government changed the name of the town of Karakol to Prjevalsk in his honour. (E. I. C.)

Process.—Until the last quarter of the 19th century reproductive processes, save as regards line reproduction, can hardly be said to have had an existence. Paintings, drawings, and engravings which it was desired to put into a form which by means of the printing-press could be multiplied indefinitely, had to go through a process of interpretation by an engraver or draughtsman, who on a metal plate, a block of wood or stone, gave a rendering of the original subject to the best of his power. The means at his disposal were lines and dots, which, varying in their thickness and proximity, expressed dark or light passages in the scheme of light and shade of the original. It will readily be understood how such interpretations would vary. An engraver with fine art instincts would produce a result as distinct in character as an engraving as was the original as a painting or drawing, and engravings were sought after as works of art, and treasured for their artistic qualities. But engraving of this kind took time. Years were devoted to the production of one steel or copper plate, while wood engravers who were artists could only work on a block when in the mood; and for that mood the publisher had to wait, and he grew impatient and was willing to accept rapid interpretation of originals by men who could produce them under other than artistic conditions. But the pain of the artist at the bad rendering of his original was often great, so that he, not less than the publisher, though for another reason, hailed the attempts that were being made to reproduce his work mechanically without the intervention of the translator or interpreter. The ideal of an artist would naturally be a reproduction of his work in facsimile, which retained all, or as many as possible of, the individual characteristics of his work; and to give him this was the aim of the school of wood engravers which originated in the United States and made a last stand to maintain the position of their art in the field of book illustration. By a system of extremely fine work the American wood engravers were able to keep much closer to the tones of an original than had previously been possible; but the result was obtained at the sacrifice of the artistic rendering of the best old engravings, and was so mechanical in its character that when it came in contact with a real mechanical process the engraving could not hold its ground, the enormous difference in the cost of production being a factor of sufficient importance in itself to make it impossible for the engraving to retain the field. A similar development had been going on in the other branches of engraving. The steel-plate engraver and the etcher, to whom had been entrusted the interpreting of works of art first produced in other forms, found themselves faced by mechanical reproductions in plate form which, while preserving more of the character of the original work, were produced in much less time and at a greatly reduced cost. It has thus come about that the last quarter of the 19th century witnessed the dispossession of the hand engraver from the field of interpretative engraving, and the occupation of his position by the chemist and the mechanician. (See Engraving.)

Definition.

The term "process," which has come to be applied to all mechanical reproductions, is a somewhat unfortunate one, inasmuch as it is descriptive of nothing. From time to time various names have been given to its varying forms, indicative either of the name of the inventor or of some peculiarity of method. Zincography, Gillotype, Photogravure, Heliogravure, Heliotype, Phototype, Albertype, are illustrations of the kind of name given often to very slightly varying applications of the same principle, but usage has come to apply the term

"process" to any printing surface that is produced by chemical and mechanical means.

The whole of these processes may be arranged under three heads—1. Relief; 2. Intaglio; 3. Planographic.

1. Relief Processes.—An engraving in relief is one in which the printing surface stands up above the surrounding ground. Its typical form is presented by the movable letter of the letterpress printer. The history of its development is really the history of photography; for whilst attempts were made to obtain results without the aid of photography, by drawing upon plates with prepared chalk or ink, "rolling them up" with printer's ink and etching away the ground with acid, as in the case of Zincography, the real progress of all process has been upon the lines of photography; and to the two Frenchmen, Niepce and Daguerre, the first a mechanician and the second a photographer, may be attributed the origin of the modern mechanical and chemical processes. These two men were both born towards the end of the 18th century.

Speaking broadly, all the modern "processes" are the outcome of a discovery that a preparation of albumen and bichromate of potash could be hardened by exposure to light, and that as a photographic negative permitted the passage through it of light in varying degrees of intensity, so a film of the preparation placed under a negative was liable to be hardened in varying degrees according as the light affecting it was intense or otherwise. This discovery governs the production of process blocks or plates of all kinds. By its application relief blocks may be made from drawings or engravings executed in line purely, or from drawings, or engravings, or photographs which are rendered in graduated tones.

The methods of reproduction of pure line work differ greatly from those for the reproduction of originals in tone, and they must be described separately. As the first necessity in securing a good result is the suitability of the original to be reproduced, it is desirable to make clear the character of a good original. This should be of one tone or degree of colour all through. It may be all grey; it is better that it be all black. It may not be black in parts only and grey in others. The lines of an original may be of any variety of thickness, but in colour they must be uniform. It is necessary, therefore, for the draughtsman to see that he works with a good black ink, or ink which will tell as black when it is exposed to the photographic plate. Inks of a warm tone—that is, inclining to red or orange—yield better results than cold inks which incline to blue.

Line blocks.

It is found in practice that most prepared liquid inks have a tendency to lose their blackness by exposure to the atmosphere on the removal of the cork from the bottle. The ideal ink is one freshly ground from a dry cake of colour when beginning work each day. Indian ink is good if well ground and kept sufficiently thick to assure the necessary blackness. It has the advantage of not washing up when colour in washes is passed over it, but it must be used freshly ground. The addition of a little Indian yellow, burnt sienna or sepia, gives a warmth of tone to it and renders it photographically more active. Bourgeois ink, prepared by M. Bourgeois of Paris, appears to be prepared with the admixture of some warm colour with the black base. It is a good ink for the purpose, and is prepared both in solid and liquid form. Lamp-black gives good black lines; so does ivory black, which is warmer in tone than lamp. Higgins's Indian Ink or American drawing ink is an American ink made in liquid form which has the reputation of not fading by exposure, as most others do. Stephens's Ebony Stain is a fine black medium which does not clog the pen; if it thickens and dries, it cracks off and does not corrode the pen. The pen is not the only medium by which originals may be prepared for reproduction by line process. A brush brought to a fine point is much preferred by some artists, as it yields a line less monotonous than that given by a pen, though the brush cannot be used so freely. The paper used should be smooth and as white as possible. A paper is made with a surface coating of white chalk, which admits of the use of a scraper to remove lines or to break them up. It is not possible to lay down a rule for the amount of reduction to be made when photographing for the reproduction; the finer the drawing the less should be the reduction made. Usually a reduction to three-quarters or two-thirds the size of the original is sufficient, but experience is the only guide. Sometimes, where the lines are very fine and the drawing minute in character, an enlargement is desirable. Where drawings are reduced too much, there is a tendency for the spaces between the lines to fill up, and to give a coarse, heavy result. Faulty drawing is not lessened by reduction. On the contrary, the fault becomes more evident, so it is desirable to make all necessary corrections in the drawing.

The original drawing which has to be reproduced is photographed to the size of the required block. The negative taken is absolutely dense except where the lines of the drawing have affected it, and these are absolutely clear, admitting the unrestricted passage of light through them. A piece of planished copper or zinc is prepared or made sensitive to light by a preparation of albumen or gelatine and bichromate of potash spread upon its surface. The negative is laid upon the sensitized metal and placed in the light in the way an ordinary photograph is printed. The light passes through the transparent lines of the negative and hardens the bichromate of potash beneath it. Both negative and plate are then taken into a dark room, where the metal plate is rolled with an inked roller, placed in a bath, and allowed to soak until the albumen and bichromate become so softened everywhere, except where the light has hardened them, that they all wash away, and nothing is left but the hardened lines. The lines are dusted with asphalt, which by heat is melted on to them, and makes a ground which resists the action of acid. A coat of varnish is put over the back and edges of the plate, to protect them from the acid also, and only the spaces between the lines on the surface are left free to its action. The plate is then placed in an acid bath, which eats away the metal wherever it is exposed; but it leaves the lines of the drawing, which are protected by the hardened film standing up above the eaten or etched surface; and these lines, which correspond to those of a wood engraving, are the printing surface of the plate. The plate is mounted on a wood or metal block, the whole is made type-high, and it can then be used along with type in the printing-press.

Various devices have been resorted to that effects of tone may be obtained by means of the simple line process. Grained papers with a surface of chalk, upon which are printed close-ruled lines crossing at right angles, or rows of dots; these give the papers a heavy, flat "tone," upon which a drawing can be made in pencil, chalk, or ink, and gradations of tone introduced by means of scrapers prepared for the purpose, which remove partially or entirely the black ruled lines or dots, leaving, if desired, high lights of pure white. A drawing on such paper consists of lines or dots, a combination of the original lines or dots of the paper and those of the drawing itself, the scraper splitting up lines into dots or removing them altogether. The result is quite easily reproduced by the line process.

Another method of obtaining a combination of tone and line by the line process is by the use of what are known as Day's "shades," or shading mediums. They are transparent films of gelatine which have upon them lines or dots in varying combination in relief, so that they can be inked up by a roller. When placed over a drawing, their transparency enables the operator to see exactly what passage he is dealing with, and he can by means of a burnisher impress the lines or dots of the shade upon any passage of the drawing; these lines or dots then become part of the drawing, and are reproduced in the usual way.

Pencil or chalk drawings upon simple white-grained paper, where the pencil or chalk passing over the ruts or hollows in the paper makes a mark on the top of the grain only, are also reproducible by the line process, but such drawings are apt to be unequal in colour and difficult to deal with.

This difficulty led to the invention of a process by Mr Henry Matheson, who, not having the capital to work it, joined the late Mr Dawson, sen., whose

sons continued to work the process with Mr Matheson under the name of the Swelled Gelatine Process. It is based upon the discovery that gelatine, sensitized with bichromate of potash, swells when placed in water, and swells in proportion to the amount of light to which it has been exposed. A negative taken from a drawing which varies in tone, not being thoroughly black all through, varies in the quality of its transparent lines and dots; and when a piece of paper or glass coated with sensitized gelatine is exposed to the action of such a negative, it is affected according to the amount of light the negative allows to pass. After making a print on such paper or glass, it is placed in a dish of water and the surface allowed to swell, which it does in varying degrees, the portion unaffected by the light absorbing most water and swelling most, the lines of the drawing not swelling at all. This swelled print is then placed in a frame, and a preparation of plaster is poured upon it to make a mould of its surface. When this has set and the gelatine has been removed, this mould is filled with a preparation of wax, which sets in a few minutes sufficiently for it to be released from its plaster mould. Additional wax is built up when necessary upon the "whites," as they are technically called—that is, the passages which represent what will be the hollows in the block—so that these may be as deep as possible; and the wax mould is then handed over to the electrotyper, who deposits a layer of copper upon it. The lines and dots of this copper block, which when finished is backed up with metal and mounted, vary slightly in height, the result being that the slightly lower dots do not come so closely in contact with the inking roller or with the paper, and so produce a grey impression corresponding to the greyness of the original drawing.

Swelled gelatine process.

The drawback to the use of the process is that it is about three times as costly as the ordinary process. It is a method much used for the reproduction of line and stipple engravings, where fine dots and lines are apt to be printed in delicate tones. The finest results by this method are producible, however, by omitting the plaster mould and wax-cast stages, and by coating the sensitized gelatine with plumbago or other impalpable metal preparation which will enable it to receive a copper deposit to qualify it to take its place in the electrotyper's bath, and so to get the needed thin coating of copper from the surface of the gelatine itself; but this needs to be done with the greatest of care, and is still more costly.

The invention of line processes only stimulated the efforts to find out means whereby tones might be reproduced on blocks or plates that could be printed along with type in the ordinary rapid printing-press. It is only possible to approximate to the printing of a flat or graduated tone by producing a surface that is broken up into some sort of granulated surface which shall present a series of lines or dots that, when inked and impressed upon paper, shall by the variations of proximity and size give the impression of an unbroken tone. This necessitates the lines or dots being so small that the eye shall not at a glance appreciate the broken-up character of the surface of the block. Many efforts resulted in the production of what is known as the screen, which itself was only made possible by the invention of ruling machines of a delicacy previously unknown. A screen is made by coating a sheet of glass—which must be flawless both as to body and surface—with a composition analogous to the ground used by an etcher to coat his plate before drawing upon it with his needle. The glass so coated is placed in an automatic ruling machine, of which the ruling point is a diamond, and which can be adjusted so finely as to produce between 200 and 300 lines to the inch. The lines are ruled diagonally on the glass, and at mathematically equal distances from each other. The sheet of glass, after ruling, is treated with acid, like the plate of an etcher, and the lines where the ground is cleared away by the diamond point are etched or bitten into it. The plate is cleaned up and an opaque dark pigment rubbed into the lines. Two such ruled sheets of glass are placed face to face, with the diagonally ruled lines crossing each other at right angles, the result being a medium or screen containing innumerable little squares of clear glass through which the light can pass, which it cannot do through the ruled lines, which are filled by the opaque pigment. To produce a half-tone block from a picture, a black and white drawing in tone, or a photograph, a negative is exposed in the camera in the usual way, with this screen quite close to it but not in contact; and the subject is photographed on to the negative through the screen, and what is termed a screen negative is the result. It is a photograph of so much of the original as could affect the negative through the little clear squares of the screen, and represents the tones of it by innumerable dots and lines, the size and proximity of which are regulated by the fineness or coarseness of the screen used. In the early days zinc was the metal used for these half-tone blocks; but experience showed that though more difficult to etch to the necessary depth, the closer, denser texture of copper rendered plates of this metal much more suitable for the production of the best blocks, and zinc now is used only for inferior blocks. Whichever metal may be used, a sheet of it, most carefully planished, is sensitized with a coating of gelatine or fish-glue and bichromate of potash, and exposed under the screen negative to the action of light, as in the ordinary method of photographic printing. The action of the light, as previously explained, hardens the gelatine film, the portion not so hardened being removable by water. The plate with the hardened lines and dots is exposed to heat and they are burnt in upon it, to enable the means of resistance to be set up to the action of acid. The plate is placed in an acid bath, which is rocked to and fro to prevent the air-bubbles produced by the acid action from settling upon the surface of the plate and interfering with the regular action of the acid. Wherever the surface of the plate is free from the lines and dots, it is bitten away by the acid, and the lines and dots are left in relief. This first biting in the bath produces a rather rough general impression of the original, and is termed "rough etching." To produce finer results, and to bring out the contrasts of black and white so necessary to a good reproduction, the block has to go through processes of stopping out and rebiting similar to those of etching an intaglio plate. This "fine etching" calls for the artistic taste and judgment of the craftsman; and with a good photograph to work from, the final quality of a block will turn almost entirely upon its treatment by the fine etcher.

Half-tone processes.

One risk that has to be most carefully guarded against is the underbiting of the lines and dots which form the printing surface. As soon as the acid has eaten its way downwards past the protecting surface film, it will attack the sides of the upstanding dots as well as the ground that supports them, with the result that they become weakened and rendered liable to break off in the process of printing, as well as to make the obtaining of electrotypes from the blocks a matter of extreme difficulty, the underbitten points breaking or tearing away in the mould. To avoid this underbiting in the course of etching and re-etching, a fatty ground is laid over the surface of the block each time it is etched; by exposure to heat this ground is sufficiently melted to permit of its running down the sides of the upstanding points, and so giving them the required protection. When completed, the copper plates are mounted on wood or metal blocks, type-high, for use with type in the printing-press.

The name by which this process of making tone relief blocks is most generally known is the Meisenbach process, from Herr

Meisenbach, of Munich, who first brought it prominently forward in Europe. It was greatly improved upon by Messrs Angerer and Göschl, of Vienna; but the great advance was due to the improvements made in the manufacture of the screens by Mr Max Levy, of Philadelphia, who made it possible, by his improvements in the ruling machines, to produce screens of a fineness not previously practicable.

The chief objection to this process is its inability to reproduce the extremes of expression employed by the artist in black and white: actual white is impossible, and delicate tones, such as are characteristic of skies, are destroyed by the cross-bar lines of the screen, which cover down all light passages and rob the reproduction of that brilliancy which characterized wood engraving. It is true that the addition of hand engraving can be resorted to in the case of the process block, and lights and other varieties of tone and form introduced, but this can only be done on blocks of very fine texture, and the cost of reproduction is greatly increased by the introduction of such handwork by the engraver.

The most important development of the half-tone process is in the direction of the reproduction of works in colour rendered possible by the researches of artists and scientists. It will be sufficient here to explain the general principles upon which the three-colour process is based. It has long been an accepted theory that all combinations of pigmental colour exhibited in pictures, flowers, or any other form resulted from a combination in varying quantities of what are known as the three primary colours, red, blue, and yellow, and that if it were possible to get at the exact amount of each colour necessary to its formation, any possible tone of colour might be produced by blending the primary colours in the necessary proportions. But the human eye has not been able to analyse tones of colour with sufficient accuracy to settle what proportion of each primary colour goes to the making up of a given tone. Such analysis, however, has been rendered practically possible by photography. The white light of daylight is the result of a combination of rays of coloured light, which for our purpose we may describe as being rays of blue, red, and yellow. It is interesting to note that the combination of these three colours, in varying proportions in the form of rays of colour, combine to produce white light; but the combination of the same three colours in the form of pigment results in black.[1] The prism which breaks up the combination of coloured rays shows that when the light rays do not contain the necessary combination of the rays of the three primary colours, white light no longer results, but that separated they give "all the colours of the rainbow." The various colours of objects are the result of the fact that surfaces have the power of absorbing and reflecting certain of the coloured rays only which strike them, and that they are unaffected by the others. Thus the green leaf absorbs and reflects the blue and yellow of white light, leaving the red unaccounted for.

Three-colour blocks.

The photographer has utilized these facts and theories by inventing *filters* of various substances, which, owing to their nature, absorb and refuse passage to certain coloured rays, while permitting the passage of others, just as a charcoal filter will keep back certain substances in water, but allow the water itself to pass through it. So a photographic filter of a certain colour will absorb and stop the passage of red and blue rays, while permitting the passage through it of the yellow. Another filter will similarly absorb and stop the yellow and red rays, while permitting the passage through it of the blue. It will then be readily perceived how, when a picture or other coloured object is placed before a camera, with one of these filters between it and the exposed negative, the rays of light of the colour which can pass through the filter to the negative will be the only ones which can affect it, and that it is possible in this way to secure on three separate negatives a record of the blue, red, and yellow rays which are reflected from its coloured surface by any object placed before the camera. These three negatives may then be used in the ordinary way, and, by means of the ruled screen already described, three half-tone blocks produced, which, when printed one over another with coloured inks corresponding with the three primary colours, give approximately a reproduction of the original in its true colours.

It was as far back as 1861 that the suggestion was made, at the Royal Institution by Mr J. Clerk-Maxwell, to reproduce objects in their natural colours by superimposing the three primary colours. Later Baron Ransomut, of Vienna, Mr Collen, a gentleman who taught drawing to Queen Victoria, and two Frenchmen, Messieurs Chas. Cros and Ducos du Nauron, carried on the idea and made experiments with the aid of photography, which were still further developed in Germany by Professor Husnik, of Prague, Dr Vogel, of Berlin, and others; but it was in America that the first three-colour blocks for letterpress printing were made, Mr Ives, at Philadelphia, being their maker in 1881.

This three-colour relief process is yet in its infancy, but already its development is such that no doubt remains as to its ultimate success. The first great practical difficulty which had to be overcome was to produce three screen blocks which could be printed one over the other. Were the screens of each block used at the same angle, the lines and dots would print on the top of one another; but a great deal of the colour result depends upon a considerable proportion of each colour being on the white paper. Artists and people who work with colours know well that much purer and more brilliant results are produced by placing touches of colour side by side than one over another: small patches of red and blue placed side by side yield to the eye a purple of much greater purity and beauty than the same touches of colour worked one over the other. Consequently it was found necessary to turn the screen at a different angle for each block, so that the lines should not fall on each other but should cross each other; but the risk of this is that, used at certain angles, the crossing of the screen lines will produce what is known as the *moiré antique* result. Dr Vogel took out a patent in Great Britain for the process, and he therein stated that the screens should be used at certain stated angles. He also proposed to use single-line screens, similar to those used by Mr Ives at Philadelphia, instead of cross-line; but it has since been found that the cross- or double-line screens can be used with better results than single-line; and that the angle at which they can be used may vary, but it is well that the lines should cross each other at an angle of somewhere about 30°.

Colour-filters.

Filters are made in a dry or wet form. The dry filter is made by spreading a film of gelatine or collodion, tinted by an aniline colour, upon a piece of glass. The wet filter is a cell or trough made of two sheets of glass, sealed all round and filled with water tinted with an aniline dye or colour. The accuracy of the tint of the colour-filter may be tested by the spectroscope, or by an instrument invented by Sir William Abney, and known as the Abney Colour Sensitometer. This is a theoretical test. The practical test is by photographing through them patches of blue, red, and yellow. If, for example, the filter for blue records the full strength of blue with the full strength of the colour of the negative, while giving no record at all of the red and yellow, it is practically a true filter. It is possible to treat the negatives themselves so as to render them more sensitive to the special colour they are intended to record. Indeed, it is necessary to see that the filters and the negatives are in working harmony. Different makes of plates demand different colour-filters. For full information as to screen-making the reader may be referred to a paper by Mr Ives in the *Photographic Journal*, vol. xx. No. 11. The efforts of the ink manufacturers have had to be directed to the production of what are termed "neutral" primaries—that is to say, a blue pigment absolutely free from any

[1] As a matter of scientific analysis, the primaries of white light are red, green, and purple, but the pigmental primaries are red, yellow, and blue; and as we are in this paper dealing with pigmental results only, it will simplify the theory, and render it more intelligible, if we treat it from the pigmental point of view, and speak of the primary colours of the artist rather than those of the scientist.

I.

II.

III.

IV.

Stages of Three-Colour Printing.

THE five prints shown on this Plate represent the various stages in the three-colour process. I., II., and IV. show the primary colours used—yellow, red, and blue. The only one of these, however, which is printed as shown is I. in yellow, II. and IV. being only printed here to give the colours used. The second stage of the process is to print a red plate over I., the result being shown in III. In the third stage a blue plate is printed over III., the result being the finished picture, shown in V.

[The picture used to illustrate this process has been reproduced, by permission, from Mr Mortimer Menpes's "Japan."]

V.

taint of red or yellow, and, similarly, a red and yellow free from admixture with their complementary colours. The preparation of these colour-filters calls for great perfection of quality in the materials employed, and great accuracy in the using of them. The glass, whether for the dry or wet filter, must be absolutely flat as to its surface, without waves or irregularities of any description, and its two sides must be absolutely parallel; in other words, it must be absolutely uniform in thickness throughout. In the wet filter the glasses forming the sides of the cell or trough must be parallel to each other.

Coloured glass is sometimes used in combination with the tinted collodion, but there is no particular advantage in this, because two glasses are always used in the making of a filter, and each one may, if desired, be coated with different dyes and afterwards cemented together with Canada balsam.

The following dyes or their equivalents form a basis for nearly all three-colour filters:—

For the red printing negative	Brilliant green. Brilliant yellow.
,, blue ,, ,,	Cochineal red. Brilliant yellow.
,, yellow ,, ,,	Methyl violet. Naphthol green.

The first dye named is the base colour in each case, the second is employed in small proportions to produce the required modification of tint.

The theory of this three-colour process is that the same three colours shall be used for the printing of every subject; and there is no doubt that if the filtration were perfect and the printing inks absolutely pure, the theory would work out fairly correctly in practice; but at present there is room for improvement in both these matters, and it is therefore often found desirable to print special subjects with special pigments, which makes it difficult to print several subjects together. Special care is called for on the part of the printer. There must be the most perfect register of the three subjects, otherwise a blurred effect results; there must be constant watchfulness to see that there is no excess of ink of any one colour, or the whole scheme of colour will be destroyed. An "eye for colour" is perhaps hardly to be looked for as one of the qualifications of a machine-minder, and yet without the oversight of some one with such an eye colour-printing cannot be successful. This three-colour process has been a rather long time in taking the place it deserves, and nothing has so tended to retard it as bad printing. For some time past good blocks have been obtainable, but in the hands of ordinary printers they have yielded but indifferent results. There is great need for the technical training of the men who have to oversee such work. It is hardly to be expected that the untrained eye of the ordinary printer should be successful where the work requires the cultivated judgment of an artist. There is one other necessity for success in all tone relief work, whether block or colour, and that is the use of the right quality of paper and ink. The blocks are so delicate they soon fill up if an excess of ink is used. Ink of a good quality can be used in much less quantity than common kinds, but it must be impressed upon paper that is sympathetic and will "bear out" the ink.

Need of careful printing.

The best results can be obtained only with the use of what is known as "coated" paper. It is paper which, after manufacture, is passed through a bath of a preparation of china clay, which by means of brushes is rubbed into the surface of the paper. When dry the surface takes a high polish, and is sensitive to the smallest amount of ink. The polish of this coated paper is objectionable to many readers of illustrated books, and the clay adds considerably to its weight.

2. Intaglio Processes.—An intaglio engraving is one in which the printing surface is sunk below the surrounding portions of the block or plate; the lines or dots—pressed, cut, or bitten into the surface—holding the ink, which is to be impressed upon the paper when the original surface of the plate is wiped clean. The old-fashioned steel engraving may be taken as the type of an intaglio plate, in which the lines which printed were cut into the surface of the plate, instead of being left standing up in relief, as in the case of a wood engraving.

Photogravure is the name by which the many processes are generally known by means of which intaglio engravings are made mechanically, *heliogravure* being another name for the process, or special application of it. Photogravure reproduces the tones of photographs or drawings, and gives the nearest approach to a facsimile reproduction that has yet been arrived at. Gelatine bichromatized, as in the case of relief blocks, is the medium by means of which the photogravure plate is produced; but as the screen is not used in ordinary work, it is necessary to produce an ink-holding grain in some way upon the plate. This is done by allowing a cloud of bitumen dust, raised inside a box, to settle upon the surface of the plate; it is fixed by heat, which, though insufficient to melt it, is enough to attach the fine grains to the plate. Over this prepared surface is laid the film of bichromatized gelatine, upon which is printed the subject through a glass positive; the usual hardening process takes place by the action of light, followed by a washing out of the unhardened portions of the gelatine. The plate is exposed to the action of perchloride of iron, which attacks it most strongly in the least exposed parts, but which cannot eat it away in broad flat masses of dark, even in the non-exposed portions, owing to the existence of the bitumen granulation, which ensures the keeping of a grained surface even in the darkest passages.

Photogravure is a costly process to employ for illustration. The plates have to be printed slowly, with much hand work, as in the case of etchings. It is the printing that makes its use expensive, rather than the making of the plates; and as each plate must be printed separately and on special paper, it cannot be employed with type, like relief blocks.

It will be readily understood that there is much uncertainty about the production of plates by the photogravure method; and although great improvements have been made in the process, it is often necessary to produce several plates before a satisfactory one is obtained; and even then a good deal has to be left to the retoucher, who with his roulette, burnisher, and graver must give qualities of transparency and brilliancy and intensity that are missed by the mere mechanical operation. In all these reproductive processes the more artistic the workman, the better the result; this is especially true of photogravure, in which the aim is to come very much nearer to the original work of the artist designer than in the less perfect processes.

The method of M. Rouisillon, which was adopted by Goupil in the production of photogravure plates in the early days of the process, was to prepare the surface of the plate with a secret preparation of certain salts, which crystallized under the action of light, so that when exposed under the negative the surface was broken up by this crystallization more or less, according to the amount of light the negative permitted to reach it. The plate with its crystallized surface was then electrotyped, and the electrotype was the plate used for printing. It was a deposit process, as opposed to an etching process.

Photogravure plates are made also by the use of the grain screen, in which the reticulations of the screen take the place of the bitumen powder in producing a grain; it is the inversion of the method by means of which points and lines are produced in the relief block. It has not, however, come much into favour, probably owing to the greater coarseness of the grain and the consequent loss of softness in the tones. An application of this method has, however, been made in the most recent development of the use of screen plates in what is known as the Rembrandt Intaglio Process. It is the property of a firm at Lancaster, and is a secret process; but the secret lies more in the press by which the plates are printed than in the plates themselves, which are intaglio plates made with a very fine screen and bent to a cylinder. The attempt to print photogravure plates by machinery was made many years ago, but it was given up because the plates were so shallow they would not stand the wear and tear, and their life was too short and

Rembrandt intaglio process.

the results too indifferent; but the use of the grain screen renders possible stronger, deeper plates, that will stand harder wear. While we are unable here to describe actually the machine in use in Lancaster, there is little doubt it is some form of the machine used to print wall papers, in which there is a central cylinder engraved with the design, inked by rollers with which it comes in contact. The ink not only fills up the intaglio or sunk portion which has to print the design, but covers as well the whole surface of the plate. To clean this surface, leaving ink only in the sunk dots and lines, another metal cylinder is employed, ground and grooved somewhat like the shaft of the common steel of the dinner table used to sharpen knives, the grooved surface of which, passing over the engraved cylinder, scrapes clean its inked surface, leaving ink only in the sunk portions, which will, as the cylinder comes in contact with the paper, deposit itself and print the picture. The results produced by the Rembrandt intaglio process are softer and smoother than those given by photogravure, and they are free from the gritty qualities which occasionally characterize photogravure; but they lack the brilliancy and depth of the latter. The process on the whole is less costly to use, mainly because the printing is so much more rapid, and is turned out by a machine instead of by hand.

Monotype. The monotype is not a new, but a revival of a somewhat old, method of reproducing on paper a painting by an artist. The design is executed on a plate by means of brushes, fingers, or other tools, with paint or printer's ink. On the completion of the painting, paper is laid upon it, and plate and paper are together passed through a press, when the ink or colour is transferred to the paper. One impression only is possible, hence the name of the process. A method has been devised by Professor von Herkomer, R.A., for dusting the painting while still wet with a fine metallic powder, which renders the surface sympathetic to a copper deposit when it is placed in the galvanic bath, by which means an electrotype of the painting, with its varying relief surfaces, is obtained, and forms a plate from which numerous impressions can be taken.

Electrotypes. The very large number of impressions it is often required to get from the etched surface of a block has made it necessary to devise means for preserving the original block, and to prepare and work from duplicates, which can be renewed when necessary. For this process the original is coated with a film of the finest plumbago (blacklead) powder before being placed face to face with a bed of soft fine wax, into which it is pressed. The plumbago prevents adhesion and facilitates the withdrawal of the block after contact with the wax. The wax mould which is thus obtained is suspended in a galvanic or electric bath in which sulphate of copper has been dissolved. The copper at once begins to deposit itself in metallic form over the face of the wax mould, and in a short time the deposit becomes thick enough, either by itself or when backed up with other metal, to be used as a block in the place of the original. The very fine nature of process blocks, and the necessity of obtaining perfect impressions from them, has led to the introduction of gutta-percha instead of wax as the medium for making a mould. It is melted and poured in a liquid state upon the block, and when cold can be removed without the risk attending the use of wax, which is apt to give way with the slightest lateral movement in the course of the separation of the block from the mould. Gutta-percha is much more tenacious, and being somewhat flexible, does not break and tear, as wax is liable to do. The whole process requires the greatest care in its manipulation, and on its success depends the final appearance of the artist's work in the printed page.

3. PLANOGRAPHIC PROCESSES, which include Photo-lithography, Woodbury-type, and other processes of printing from a flat surface, are described in vol. xxiii. p. 704.

Steel-facing. Steel-facing is resorted to where long numbers have to be printed from photogravure plates. The finest film of steel is deposited by an electric battery over the whole face of the plate, which it hardens and protects. This steel face in time begins to wear, through the constant pressure and rubbing incidental to the process of printing, and the copper begins to show through it. As soon as this happens, the plate is placed in an acid bath, in which the steel film disappears like dew from the grass before the heat of the sun. The plate itself being still intact, can be resteeled for further work.

The changes which have taken place in the form of illustrations have necessarily been accompanied by changes in the machinery by which they are printed.

Changes in machinery. Almost all the changes and improvements have been initiated in the United States of America, which country has taken the lead in all developments of printing machinery and processes. The vital change made in the interest of process block-printing is what is technically known as "hard packing." Before the introduction of process blocks, *the blanket* played an important part in all printing machines. It was a soft woollen sheet, which came between the plate or cylinder and the type and blocks, and modified the force of the contact between them. Owing to the increased fineness of the texture of the process block as compared with the wood engraving, it was found that the blanket was too coarse and soft a material, and that it interfered with the clearness and fineness of the printed result. Blankets of finer material were tried, with improved results; but at last the blanket was entirely discarded, the machinery was more accurately constructed, and the hard, finely polished steel cylinder, without any intervening substance save the sheet of paper to be printed, was brought in immediate contact with the type and blocks. The old soft blanket kept the cylinder or the flat press in contact with the type, in spite of the weak construction of much printing machinery. The new method of work made no allowances for such construction; and the new machinery, to meet the new conditions, had to be very perfect in manufacture. About the old machines there was a lack of solidity, which allowed vibration. Modern work demands absolute rigidity in the machine; and a chief characteristic of the best modern printing machinery is strength and solidity, admitting of precision of impression. Another change has been in the nature and treatment of the printing paper. Most elaborate methods were adopted in all large printing establishments for the moistening of the substance of paper before use. Most paper was printed on whilst damp; but damp paper had to disappear with the soft blanket, and a clay-surfaced paper was introduced with a highly glazed face in harmony with the polished steel cylinder which pressed it against the type and blocks. It is essential to this paper that it be dry when used; to ensure the best results with it, the paper should be kept some weeks or months before use, so that it may be absolutely dry, or seasoned. If printed on too soon, its surface tears away when in contact with the "tacky" ink: and instead of the ink being deposited on the paper, bits of the paper surface are left on the forms, and white spots appear in the impression. The bits of paper surface so deposited on the forms get inked as they pass under the rollers, and impress black spots on the sheets that come after. New and unseasoned paper accounts for much bad printing, and this form of badness is due to the change in material due to the necessities of modern process work.

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Proctor, Richard Anthony (1837–1888), British astronomer, was born at Chelsea on 23rd March 1837. His father died when he was thirteen years old, and, being rather a delicate child, he was kept at home as long as possible by his mother, who attended to his education herself. On his health improving he was sent to King's College, London, from which he obtained a scholarship at St John's College, Cambridge. He graduated in 1860; but his position as 23rd Wrangler disappointed many of his friends, who had formed a high estimate of his abilities. While still an undergraduate he was privately married, a circumstance which may have contributed to the comparative failure at his degree. For some time he thought of taking up the profession of law, but having imbibed a taste for astronomy, and being impressed with the independence and importance of the position of an author, he decided to devote himself to that subject. He made his first appearance as a writer on astronomical subjects in an article on the "Colours of Double Stars," published in the *Cornhill Magazine* (1865). His first book—*Saturn and his System*—was published in the same year, at his own expense. This work contains an elaborate account of the phenomena presented by the planet, his satellites, and rings, a discussion of the various motions of the planet, and the possibility of life upon its globe. It was favourably received by astronomers; but although marked by a lucidity of exposition and enthusiasm for his subject which distinguish his later works, and although it possesses elements of permanent value as a contribution to astronomical literature, it had no great sale. He has left it on record that he intended to follow it up with similar treatises on Mars, Jupiter, Sun, Moon, Comets and Meteors, Stars, and Nebulæ, and had in fact commenced a monograph on Mars, when the failure of a New Zealand bank, in which he was a considerable shareholder, deprived him of an independence which would have enabled him to carry out his scheme without anxiety as to its commercial success or failure. Being thus obliged to depend upon his writings for the support of his family, and having learned by the fate of his *Saturn* that the general public are not attracted by works requiring prolonged attention and arduous study, he cultivated with success a more popular style. He wrote for a number of periodicals; and although he has stated that he would at this time willingly have "turned to stone-breaking on the roads, or any other form of hard and honest but unscientific labour, if a modest competence had been offered" him in any such direction, he attained a high degree of popularity as an exponent of astronomy, and his numerous works have had a wide influence in familiarizing the public with the main facts of astronomy, and have doubtless had far-reaching effects in stimulating an interest in astronomical subjects. His earlier efforts were, however, not always successful. His *Handbook of the Stars* (1866) was refused by Messrs Longmans and Messrs Macmillan, but being privately printed, it sold fairly well and paid expenses. For his *Half-Hours with the Telescope* (1868), which eventually reached a 20th edition, he received originally £25 from Messrs Hardwick. Although the work of teaching was uncongenial to him, he took pupils in mathematics, and held for a time the position of mathematical coach for Woolwich and Sandhurst. His position as a writer was, however, improving, and he became a regular contributor to *The Intellectual Observer*, *Chambers's Journal*, and the *Popular Science Review*. In 1870 appeared his *Other Worlds than Ours*, in which he discussed the question of the plurality of worlds in the light of new facts ascertained since the time of Whewell and Brewster. This was followed by a long series of popular treatises in rapid succession, amongst the more important of which are *Light Science for Leisure Hours* and *The Sun* (1871); *The Orbs around Us* and *Essays on Astronomy* (1872); *The Expanse of Heaven*, *The Moon*, and *The Borderland of Science* (1873); *The Universe and the Coming Transits* and *Transits of Venus* (1874); *Our Place among Infinities* (1875); *Myths and Marvels of Astronomy* (1877); *The Universe of Stars* (1878); *Flowers of the Sky* (1879); *The Poetry of Astronomy* (1880); *Easy Star Lessons* and *Familiar Science Studies* (1882); *Mysteries of Time and Space* and *The Great Pyramid* (1883); *The Universe of Suns* (1884); *The Seasons* (1885); *Other Suns than Ours* and *Half-Hours with the Stars* (1887). In 1881 he founded *Knowledge*, a popular weekly magazine of science (converted into a monthly in 1885), which had a considerable circulation. In it he wrote on a great variety of subjects, including chess and whist. He was also the author of the articles on astronomy in the *American Cyclopædia* and the ninth edition of the *Encyclopædia Britannica*, and was well known as a popular lecturer on astronomy in England, America, and Australia. Elected a fellow of the Royal Astronomical Society in 1866, he became honorary secretary in 1872, and took an active part in its proceedings, contributing no less than eighty-three separate papers to its *Monthly Notices*. Amongst the more important of these are papers dealing with the distribution of stars, star-clusters, and nebulæ, and the construction of the sidereal universe. He made frequent use of accurately drawn charts to support and illustrate his arguments, was an expert in all that related to map-drawing, and published two excellent star-atlases. A chart on an isographic projection, exhibiting all the stars contained in the *Bonn Durchmusterung*, may be specially mentioned, in which, within a circle 11 inches in diameter, are 324,198 minute dots, each representing a star in size and position, designed to show the laws according to which the stars down to the 9–10th magnitude are distributed over the northern heavens. Two papers entitled "Theoretical Considerations respecting the Corona" (*Monthly Notices* of R.A.S. vol. xxxi. pp. 184 and 254) are worthy of note, as are also his early papers on the rotation of Mars, in which, from a discussion of observations from 12th March 1666 to 4th February 1889, including 72,232 rotations of the planet, he deduced the period of its rotation with a probable error of $0^{s}{\cdot}005$. He also contributed several papers dealing with the transits of Venus of 1874 and 1882, in which he vigorously criticized the official arrangements for observing them. His largest and most ambitious work, *Old and New Astronomy*, to which he had devoted his

best energies for several years, was unfortunately left unfinished at his death, but was completed by a friend—A. Cowper Ranyard—and published by Messrs Longmans, Green and Co. in 1892. He died at New York, on his way to England, on 12th September 1888. (A. A. R*.)

Prohibition.—See Liquor Laws.

Prome, a district in the Pegu division of Lower Burma, with an area of 2914 square miles and a population of 368,466 (1891); 365,860 (1901). There were 1848 villages in the district in 1898–99, paying Rs.755,672. The population was made up as follows in 1891:—Buddhists and Jains, 354,650; aborigines, mostly Karens, 8521; Hindus, 2384; Mahommedans, 2283; Christians, 628, of whom 381 were natives.

Of the 1,864,960 acres in the district, 306,149 acres were cultivated in 1898–99, and the rest was made up of forests, 316,697 acres; uncultivable land, 942,604 acres; cultivable land, 278,765 acres; and current fallow, 20,745 acres. The total rainfall, taken at Prome in 1898–99, was 37·83 inches. The highest thermometer reading in May was 104°, and the lowest in December was 53° F. The chief towns in the district are Prome, with a population of 30,022 in 1891; Shwedaung, 12,424; and Paungdè, 10,233. Prome is the terminus of the railway from Rangoon. There is a reformatory school for the province at Paungdè, but it is being converted into a district gaol, and the reformatory is moved to Insein. There were 88 boys at the school in 1898–99. In addition to agricultural work, the boys are taught trades, such as those of tinsmith and carpenter.

Proof-Reading.—Proof-reading as a distinct department in the work of a printing office does not date from the very earliest days of "the art preservative of all arts." The first products of the printing-press show abundant evidences of the non-existence of any one specially charged with the duty of correcting the compositors' mistakes. How much conjectural emendation and consequent controversy would have been avoided if the First Folio Shakespeare had been more typographically correct! Sir Theodore Martin said that the typographical errors alone of that work had been computed to number nearly 20,000, which amounts to 2·25 per cent. of the total number of words in the volume. It was a usual practice in the 17th and 18th centuries for authors to send the proofs of their works round amongst their personal friends for correction; and in the universities and colleges sheets of works passing through the press were frequently hung up in the quadrangles for public inspection and correction. With the growth of printing gradually came a demand for systematic proof-reading, and the leading printers engaged scholars and men of letters to read proofs for them. Among these may be mentioned Cruden, of *Concordance* fame ("Alexander the Corrector"), and William Julius Mickle, poet, and translator of Camoens's *Lusiads*, who was a reader at the Clarendon Press. Goldsmith and Dr Johnson also are credited with having wielded the proof-reader's pen. Times, however, have changed since, as the elder D'Israeli wrote, "it became the glory of the learned to be correctors of the press to eminent printers," and to-day in every printing office the proof-reader is found—an unobtrusive functionary, known to publishers, authors, editors, and journalists, but for the most part unknown to the general reading public; a functionary who yet does useful, often valuable, and always indispensable work. The influence of good proof-reading upon the character of book, newspaper, and general printing is too often underrated. The celebrated old printing offices and the foremost of the modern ones owe their reputation for good workmanship largely to the excellence and thoroughness of the work done in their reading-rooms, for no perfection of paper, ink, machining, or binding can atone for bad or slipshod typography.

The nature of the proof-reader's work, frequently monotonous and uninteresting, will be made clear by what follows. After the compositor (see Typography, in the earlier volumes of this Encyclopædia) has set up by hand or type-setting machine (*q.v.*) the "copy" supplied to him, a slip or page proof is "pulled" and sent with the manuscript to the proof-reader. The manuscript is then read aloud by a reading-boy or copyholder, while the proof-reader carefully follows the text before him letter by letter, marking on the margin of the proof all the misspellings, turned letters, "wrong fonts" (letters differing in size or style of face from those in the immediate context), and other errors, and seeing that the punctuation clearly defines the author's meaning. The reading-boy reads rapidly—indeed, an ordinary listener would imagine it to be impossible for the reader to understand him—and as the reader is obliged to keep pace, he goes through the proof again, without the aid of the boy, in order to mark any errors that may have escaped him in the first rapid reading. The proof, called the "first proof," is then sent to the compositor to be corrected. When this has been done, a further proof is submitted to the reader, who, upon satisfying himself by careful revision that it is free from typographical mistakes, passes it as "clean." If the reader, when dealing with the first proof, notices any slips in grammar or errors of fact on the part of the writer, or is in doubt whether any particular word in the manuscript has been correctly deciphered, he underlines the word or passage, and places "Qy." (query) in the margin. The proof is then despatched to the author or editor. On the return of the proof, after the writer's corrections and alterations have been carried out the type is made up into pages and sheets, and another proof pulled. This passes into the hands of the press reader (as distinguished from the "first-proof reader"), who checks the headlines, page numbers, and sequence of chapters or sections, and observes that the pages are of uniform length and that a sufficient amount of margin is allowed, before finally reading through the text. When the press reader's corrections have been effected, the work is ready for the printing machine or the stereotyping foundry.

The cost of proof-reading may be said to range from about 7½ to 20 per cent. of the cost of composition, varying, of course, with the nature of the work.

Many prominent authors have expressed in warm terms their gratitude to the proof-reader for valuable assistance rendered by apt queries and pertinent suggestions. Two of these expressions of opinion may be given as typical, one from a novelist and one from a poet. Charles Dickens said: "I know from some slight practical experience what the duties of correctors of the press are, and how these duties are usually discharged. And I can testify, and do testify here, that they are not mechanical—that they are not mere matters of manipulation and routine; but that they require from those who perform them much natural intelligence, much superadded cultivation, considerable readiness of reference, quickness of resource, an excellent memory, and a clear understanding. And I most gratefully acknowledge that I have never gone through the sheets of any book I have written without having had presented to me by the corrector of the press something I had overlooked—some slight inconsistency into which I had fallen—some little lapse I had made—in short, without having set down in black and white some unquestionable indication that I had been closely followed in my work by a patient and trained mind, and not merely by a skilful eye. In this declaration I have not the slightest doubt that the great body of my brother and sister writers would, as a plain act of justice, heartily concur." Robert Browning thus corroborated Dickens: "I have had every opportunity of becoming acquainted with, and gratefully acknowledging, the extreme service rendered to me; and, if mine be no exceptional case, the qualifications of readers and correctors are important indeed." P. Larousse spoke of French proof-readers as his "collaborateurs les plus chers," and Hugo referred to them as those "modestes savants" so well able "lustrer les plumes du génie"; while the Académie Française consulted them on points arising in the revision of the Academy's dictionary.

Though much good work is done by readers who have

not been practical printers, yet the technical knowledge gained by working as a compositor is essential to the best proof-reading. The reader must possess a quick eye, alert to note every error or mechanical imperfection in the type, and must scrutinize closely every letter of every word, clause, and sentence, while keeping a grasp of the sense of the matter he is dealing with. The more varied his information and the wider his knowledge, the better. Though his strict duty is merely to see that the author's copy is properly reproduced, he is always glad to give the author the benefit of the experience and knowledge he has acquired, and, as a consequence, he is constantly crossing the line which separates proof-reading from sub-editorial duties. From this last consideration has arisen the plea for the reader, on the daily press especially, being placed under the control of, and made responsible to, the editorial department rather than the head of the composing-room.

Proof-readers, as such, have no trade unions, though many of them in Great Britain retain membership of the unions to which they belonged when working as compositors; and in some states of the American Union the compositors insist upon readers being also members of their society. The oldest organization devoted entirely to the interests of proof-readers is the London Association of Correctors of the Press, founded in 1854. For many years it was restricted to a membership of 150, but since the abolition of this limit the membership has steadily increased, and stood in January 1902 at 500. The chief aim of the association is to give its members information as to vacant situations, so as to keep them in full employment; but it also assists members in distress from its benevolent fund, and provides pensions, as well as a sum of money at death. At the end of 1894, when the association had existed forty years, the total funds amounted only to £65; at the close of 1901 they stood at £811. There is in France the Société des Correcteurs des Imprimeries de Paris. There are also proof-readers' societies in several American cities, many of whose members are women, for in the United States women bulk largely in the rank of proof-readers. There are very few women proof-readers in London. In Edinburgh, however, women form a considerable proportion of the proof-readers. (J. A. BL.; J. R*.)

Propellants.—Explosives are those substances, either solid or liquid, which, upon the application of heat or other cause setting up chemical action in them, are capable of instantaneous or extremely rapid conversion into gases occupying a very great volume as compared with that of the original substance, the gases in addition being highly expanded by the enormous heat resulting from the chemical action accompanying the change of state. Those explosives which are used for the purpose of imparting motion to projectiles of all kinds, whereby they are enabled to travel at great velocity through the air, are termed *propellants*. Any gas subjected to great pressure can by the sudden removal of that pressure be made to act as a propellant. Compressed air has been used in this way as a propellant in the Zalinski dynamite gun. (See AIR-GUN, vol. xxv.) The article on GUNPOWDER in the ninth edition of this work may be consulted for the history of its manufacture.

SMOKELESS PROPELLANTS.

History.—The proportions of the ingredients of the British service gunpowder remained for a very long period unaltered. But the introduction of heavy breech-loading guns necessitated the employment of a very slow-burning explosive; and the manufacture of prismatic powders, consisting of seventy-nine parts saltpetre, eighteen parts charcoal, and three parts sulphur, was begun in England in 1884. Smokeless explosives have now very generally superseded gunpowder for all propulsive purposes. As a result of the new processes, described under the article GUN-COTTON in the ninth edition of this work, it became possible to use gun-cotton as a military explosive; the regulation of its rate of combustion sufficiently to enable it to be employed as a propellant in ordnance and small arms had, however, not been effected. It was not until 1885, when the introduction of small-calibre magazine rifles, rendering absolutely necessary the use of a smokeless powder, was occupying the attention of the principal European Powers, that the problem of using gun-cotton or other forms of nitro-cellulose as a propellant was solved by converting it into a substance devoid of all porosity. This result was attained by subjecting the nitro-cellulose to the action of a suitable solvent, by which it was gelatinized, and after evaporation left as a compact homogeneous non-porous material, capable only of burning from the exterior surface towards the centre. The gelatinized material before the evaporation of the solvent can, while still plastic, be rolled out or pressed into sheets, cords, or other desired form, and when dry be cut up into discs, tablets, cylinders, &c. On these lines many smokeless powders have been produced, and are in general use. They differ in details of manufacture, and frequently contain, besides nitro-cellulose, other explosive or non-explosive ingredients. The first country to adopt a smokeless powder for her magazine rifle was France. The Vieille powder was invented in 1885, and contained probably picric acid as well as gelatinized nitro-cellulose. This powder appears soon to have been replaced by what is known as Poudre B, a gelatinized mixture of two varieties of nitro-cellulose. A further development in the production of smokeless powders for propulsive purposes has been the employment of nitro-glycerine as an essential constituent. This substance had been discovered in the year 1847 by the Italian chemist A. Sobrero at Turin. For many years it remained a laboratory curiosity, and it was not until about the year 1863 that Mr Alfred Nobel, a Swedish engineer, commenced its manufacture on a large scale on the Continent, with a view to using it as a blasting agent. In 1875 Mr Nobel made the discovery that the less highly nitrated form of nitro-cellulose known as soluble nitro-cellulose or collodion cotton had the property, when kneaded with nitro-glycerine under the influence of heat, of absorbing the nitro-glycerine. At the same time it lost its fibrous character and became a stiff gelatinous product, in which the nitro-glycerine largely predominated. This product was patented by Mr Nobel as an explosive under the name of blasting gelatine. In 1886 he made the further discovery that if the proportion of soluble nitro-cellulose were increased until it about equalled the nitro-glycerine, and the materials were incorporated by malaxation, or rolling between hot rollers, a horn-like product suitable for use as a propellant resulted. To this product the name of "Ballistite" was given, and it soon became the Italian service smokeless powder. Although a vast number of explosive substances have been proposed as constituents of smokeless powders, the only ones which are now employed for service propellants and for the most generally used sporting powders are varieties of nitro-cellulose and nitro-glycerine (see ninth edition, GUN-COTTON and NITRO-GLYCERINE).

Classification.—Smokeless propellants, whether for warlike or for sporting purposes, may be broadly classed under two heads as follows:—(1) those which are composed of nitro-cellulose, either soluble or insoluble, or a mixture of the two varieties, with the addition sometimes of small quantities of other explosive and non-explosive substances; (2) those which contain nitro-glycerine in addition to the above ingredients. It would be impossible to give a complete list of the very large number of such explosives proposed, patented, and introduced, and it would be equally impossible to give their exact compositions with certainty, as, in the case of the service powders particularly, the ingredients and their proportions are more or less secret. Belonging to class 1 are the service powders of Austria (small arms), Belgium, Denmark, France (small arms), Germany (small arms), Holland, Norway, Russia, Spain, Sweden, Switzerland, Turkey, and the United States. Belonging to class 2 are the service powders of Austria (ordnance), France (ordnance), Germany (ordnance), Great Britain (small arms and ordnance), Italy (small arms and ordnance), and the United States. The most important varieties of sporting powders are as follows:—*Class* 1. Amberite, Cannonite, E.C., Kynochs, Normal, Plastomenite, Rifleite, Schultze, Troisdorf, Von Forster, Walsrode, and Wetteren. *Class* 2. Amberite, Cordite, and Sporting Ballistite.

Qualities.—The principal qualities which all smokeless powders should as far as possible combine are as follows:—(1) Smokelessness. Smoke is due to the presence of solid products of combustion in a very fine state of division. Substances which on explosion could produce nothing but non-condensible gases would be perfectly smokeless; as, however, the explosion of practically all modern powders gives rise to vapour of water which condenses, they all show a slight amount of smoky vapour varying according to the degree of moisture in the air. This is slightly increased by the products of combustion of the small proportions of organic and inorganic matter, in most cases added as moderants. As a rule the smoke is small and dissipates quickly. (2) Freedom from objectionable products of combustion. The gases given off should not be such as will injuriously affect the firer. Carbonic oxide, a poisonous gas, is produced in considerable quantity by the combustion of most smokeless powders; but as it is a combustible gas, and at the moment of its production highly heated, it takes fire on issuing from the barrel and burns away. Other objectionable gases which it was thought nitro-powders might evolve are nitrogen oxides, but these under the ordinary conditions of firing are not

produced, or if produced are instantly destroyed again by the combined action of the large volume of reducing gases, carbonic oxide and hydrogen, and the high temperature. The tendency of rifle- and gun-barrels to become rusty after firing nitro-powders was at one time ascribed to the presence of nitrogen oxide in the explosive gases, and special oils containing alkali were recommended for cleaning the barrels. It is now understood that this tendency is due to another cause, *i.e.*, to the fact that the very high temperature of the explosive gases affects the surface of the bore and renders it more susceptible to the corroding action of air and moisture. Oiling the barrel after firing with a more viscous lubricant than the oil ordinarily used gets over the difficulty. In the case of heavy guns the quantity of heat evolved has an important bearing on the amount of erosion or wearing away which takes place in the bore. It is greater with smokeless powders than with the old black powders, and greatest in the case of those containing nitro-glycerine. Although these nitro-glycerine powders possess the undoubted advantage that a lesser weight of charge is required for the production of the same velocities with lower chamber pressures, owing to the increased expansion of the gases due to the extra heat, this extra heat appears to increase the amount of erosion, and this has to a certain extent restricted their more general adoption. (3) Stability both chemical and ballistic, under all conditions of climate, storage, and use, is undoubtedly one of the most important properties of any explosive. With black powders there was no question of want of stability so long as they were kept dry. Now that the manufacture and proper purification of nitro bodies are well understood, there is also no difficulty in making those used for smokeless powders very stable, and the experience of some years has proved that these powders can stand severe climatic conditions without showing signs of deterioration, and without their ballistic qualities being impaired. (4) High velocities with moderate pressures. The introduction of magazine rifles and quick-firing guns necessitated not only the employment of a powder producing little if any smoke, but also, to enable them to develop their full effect, one giving much higher velocities than those obtainable with the old black powder, without exceeding the permissible limits of pressure in the bore. These improved ballistics became possible with the new powders owing to a great extent to their colloidal or structureless form. Ignition having taken place on the surface of the flake, cube, or cord, combustion can only proceed by successive layers; with the result that although a much larger total volume of gas, with consequent greater velocity of the projectile, is now developed than formerly, this development of gas takes place gradually during the whole time of the passage of the projectile down the bore, with correspondingly more uniform distribution of pressure. The total propelling force is naturally greater, but as it is more sustained, the maximum pressure is not correspondingly increased. It follows, therefore, that for equal velocities much smaller charges are required than when black powder was used, and the chamber pressures are lower; also that for the same or even lower chamber pressures, higher velocities are obtained. In the old powders complete combustion of the explosive took place before the projectile had time to move far down the bore of the gun; high pressures were in consequence set up in the chamber, necessitating a massive breech. As the development of the gas and therefore of the pressure fell off rapidly, the gun thinned down considerably towards the muzzle, and was comparatively short. For smokeless powders the guns are more uniform in outline, to suit the more uniform distribution of pressure, and they are longer, to enable the full effects to be obtained from the comparatively slow-burning explosive. It is obvious that the property of burning in successive layers affords a ready means of adapting the new explosives to the various calibres of small arms and ordnance for which they are used. By increasing the thickness of the flakes or cubes, or the diameters of the cords or cylinders, the surface of ignition for a given weight is decreased with a corresponding decrease of initial development of gas, and consequently of initial pressure, whereas the time of total combustion is increased. The thicker the flake, cube, or cord, the slower-burning the powder and the larger the gun in which it can be advantageously used. (5) Ease and safety of manufacture. The manufacture of smokeless powders consists in, firstly, the production of the nitro-compounds, and secondly, their treatment with suitable solvents to give them the required colloidal condition. As regards nitro-cellulose, the operations are simple and free from all risks, as throughout the operations the nitro-cellulose is always being dealt with in large volumes of water, in which condition it is quite harmless. The manufacture of nitro-glycerine is one of more difficulty and danger. It is a liquid, very sensitive to friction and percussion, and when acid it has a great tendency to decompose spontaneously if adequate means are not adopted of controlling the temperature while the material is in contact with acids. The precautions to be observed in its manufacture are based on these considerations. In most processes for the production of smokeless powders, the nitro-cellulose has to be dried before further treatment. This operation must be conducted with great care, as dry nitro-celluloses, particularly gun-cotton, are very sensitive to shock of all kinds. When once the solvent is added to the nitro-cellulose, or to the mixture of nitro-cellulose and nitro-glycerine, the danger of accidents is much lessened, and the manufacture of smokeless powders from this point is much safer than that of the old gunpowders. In the latter case there was always present a more or less considerable amount of gunpowder dust which formed a highly explosive mixture with the air, ignitable by the smallest spark, and in its turn exploding the dusty gunpowder in process of manufacture. In the case of smokeless powders there is practically no dust; and the explosives themselves, wetted with the solvent, and more or less gelatinized, would, if ignited, burn away very fiercely but without explosion unless confined; and even if confined, as in the press cylinders, an ignition or explosion would be entirely local, and would not spread to the bulk of the material under treatment.

Most naval and military smokeless powders are in the form of flakes, cubes, cords, ribbons, or cylinders either solid or with one or more perforations; sporting powders are required to be quicker-burning, and are often granular like the old gunpowders, or in the form of very thin flakes. Some cord powders have one or more axial perforations. Flat strips with and without perforations are also made. The colours vary considerably, and depend to a great extent on the added non-explosive ingredients. Pure nitro-cellulose powders are, as a rule, greyish or yellow; those in which nitro-glycerine is present vary in colour from light yellow to deep brown. Sporting powders sometimes contain colouring matters, and are frequently coated with graphite, which gives them a silvery grey appearance. The surface of the flake, cube, and cord powders is usually smooth and hard, and in texture they are horn-like if made from nitro-cellulose, but softer and more of the consistency of india-rubber if containing nitro-glycerine. Their density varies according to the ingredients and method of manufacture. Unless they contain ingredients soluble in water such as metallic nitrates, they are unaffected by damp, and they do not absorb any appreciable amount of moisture. They are more difficult to ignite than black powders, and in the case of small-arm powders require a stronger cap; cannon cartridges require a priming of fine-grain gunpowder or of gun-cotton. Experiments carried out with cordite on several occasions have shown that when packed in the service stout wood boxes with screwed down lids, the boxes may be subjected to a fierce fire which only ignites the cordite without explosion when the flames reach it; and that the cordite in a box may be ignited and burnt away without exploding or even setting fire to boxes packed round it. As far as experiments have hitherto shown, most smokeless powders are fairly insensitive to shock, and are not exploded by the impact or passage through them of rifle bullets even when made up in small-arm cartridges packed in boxes.

Manufacture.—The process of manufacture of both classes of smokeless powders referred to above is similar in all essential particulars, and consists of the three following main operations:—

1. Incorporating and gelatinizing the ingredients either by means of a solvent or by heat.
2. Forming the gelatinized material into the desired shape.
3. Drying or expelling the solvent and any moisture.

The nitro-cellulose, in a very fine state of division, and free from small lumps and knots which would delay the action of the solvent, is thoroughly dried. The gelatinization and the incorporation of the other ingredients are effected almost universally in the kneading machines of Messrs Werner, Pfleiderer and Perkins. This machine is described below under the manufacture of cordite. The usual procedure is to pour in the solvent and start the machine, and then add the nitro-cellulose, or it may be roughly mixed with the solvent before charging into the machine. The other ingredients may be added separately in a fine state of division if solid, usually after incorporation has been proceeding for some little time, or if they are soluble in the solvent they may be added immediately. When nitro-glycerine is an ingredient it is either mixed roughly with the nitro-cellulose by hand before being charged into the machine, or it is mixed with a portion of the solvent and then added. The solvents most generally used are acetic ether or acetone, but when soluble nitro-celluloses only have to be dealt with, an ether-alcohol mixture may be employed. Less used solvents are ether, and the methyl, ethyl, and amyl acetates. The gelatinizing action of the solvent is much assisted by the kneading and squeezing action, and the constant agitation the materials receive in the machine. The time of incorporation varies from about four to eight hours, but it depends on the amount of solvent and to a certain extent on the nature of the other added ingredients. On completion of the gelatinization the mass is of a pasty consistency due to the presence of the solvent, and is in a very suitable condition for rolling out into sheets or pressing through dies to form cords. To form it into sheets, the paste is passed backwards and forwards through hollow chilled cast-iron rollers usually steam heated, their distance apart being capable of adjustment so as to produce any required thickness

of sheet. The sheets are next placed in drying stoves, where the solvent is driven off; and as the drying generally produces blisters and unevennesses in the sheets, they are again passed through hot rollers. The sheets are rolled out very thin in the first instance; to form thicker flakes or cubes they are folded over and over and passed through the rolls between each successive folding until the desired thickness is obtained. This treatment dispels all traces of the solvent, and welds the sheets thoroughly together. The sheets are then cut first of all into strips, and the strips divided into flakes or cubes, for which purposes various machines are in use; or the sheets may be converted into grains much in the style of gunpowder. For the manufacture of cord powders such as cordite, screw or hydraulic presses are employed. They consist of a cylinder for containing the paste, closed at the bottom by a plug having one or more orifices of the required shape. A piston slowly descending into the cylinder forces the paste out through the holes in a continuous cord or cords. The cord is delivered either on a revolving reel or on an endless band on which it can be cut to any desired length. The construction and use of the presses are more fully described below, under the manufacture of cordite. The cords, either on reels or cut to lengths and packed on trays, are dried in stoves at a temperature of about 100° F. (37·5° C.). The drying is effected either by hot air blown into the stove, or by radiation from steam or hot-air pipes. In some drying processes, where the recovery of the solvent is aimed at, the drying chambers are in connexion with vacuum-producing and condensing arrangements. All natures of smokeless powders when thoroughly dry are blended and packed. Another method of granulating powders for sporting guns is, when gelatinization is completed, to add hot water to the mass in the machine and to blow in steam; this treatment has the effect of quickly reducing the paste to a granular condition. The solvent is next evaporated and the water got rid of by pressing, centrifugalling, and drying. The grains are finally sifted to the required sizes.

Cordite.

Cordite is the smokeless powder which has been used by the British service since 1891. It was introduced on the recommendation of a committee presided over by Sir Frederick Abel, who came to the conclusion that an explosive containing a considerable amount of nitro-glycerine offered many advantages over any of the purely nitro-cellulose powders then in existence. Experiments by the committee eventually led to the production of a smokeless powder made from nitro-glycerine and gun-cotton gelatinized by means of a solvent, to which a small proportion of a mineral hydrocarbon was added as a moderant. This explosive is known as "Cordite Mark I," and consists of nitro-glycerine, 58 %; gun-cotton, 37 %; mineral jelly, 5 %.

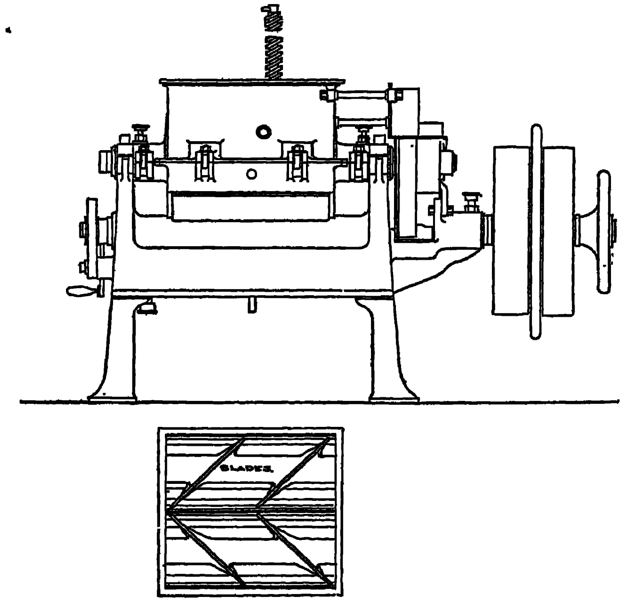
The mineral jelly is a hydrocarbon having the formula $C_{16}H_{24}$, and is obtained by the fractional distillation of crude petroleum oil at a temperature of over 200° C. The variety used for cordite must have a flash point not below 204·4° C. (400° F.), and a melting point not below 30° C. (86° F.). It must also be free from acidity and foreign mineral matters. The solvent used is acetone, C_3H_6O. Acetone is obtained by the destructive distillation of acetates, generally acetate of lime; the principal source of the acetic acid being the destructive distillation of wood. The acetic acid as it distils over from the wood is at once neutralized by lime (or other base) and converted into acetate. The crude acetone as obtained from the acetate, is purified by rectification. It is a colourless aromatic liquid, and as used for the manufacture of cordite it must have a specific gravity of not more than 0·80, must leave no residue on evaporation at 100° C. (212° F.), and must not contain more than 0·005 per cent. of acidity; further, when it is mixed with a 0·1 per cent. solution of potassium permanganate the mixture must retain its pink colour for not less than 30 minutes. The composition of cordite is the same for all descriptions of small arms and ordnance, the required rate of combustion being obtained by varying the diameter of the cords. The density is constant (specific gravity 1·56); it contains practically no moisture, nor is it affected in any way by water. It is poisonous. An exhaustive series of experiments carried out in England, in India, in Canada, and in the Arctic regions, extending over a lengthened period, with the view of testing its keeping qualities, proved that it remained stable in its composition and uniform in its ballistic properties. Experiments also demonstrated its absolute non-sensitiveness to detonation in the form and under the conditions in which it is employed. The different sizes of cordite are designated by a fraction; the numerator gives in hundredths of an inch the nominal diameter of the die through which the cordite is pressed, the denominator, the nominal length of the sticks in inches.

To diminish the erosion produced by cordite of the above composition, especially when firing the heavy charges necessary to produce the high velocities now required from modern ordnance, a modified cordite, known as "Cordite M.D.," is being introduced. Its composition is—nitro-glycerine, 30 %; gun-cotton, 65 %; mineral jelly, 5 %. With Cordite M.D., slightly heavier charges than of Cordite Mark I are required to give the same velocities, but the corresponding pressures are lower, so that by a further increase in the charge, higher velocities can be obtained without exceeding the permissible pressures, and without undue erosion. The manufacture of Cordite M.D. is similar to that of Cordite Mark I.

Manufacture.—The various processes in the manufacture of cordite are as follows:—1. Drying the gun-cotton. 2. Mixing the gun-cotton and nitro-glycerine. 3. Incorporating. 4. Pressing, and reeling or cutting. 5. Drying. 6. Blending and packing.

1. *Drying the gun-cotton.*—The gun-cotton after pulping, is compressed into cylinders 3 inches in diameter and 4½ inches high, of sufficient consistency to enable them to be handled with care. It contains from 40 to 45 per cent. of water. In this form it is placed on trays with copper wire gauze bottoms, arranged on racks in the drying stoves. The drying is effected by means of warm air blown into the stove, the temperature in the stove being kept as nearly as possible at 104° F. (40° C.). The gun-cotton is dried down to under 1 per cent. of moisture.

2. *Mixing the gun-cotton and nitro-glycerine.*—When dry the gun-cotton is weighed out into brass-lined wooden boxes and taken over to the nitro-glycerine final-washing house. The corresponding quantity of nitro-glycerine is weighed out as it comes from the filter tank, and poured over the gun-cotton. The boxes are taken to the mixing house, and the gun-cotton and nitro-glycerine thoroughly



Plan of troughs.

Fig. 1.

mixed by hand so as to break up the gun-cotton and make it absorb the nitro-glycerine. This mixture of gun-cotton and nitro-glycerine is not nearly so sensitive or dangerous to handle and transport as either the dry gun-cotton or the nitro-glycerine alone. The gun-cotton and nitro-glycerine in this roughly mixed condition are known as *cordite paste.*

3. *Incorporating.*—The cordite paste is next taken to the incorporating machines. This machine (Fig. 1) is an iron box, on suitable supports, open at the top, and with a bottom shaped to form two semicircular troughs, in each of which a spindle with screw-shaped blades revolves. The spindles turn in opposite directions, one moving at about twice the rate of the other. They are driven by cog-wheels on a third spindle running underneath the machine. This driving spindle has two pulleys on it, either of which can be put into gear by means of a friction cone. Both pulleys are driven from an overhead shaft, and as one has an open and the other a crossed belt, the blades can be made to revolve inwards or outwards as desired. At the back of the machine is a screw arrangement for tilting it to facilitate the removal of its contents. The lower or trough portion has an iron jacket, through which cold water circulates to keep down the temperature during incorporation. When at work the blades revolve in close proximity to the bottom of the machine, and the paste is continually being squeezed between the blades and the bottom and between the blades themselves as they meet along the centre line. The action is in fact a kneading one, and the machine is very similar to those used for making biscuit dough and for many other like purposes.

The details of the process are shortly as follows:—A portion of the charge of acetone having been poured into the machine, the

blades are started to revolve inwards, that is, towards one another, and the cordite paste ladled in with a wooden scoop, the remainder of the acetone being poured in as the paste is being added. The operation of charging only takes a few minutes, and as soon as it is completed the top of the machine is closed with a wooden cover to prevent the loss of acetone by evaporation, and the machine allowed to run for $2\frac{1}{2}$ hours. At the end of this time the weighed quantity of mineral jelly is added, and the machine set to work for another $2\frac{1}{2}$ hours. For about the last quarter of an hour the motion of the blades is reversed—that is, they are made to revolve away from one another; this has the effect of breaking up the "cordite dough," as it is now termed, in which condition it is more easily filled into the press cylinders. At the end of the five hours the gelatinization of the gun-cotton, and its admixture with the nitro-glycerine by the aid of the common solvent, acetone, is complete, and the mineral jelly is also uniformly distributed throughout the mass. The blades are now stopped, and the cordite dough removed from the machine and placed in barrels for conveyance to the press house.

4. *Pressing.*—There are three kinds of presses in use at Waltham Abbey for pressing cordite, viz., screw, screw and hydraulic combined, and hydraulic. The screw presses are used for the manufacture of small-arm cordite, and are combined with an automatic reeling arrangement for winding the cordite on reels as it issues from the die. The screw and hydraulic combined, and the hydraulic presses, are for producing the large natures of cordite, and are provided with cutting gear for cutting the cordite to the required lengths as it is pressed. The general construction of the screw press for small-arm cordite is shown in Fig. 2. The plunger, the upper portion of which is screwed, passes up through the centre of a worm wheel worked by a worm on a horizontal shaft, to which the driving pulleys are attached. By means of automatic striking gear the motion of the worm is reversed when the plunger comes to the bottom of its stroke, and stopped when the return stroke is completed.

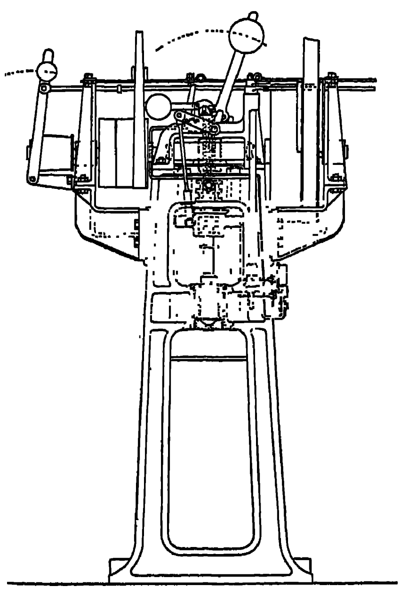


Fig. 2.

The reeling gear is shown in Fig. 3. The reel, the body of which is of sheet brass, with skeleton brass ends, is mounted in front of the press on a horizontal spindle with a cone pulley fixed to one end, and is driven by another cone pulley on the worm shaft; this latter pulley is made to revolve by means of a friction cone worked by a lever on the right side of the machine. The object of the cone pulleys is to enable the speed of the reel to be adjusted to suit the rate at which the cordite is issuing from the die. The cordite is traversed automatically from side to side of the reel as it is wound upon it. The press cylinders are closed at the bottom by a plug, in the centre of which is the die. Resting on the plug is a steel plate with a number of holes in it. This plate supports a fine wire gauze disc, which acts as a sieve to prevent small particles of foreign substances from getting into and blocking up the die. The cylinder is shown in section in Fig. 2. The press cylinders are filled by hand ramming. The full cylinder is placed in the press under the plunger, and the machine started and worked as above described. On completion of the up-stroke, the empty cylinder is removed from the press and another full one inserted. Each cylinder contains a little over one pound of cordite dough. A fresh reel is used for each cylinder, and the reels as filled are taken to the drying-stove.

The screw and hydraulic presses for the large natures of cordite are, as far as the actual pressing is concerned, on practically the same principle as the screw press just described. The press cylinders, however, are an integral part of the machine, and are not removed for filling, the filling being done from a hopper attached to the cylinder, which latter is deep enough to contain the whole charge in an uncompressed condition.

In one pattern of press the plunger screw is attached to and revolves in a ram working in a small hydraulic cylinder. When the press cylinder is charged the valve leading to the hydraulic cylinder is opened, and the pressure, acting on the ram and plunger, forces it down, and it compresses the material into the actual press cylinder. The screw gear is then started and the material pressed out through the die. The arrangement of perforated plate and wire gauze strainer is the same as in the small press cylinder. The number of dies in the plug, that is the number of cords that can be pressed at one time, depends on the diameter of the press cylinder and on the size of the cordite which is being pressed.

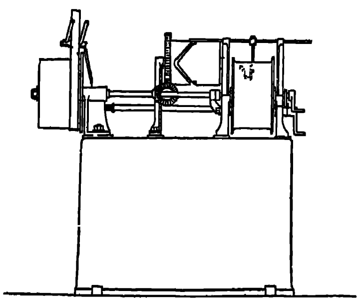


Fig. 3.

The smaller sizes of cordite, sizes $\frac{5}{12}$, $\frac{7\cdot5}{12}$, and $\frac{10}{7}$, are reeled by hand as they issue from the die, on reels of similar materials to those used for small-arm cordite. As soon as a pressing is completed, the reels are taken to a cutting machine, consisting of two horizontal steel blades mounted on a stand opposite one another and in the same plane. The reel is supported in the stand so that the cordite lies at right angles to and between the two blades, which are then brought together, cutting through the cordite and dividing it into a number of strands of equal or nearly equal length, this length being that of the semi-circumference of the reel. The cordite is then laid out flat on shallow wooden trays, the bottoms of which are formed of narrow battens with open spaces between them.

The larger sizes of cordite, viz., $\frac{15}{17}$ and above, are led as they issue from the die on an endless leather band travelling at the same rate as the issuing cordite. This band has steel blades on its surface, fixed at right angles to the direction of its motion. The band passes under a roller, adjusted so as to press the cordite on to the knives, and in this way it is cut to length, the length being regulated by the distance apart of the blades on the belt. As they are cut, the strands are picked off the belt by hand, and arranged on trays, as described above in the case of the smaller sizes.

The hydraulic press is on the usual principle of such presses. The plunger is fixed, and the cylinder is supported on a table which is secured to the ram. As the ram ascends, the cordite is pressed out, and reeled or cut on the endless band; as already described.

5. *Drying.*—All cordite, after pressing, is dried in stoves, heated by means of steam pipes or hot-air blast to a temperature not exceeding 38° C. (100° F.). The reels or trays are arranged on open racks in the centre of the stove. Small-arm cordite takes about three days, the larger sizes about six days, and the largest nearly three weeks to dry. The object of the stoving is to remove the acetone and any moisture from the cordite.

6. *Blending and Packing.*—After drying, small-arm cordite is blended as follows:- Ten single-strand reels are mounted on a frame and wound off simultaneously on a larger reel. The winding is done by a small machine in which the single large reel is made to revolve and draw the cords from the 10 single-strand reels; a lever actuated by cam, through which the ten strands pass, guides them from side to side of the larger reel as they are wound on it. Six of the full 10-strand reels are next taken, mounted on a stand, and the 60 strands wound off on a drum in the same way as the 10 single strands were wound on the 10-strand reel. When the reeling is completed, the ends are all secured by a band of stout tape wound round the drum, and the drum is packed in a box or barrel for transport. Larger sizes of cordite, which have been cut into lengths, are blended as follows:—As the trays come from the stove, their contents are packed into boxes, each containing about 100 ℔ of cordite, until a sufficient number of boxes to form a lot have been filled. This number is subdivided into batches, the number of boxes in a batch varying with the size of cordite, and the cordite in each batch of boxes is blended, by taking a few sticks from each box of the batch and packing them into another set of boxes, filling one box at a time until the whole of the original boxes have been emptied. A box of the blended material is then taken from each batch, and the contents of these boxes are again blended, as above described, so as to form when completed a uniform lot, the number of boxes forming a lot varying with the nature of the cordite. Cordite is packed in wooden boxes holding from 50 to 115 ℔, according to the size of the box and the nature of the cordite.

Cordite for blank ammunition and for Webley pistol cartridges.—Cordite for blank ammunition is prepared from size 20. After the cordite has been dried it is wound on reels. These reels are mounted on a stand in front of a machine which automatically feeds about 40 strands at a time through rows of holes in a fixed plate, in front of which, and close up against it, a disc revolves at a very high rate of speed. Attached to this disc are four knives, set at right angles to one another, which take thin slices off the strands as they are fed through the plate, the principle of the machine much

resembling that of a chaff-cutter. The flakes should vary in thickness between 0″·008 and 0″·003. It is designated $\frac{20}{\text{s.c.}}$.

Cordite for the Webley pistol is prepared by slicing size 1 cordite in a machine similar in principle to the one used for making $\frac{20}{\text{s.c.}}$. It is designated $\cdot\frac{1}{05}$.

Tests.—The tests for finished cordite are as follows :—

1. *Analysis.*—To ascertain that the percentage composition is correct.

2. *Moisture test.*—To ascertain that it does not contain more than a certain percentage of volatile matter varying with the size of the cordite.

3. *Heat test for stability.*—This test is briefly as follows:—20 grains of finely ground cordite are placed in a test tube provided with a stopper, through which passes a glass rod terminating in a hook. A piece of filter paper saturated with a solution of starch and potassium iodide, and dried, is attached to the hook, and the upper half of the paper moistened, when about to be used, with a solution of glycerine in water. The paper is inserted in the test tube, and the test tube placed in a water bath heated to 180° F. The test is completed when the faint brown line, which after a time makes its appearance at the margin between the wet and dry portions of the test paper, equals in depth of tint the brown line drawn on a standard test paper. This test with slight modifications is the one in general use for testing the purity of all nitro-explosives.

4. *Ballistic proof.*—Each size of cordite is fired in the small arm or piece of ordnance with which it is intended to be used, under certain fixed conditions as to weight of charge and projectile, &c., and must give velocities and pressures within certain defined limits.

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(F. L. N.)

Prossnitz (Czech, *Prostějov*), chief town of a government district in the fertile plain of Hanna, in Moravia, Austria. It has important textile, malt, and sugar industries, distilling, brewing, and milling, manufactures of agricultural implements and lucifer matches. Geese are bred in large numbers, and there is a brisk trade in corn. Population (1890), 19,512; (1900), 24,054.

Prostitution.—Prostitution may be defined as promiscuous unchastity for gain. In German law it is described as *Gewerbsmässige Unzucht.* It has always been distinguished in law and custom from concubinage, which is an inferior state of marriage, and from adultery and other irregular sexual relations, in which the motive is passion. Prostitution has existed in all civilized countries from the earliest times, and has always been subject to regulation by law or by custom. In Christian countries attempts have repeatedly been made to suppress it, but without success. Its ultimate basis lies in the two most elementary attributes of living things, namely, the will to live and the instinct of reproduction. The one represents the interest of the individual, the other that of the race; and the essential character of prostitution is that it utilizes the latter to satisfy the former, whereas in true sexual passion, as Schopenhauer has pointed out, the advantage of the individual is subordinated to the needs of the race. In practical language, prostitution offers, through abuse of the sexual instinct, a means of livelihood which a certain proportion of women prefer to other means. It is often assumed by philanthropic moralists that no other means are open to them. That may be so in cases in which deception or constraint has been used, and adverse circumstances—such as lack of friends and a harsh social code—close the door to other occupations; but to suppose that such cases account for prostitution is to misapprehend the problem. The detailed investigations of various observers and the experience of rescue societies prove that the great majority of prostitutes prefer that means of livelihood to others entailing regular work, discipline, and self-control. When they really cease to prefer the life, they leave it voluntarily.[1] Otherwise there is extreme difficulty in reclaiming even the few who will consent to try, and permanent success is only attained with a small proportion of them. The earliest attempt at reclamation met with the same result. It was carried out by the Roman Empress Theodora, wife of Justinian, herself a prostitute in early life. She established a home for 500 women on the Bosphorus, but after a time they could not bear the restraint; some threw themselves into the sea, and eventually the scheme was abandoned. The preference is due to several causes, of which indolence is the chief. Prostitutes are drawn mainly from the lower classes: the life offers them an escape from the toil which would otherwise be their lot. Women who present themselves to the police for inscription on the Continent frequently give as their reason for embracing the life, that they do not intend to work any more. Other causes are love of excitement and dislike of restraint. The same qualities make the criminal and the wastrel. In addition, a large proportion have the sexual appetite developed in an abnormal degree. Of 3505 women interrogated by M. Buls in Brussels, 1118 admitted *le goût pour l'homme.* The foregoing are primary causes. External conditions which foster any of these tendencies, or destroy the self-respect and sense of modesty which are their natural antidotes, are secondary causes of prostitution. The more important are: (1) difficulty of finding employment; (2) excessively laborious and ill-paid work; (3) harsh treatment of girls at home; (4) promiscuous and indecent mode of living among the overcrowded poor; (5) the aggregation of people together in large communities and factories, whereby the young are brought into constant contact with demoralized companions; (6) the example of luxury, self-indulgence, and loose manners set by the wealthier classes; (7) demoralizing literature and amusements; (8) the arts of profligate men and their agents. Alcohol is often an aid to prostitution, but it can hardly be called a cause, for the practice flourishes even more in the most abstemious than in the most drunken countries. These observations apply to the West. In Oriental countries girls are commonly born into or brought up to the trade, and in that case have no choice.

Among the ancient nations of the East, with the exception of the Jews, prostitution appears to have been connected with religious worship, and to have been not merely

[1] The number of those who do so is considerable. In Copenhagen from 1871 to 1896 33 per cent. of the registered prostitutes were removed from the register by marriage and by returning to their friends. Many women resort to prostitution occasionally, in alternation with work.

tolerated but encouraged. From the Mosaic ordinances and the narrative of the Old Testament it is clear that the separation of the Jews as the chosen people, and the maintenance of their faith, were always felt by Moses and by the later prophets to be chiefly endangered by the vicious attractions of the religious rites practised around them. The code of sexual morality laid down in the Book of Leviticus is prefaced by the injunction not to do after the doings of the land of Egypt, nor after the doings of the land of Canaan, where all the abominations forbidden to the Jews were practised; and whenever the Israelites lapsed from their faith and "went a-whoring after strange gods," the transgression was always associated with licentious conduct. In Egypt, Phœnicia, Assyria, Chaldea, Canaan, and Persia, the worship of Isis, Moloch, Baal, Astarte, Mylitta, and other deities consisted of the most extravagant sensual orgies, and the temples were merely centres of vice. In Babylon some degree of prostitution appears to have been even compulsory and imposed upon all women in honour of the goddess Mylitta. In India the ancient connexion between religion and prostitution still survives; but that is not the case in China, a most licentious country, and, considering the antiquity of its civilization, and its conservatism, we may perhaps conclude that it formed an exception in this respect among the ancient nations. Among the Jews, who stood apart from the surrounding peoples, the object of the Mosaic law was clearly to preserve the purity of the race and the religion. Prostitution in itself was not forbidden, but it was to be confined to foreign women. Jewish fathers were forbidden to turn their daughters into prostitutes (Lev. xix. 29), and the daughters of Israel were forbidden to become prostitutes (Deut. xxiii. 17), but no penalty was attached to disobedience, except in the case of a priest's daughter, who was to be burnt (Lev. xxi. 9). This distinction is significant of the attitude of Moses, because the heathen "priestesses" were nothing but prostitutes. Similarly, he forbade groves, a common adjunct of heathen temples and a convenient cover for debauchery. Again, his purpose is shown by the severe penalties imposed on adultery (death) and on unchastity in a betrothed damsel (death by stoning), as contrasted with the mild prohibition of prostitution. So long as it did not touch the race or the religion, he tolerated it; and even this degree of disapproval was not maintained, for Jephthah was the son of a harlot (Judg. xi. 1). There is abundant evidence in the Old Testament that prostitution prevailed extensively in Palestine, even in the earlier and more puritan days. The women were forbidden Jerusalem and places of worship; they infested the waysides, and there is some evidence of a distinctive dress or bearing, which was a marked feature of the trade among the Greeks and Romans. In the later period of aggrandizement that increase of licentious indulgence which Moses had foreseen took place, associated with infidelity. The people plunged into debauchery, the invariable sign of national decadence, which has always accompanied over-prosperity and security, and has always heralded national destruction. Before leaving the Jews, it may be noted as an interesting fact that the remarkable series of ordinances laid down by Moses in the interest of public health contains unmistakable recognition of venereal disease and its contagious character (Lev. xv.).

History.

Passing on to the ancient Greeks, we find prostitution treated at Athens on a new principle. The regulations of Solon were designed to preserve public order and decency. He established houses of prostitution (*dicteria*), which were a State monopoly and confined to certain quarters. The *dicteriades* were forbidden the superior parts of the town, and were placed under various disabilities. They were compelled to wear a distinctive dress, and, so far from being connected with religion, they were not allowed to take part in religious services. These laws do not seem to have been carried out at all effectually, and were presently relaxed. After the Persian wars more stringent regulations were again introduced. The *dicteriades* were placed under police control, and were liable to prosecution for various offences, such as ruining youths, committing sacrilege, and treason against the State. It is clear, however, that as time went on the Athenian authorities experienced the difficulties encountered by modern administrations in carrying out State regulation. There were grades of prostitution, socially though not legally recognized, and women of a superior order were too powerful for the law, which failed to maintain the ban against them. The Greek *hetœrœ*, who were prostitutes, not "mistresses," and the most gifted and most brilliant members of their class known to history, wielded great and open influence. The test case of Phryne, in which the stern attitude previously maintained by the Areopagus broke down, established their triumph over the law, deprived virtuous women of their sole advantage, and opened the door to general laxity. In later times any one could set up a *dicterion* on payment of the tax. In other Greek cities extreme licence prevailed. At Corinth, which was famous for sensual practices, a temple, with a huge staff of common prostitutes for attendants, was established in honour of Aphrodite and for the accommodation of the sailors frequenting the port. The worship of this goddess became generally debased into an excuse for sexual excesses.

The Romans united the Jewish pride of race with the Greek regard for public decency, and in addition upheld a standard of austerity all their own. In early days female virtue was highly honoured and strenuously maintained among them, of which the institution of the vestal virgins was a visible sign. Their attitude towards prostitution differed, accordingly, from that of other ancient nations. Among them, alone, it was considered disgraceful to a man to frequent the company of prostitutes; and this traditional standard of social conduct, which markedly distinguished them from the Greeks, retained sufficient force down to the later days of the Republic to furnish Cicero with a weapon of rhetorical attack against his political opponents, whom he denounced as *scortatores*. Prostitution was more severely regulated by them than by any other ancient race. They introduced the system of police registration, which is the leading feature of Continental administration to-day. From the earliest days of the Republic prostitutes were required to register at the ædiles' office, where licences were issued to them on payment of a tax. They were placed under stringent control, had to wear a distinctive dress, dye their hair or wear yellow wigs, and were subject to various civil disabilities; but the severest feature of the system was that, once registered, their names were never erased, and consequently remained for ever under an indelible stain. As in our times, registration became ineffective, and neither law nor tradition could check the demoralizing influence of ease and luxury when once external conquest left the Romans free to devote their energies to the pursuit of pleasure. An attempt was made, by the enactment of severer laws against prostitution, to stem the rising tide of immorality, which threatened to taint the best blood in Rome with the basest elements in the later days of the Republic. Citizens were prohibited from marrying the descendants or relatives of prostitutes, daughters of equestrians were forbidden to become prostitutes, and married women who did so were liable to penalties. More stringent regulations were also imposed on prostitutes themselves, in addition to the old disabilities and police system, which remained in force. If

these laws had any effect at all, it was to promote the general prevalence of immorality; they certainly did not diminish prostitution. The profligacy of imperial Rome has never been surpassed for gross and obscene sensuality.

The greatest change introduced by Christianity with regard to prostitution was the adoption of a more charitable attitude towards these social and legal outcasts. The Roman state tax, which had descended to the emperors and had been further regulated under Caligula, was partly given up in the 4th century by Theodosius, on the representations of Florentius, a wealthy patrician, who offered to make good the loss of revenue out of his own pocket. It was fully and finally abolished by Anastasius I. in the next century, and the old registers were destroyed. Then some of the civil disabilities of prostitutes were removed by Justinian in the 6th century. Gibbon, who never gave credit for a good motive when a base one could be found, attributes Justinian's action solely to his desire to marry Theodora, whose life had been notorious; and no doubt she influenced him in the matter, but it is permissible to assume a good motive. Even Gibbon is constrained to admit her virtue after marriage, and to give her credit for "the most benevolent institution" of Justinian's reign, the rescue home for fallen women in Constantinople, which was at any rate disinterested. Though it did not succeed, it marks a turning-point in the treatment of a class which had never met with public sympathy before. At the same time procuration and connivance were severely punished, which is in keeping with the Christian attitude. The early Christian Church laid great stress on chastity, which probably suggested to its Roman persecutors the horrible punishment of forcibly prostituting Christian maidens. Such malignity enhanced the glory of martyrdom without shaking the constancy of its victims; and the triumph of purity in an age of unbounded licence was conspicuously recognized by Alaric, the Gothic conqueror, who gave strict orders in the sack of Rome that the virtue of Christian women was to be respected. The Church, however, was not severe upon prostitutes, to whom the altar was open upon repentance, and some of the fathers explicitly recognized their trade as a necessary evil. Among them was St Augustine, a man of the world, who saw that its suppression would stimulate more destructive forms of immorality. Gradually charity degenerated into patronage. Rome, conquered spiritually by Christianity and materially by the Northern barbarians, sapped the virtue of both. Before the Middle Ages the institutions and ministers of the Church became a by-word for vice. Charlemagne made an effort to suppress the prevailing disorder, but his private life was licentious, and his capitularies, which ordained the scourging of prostitutes and panders, were not inspired by any regard for morality. A period of reform followed. The rise of chivalry, with its lofty idealization of women, and the wave of Christian fervour connected with the Crusades, inspired a vigorous and high-minded campaign against an all-prevalent evil. The Church became exceedingly active in prevention and rescue work, and was assisted by a devout and zealous laity. Rescue missions were organized, convents were founded everywhere for the reception of penitents, and dowries were subscribed to procure them husbands. Fulke de Neuilly was a conspicuous figure in this work. He held missions, preached, and collected large sums for marriage dowries. Pope Innocent III. (1198–1216) pronounced it a praiseworthy act to marry a prostitute; and Gregory IX., a few years later, wrote to Germany that brothel-keepers were not to prevent prostitutes from attending missions, and that clergy and laity who drew profit from prostitution were banned. "Urge bachelors," he wrote, "to marry repentant girls, or induce the latter to enter the cloister." In spite of such efforts, and of occasional spasms of severity by individual rulers, prostitution flourished everywhere throughout the Middle Ages. It was not merely tolerated, but licensed and regulated by law. In London there was a row of "bordells" (brothels) or "stews" in the Borough near London Bridge. They were originally licensed by the Bishops of Winchester, according to John Noorthouck, and subsequently sanctioned by Parliament. Stow quotes the regulations enacted in the year 1161, during the reign of Henry II. These were rather protective than repressive, as they settled the rent which women had to pay for the rooms, and forbade their compulsory detention. The Act was afterwards confirmed in the reigns of Edward III. and Richard II. In 1383 the bordells belonged to William Walworth, Lord Mayor of London, who farmed them out, probably on behalf of the Corporation, according to Continental analogy. They were closed in 1506, but reopened until 1546, when they were abolished by Henry VIII. In London we get the earliest known regulations directed against the spread of venereal disease. The Act of 1161 forbade the bordell-keepers to have women suffering from the "perilous infirmity of burning"; and by an Order of 1430 they were forbidden to admit men suffering from an *infirmitas nefanda*. Probably it was by virtue of this Order that in 1439 two keepers were condemned to eleven days' imprisonment and banishment from the city. In 1473, again, it is recorded that bawds and strumpets were severely handled by Lord Mayor Hampton. On the Continent much the same state of things prevailed during the same period. Prostitution was both protected and regulated, and in many places it constituted a source of public revenue. In France prostitutes were distinguished by a badge, and forbidden to wear jewels and fine stuffs and to frequent certain parts of the town. Public brothels on a large scale were established at Toulouse, Avignon, and Montpellier. At Toulouse the profits were shared between the city and the university; at Montpellier and Avignon the trade was a municipal monopoly, and farmed out to individuals; at Avignon, where the establishment was kept up during the whole period of the popes' residence, the inmates were subjected to a weekly examination. In 1254 Louis IX. issued an edict exiling prostitutes and brothel-keepers; but it was repealed two years later, though in this and the succeeding century procuration was punished with extreme severity. In some parts of France prostitutes paid a tax to the seigneur. In Germany, according to Fiducin, the public protection of *Lust-Dirnen* was a regular thing in all the large towns during the Middle Ages. "Frauenhäuser," similar to those in London and in France, existed in many places. They are mentioned in Hamburg in 1292; and from later records it appears that they were built by the corporation, which farmed them. So also in Ulm, where special regulations were issued in 1430. We find them existing at Regensburg in 1306, at Zürich in 1314, at Basel in 1356, and Vienna in 1384. According to Henne-am-Rhyn, admission to these houses was forbidden to married men, clergy, and Jews, and on Sundays and saints' days they were closed. The laws of the Emperor Frederick II. in the 13th century contain some curious provisions. Any one convicted of a criminal assault on a prostitute against her will was liable to be beheaded; if she made a false accusation, she was subject to the same penalty. Any one not going to the assistance of a woman calling for help was liable to a heavy fine. In these ordinances the influence of chivalry may be detected. At the same time prostitutes were forbidden to live among respectable women or go to the baths with them. Hospitality to important guests included placing the public Frauenhäuser at their disposal. So King (afterwards Emperor) Sigismund

was treated at Bern in 1414 and at Ulm in 1434, so much to his satisfaction that he publicly complimented his hosts on it. Besides the municipal Frauenhauser, there were "Winkelhäuser," which were regarded as irregular competitors. In 1492 the licensed women of Nuremberg complained to the mayor of this unfair competition, and in 1508 they received his permission to storm the obnoxious Winkelhaus, which they actually did. In Italy and Spain the system appears to have been very much the same. At Bologna prostitutes had to wear a distinctive dress, in Venice they were forbidden to frequent the wine-shop, and in Ravenna they were compelled to leave a neighbourhood on the complaint of other residents. At Naples a Court of Prostitutes was established, having jurisdiction over everything connected with prostitution. It led to great abuses, was reformed in 1589, and abolished about a century later.

Such was the state of things in the Middle Ages. In the 15th and 16th centuries a great change took place. It was due to two very different causes: (1) fear of disease; (2) the Reformation. With regard to the first, there can be little doubt that both the slighter and graver forms of venereal disease existed in very remote times, but until the 15th century they attracted comparatively little attention. The constitutional character of syphilis was certainly not understood,—which is by no means surprising, since its pathology has only been elucidated during the last half century and is still extremely obscure,—but one would still have expected to find more notice taken of it by historical, moral, and medical writers in classical and mediæval times. Nor is it possible to explain their reticence by prudery, in view of the unbounded literary licence permitted in those ages. One can only conclude that the evil was less widely spread or less virulent than it afterwards became. At the end of the 15th century it attracted so much notice that it was supposed to have originated then *de novo*, or to have been brought from the West Indies by Columbus—both untenable hypotheses; and, as usual, each country accused some other of bringing the contagion within its borders. To speculate on the causes of this increased prevalence would be idle; it is enough to note the fact and its consequences. It was immediately followed by the Reformation, and the two together led to a general campaign against the system of licensed prostitution. The last Frauenhaus was closed in Ulm in 1531, in Basel in 1534, and in Nuremberg in 1562. In London, as already noted, the bordells were abolished in 1546. In Paris an ordinance was issued in 1560 prohibiting these establishments, and later all prostitutes were required to leave the city within twenty-four hours. These instances will suffice to show the general character of the movement. Nor were municipal brothels ever tolerated again. It is observed by Henne-am-Rhyn — no friend of toleration — that their suppression was followed by the appearance of the crime of infanticide, by the establishment of hospitals for foundlings and for syphilis. This suggests an indictment against humanity which is hardly justified by the facts. Infanticide was no new thing, and foundling hospitals date from the beginning of the 13th century. Their marked increase and the establishment of syphilitic hospitals came a century later than the Reformation campaign against the Frauenhäuser. The suppression of the latter did not affect the prevalence of prostitution. In the 17th century another spasm of severity occurred. In 1635 an edict was issued in Paris condemning men concerned in the traffic to the galleys for life; women and girls to be whipped, shaved, and banished for life, without formal trial. These ordinances were modified by Louis XIV. in 1684. The Puritan enactments in England were equally savage. Fornication was punishable by three months' imprisonment, followed by bail for good behaviour. Bawds were condemned to be whipped, pilloried, branded, and imprisoned for three years; the punishment for a second offence was death. In Hamburg all brothels were pulled down and the women expelled from the town. If these measures had any effect, it was speedily lost in a greater reaction; but they have some historical interest, as the present system was gradually evolved from them.

It would be tedious and unprofitable to follow all the steps, the shifts and turns of policy, adopted in different countries during the 18th century for the suppression or control of an incurable evil. They involve no new principle, and merely represent phases in the evolution of the more settled and more systematic procedure in force at the present time. Its chief feature, as compared with the past, is the establishment of an organized police force, to which the control of prostitution is entrusted, coupled with a general determination to put the subject out of sight and ignore it as far as possible. The procedure on the continent of Europe is virtually a return to the old Roman system of registration and supervision, except that there is no State tax, and names can be removed from the register. The objects are the same, namely, public order and decency, with one important addition, which has given rise to much controversy. This is the protection of health. From what has gone before, the reader will have gathered that it is not, as frequently supposed, a new thing. Already in the Middle Ages the question occupied the attention of Parliament in England, and a weekly examination of public women by the barber (the surgeon of that time) was instituted at Avignon. The practice was adopted in Spain from about 1500, and later in many other places. But the abolition of licensed brothels, and the consequent growth of private prostitution, rendered it a dead letter. To meet the difficulty, registration was devised. It was first suggested in France in 1765, but was not adopted until 1778. The present regulations in France are based on the ordinances of that year and of 1780, which in their turn were borrowed from those of the 16th and 17th centuries, previously mentioned. The *theory* of the modern attitude towards prostitution is clearly laid down by successive ordinances issued in Berlin. Those of 1700 stated that "this traffic is not permitted, but merely tolerated"; the more precise ones of 1792 pronounced the toleration of prostitution a necessary evil, "to avoid greater disorders which are not to be restrained by any law or authority, and which take their rise from an inextinguishable natural appetite"; and the regulations of 1850 and 1876 are headed "*Polizeiliche Vorschriften zur Sicherung der Gesundheit, der öffentlichen Ordnung und des öffentlichen Anstandes.*" This embraces the whole theory of present administration, and if *Gesundheit* be omitted, is not less applicable to the United Kingdom than to the Continent. The last attempt to suppress prostitution in Germany is worth noting, as it occurred so late as 1845. Registration was stopped and the tolerated houses were closed in Berlin, Halle, and Cologne. The attempt was a complete failure, and it was abandoned in 1851 in favour of the previous system.

We proceed to state the present condition of the law in France, Germany, Austria, and the United Kingdom.

Present laws.

France.—The French criminal law takes no cognizance of prostitution. The subject was omitted from the penal code drawn up by the first Republic, and was never restored, although many attempts were made to introduce legislation, on account of the great disorder which arose. Procuration is to a certain extent a criminal offence. Paragraph 334 of the code for-

bids the exciting, favouring, or facilitating habitually the debauch of girls or boys under twenty-one years of age; the penalty is imprisonment for six months to two years, and a fine of 50 to 500 francs. If the offence is committed by parents, guardians, or other persons in a tutelary position, imprisonment is from .two to five years, and the fine 300 to 1000 francs. The regulation of prostitution rests on the law of 1790, which entrusted the preservation of public tranquillity to the administrative authorities; these are in Paris the prefect of police, and in other communes the mayor. The Parisian regulations have been built up by the decrees of successive prefects. They are based on those of 1778, which fell into abeyance at the Revolution, were reintroduced in 1816, amended in 1823, and made more complete in 1830 and 1841. Those adopted in other towns do not differ in any essential particular. The more important points are: (1) registration of prostitutes, which is either voluntary, or compulsory after repeated arrest; (2) recognized brothels, which are of two classes — *maisons de tolérance* (residential) and *maisons de passe* (houses of call); (3) medical examination, which is weekly at the *maisons de tolérance*, while other registered prostitutes must present themselves fortnightly at the dispensary; (4) hospital treatment of those found diseased; (5) rules with regard to solicitation, the frequenting of public places, &c. A small fee is paid for examination. The penalty for infraction of regulations is imprisonment; offences are divided into two classes: (1) slight, (2) grave, and the term of imprisonment varies accordingly from fourteen days to one year. Names may be erased from the register on the following grounds: (1) marriage, (2) organic disease such as to render the calling impossible, (3) return to relations and proof of good behaviour. The whole procedure appears to rest on grounds of doubtful legality. Prostitution never comes before the courts which alone can try offences and pronounce sentence. The police have no power to do so, yet they both try and sentence these women. That is to say, the whole system depends on their doing, by some verbal quibble, what they have no power to do. The question came before the court of Rheims in 1876, in the case of two women who refused to submit to medical examination, and the judge decided in their favour. He was dismissed in consequence, which does not make the situation more satisfactory.

Germany.—The German law is more explicit and more logical. Prostitution is not forbidden, but by paragraph 361 of the Imperial Code women are liable to arrest for practising prostitution without being under police control, and for contravening regulations after they have been placed under such control. This brings the traffic completely under the police, and gives legal sanction to their regulations. These vary to some extent in different places, but their general tenor is the same. They include compulsory registration and weekly or semi-weekly medical examination, together with rules, for the most part extremely strict, with regard to public demeanour and conditions of life. In Hamburg, for instance, prostitutes are confined to certain streets or houses, forbidden to share lodgings with persons not registered, to have female servants under twenty-five years of age, to keep children after school age, to admit young men under twenty, to make a noise or quarrel, to attract attention in any way, to go out between two and five in summer, to frequent certain parts of the town, or public balls, or superior seats in the theatre, to remain out after 11 p.m. (Regulations of 1886). On proved reclamation, supervision may be relaxed or names struck off the register. Generally, the women are compelled to contribute a fixed sum to a sick fund, for defraying the cost of medical examination; and in some places also to a journey fund, which is applied to sending strangers to their homes. Brothels are absolutely illegal throughout Germany. Paragraph 180 of the Imperial Code (1876) makes *Kuppelei* a penal offence. *Kuppelei* is defined as promoting prostitution, either by procuration or by providing facilities of any kind. There is (1) ordinary *Kuppelei*, or simply assisting prostitution for gain, and (2) aggravated *Kuppelei*, which includes false pretences and procuration by parents, guardians, teachers, &c. The penalty for the former is a short term of imprisonment and police supervision; for the latter, penal servitude up to five years. It is obvious that if this law were strictly enforced, it would amount to suppression, for every householder or houseowner who harboured a prostitute would be liable to prosecution. Its actual interpretation, however, is very elastic. A law passed in Prussia in 1900 has for its object the reclamation of the young. Girls under eighteen may be placed under control until they are twenty-one.

Austria.—The Austrian law goes further than the German, and is still more inconsistent with the existing practice. By paragraph 5 of the Criminal Act of 1885 prostitution is actually forbidden, but permission is given to the police to tolerate it under conditions, and to prescribe regulations according to circumstances. Power to punish is also given to the police. Only certain cases of prostitution are liable to criminal prosecution, namely, when continued after police punishment, with disregard of regulations, when practised by persons suffering from venereal disease, and when accompanied by public scandal. Seduction of the young is punishable by imprisonment, eight days to six months; living on the prostitution of others, by eight days to three months. *Kuppelei* is a penal offence. Simple *Kuppelei* includes (1) harbouring prostitutes for the purpose of pursuing their trade, (2) procuration, (3) having any connexion with the traffic —penalty, three to six months' imprisonment; qualified *Kuppelei* is (1) procuration of innocent persons (equivalent to use of false pretences), (2) procuration by parents, guardians, &c.—penalty, one to five years. The police regulations and procedure are similar to those in Germany, but less strict. In all these countries a special service of police is employed.

Great Britain.—The English law differs markedly from the foregoing. It regards prostitution solely as a public nuisance, and dates from the middle of the 18th century. The principal Act (25 Geo. II.) was passed in 1755, making perpetual a previous Act of 1752. It is entitled "An Act for encouraging prosecutions against persons keeping bawdy-houses," and provides that two ratepayers, on giving notice to a constable, may go with him before a justice and obtain an order for proceeding against the persons in question. A further Act was passed in 1763, fixing the penalties; and a third in 1818 (58 Geo. III.), enabling the overseers of the parish to take the requisite proceedings. Thus machinery was provided for dealing with brothels, but it was left to the public to put it in motion. The Vagrancy Act of 1824 enables the police to proceed against "common prostitutes for behaving in a riotous or indecent manner," and also forbids indecent literature. This was strengthened by a special Act (2 and 3 Vict.), applying to London only, for the prevention of "loitering for the purpose of prostitution or solicitation, to the annoyance of passengers or inhabitants." Other large towns have since obtained private Acts for the same purpose. The penalties are fines and short terms of imprisonment. In 1847 an Act was passed making it an offence for publicans to allow "common prostitutes to assemble and continue" in licensed premises. The Licensing Act of 1872 contains a provision to the same

effect. The previous law for dealing with brothels by indictment was strengthened by the Criminal Law Amendment Act of 1885 (48 and 49 Vict. c. 69), which renders "any person who keeps, manages or acts or assists in the management of a brothel," and any owner or occupier who knowingly permits the same, liable to summary conviction under the Summary Jurisdiction Act; penalties for first offence, a fine up to £20, or imprisonment up to three months, increased for second offence to £40 and four months respectively. The same Act also strengthened the law, which had previously been very weak, for the protection of the young and the prevention of procuration. It makes the procuration or attempted procuration of any girl or woman "to become a common prostitute" a misdemeanour punishable by two years' imprisonment, and places the following offences on the same footing: procuring defilement by threats, fraud, or drugs; compulsory detention for defilement or in a brothel; procuring the defilement of girls under twenty-one; inducing them to leave the kingdom or to leave home and go to a brothel, with intent. The defilement of girls under sixteen and over thirteen years of age is also a misdemeanour, and subject to the same penalty; the defilement of girls under thirteen is felony, punishable by penal servitude from five years up to a life-sentence. Owners or occupiers of premises conniving at these offences are equally liable.

No account of the law in the United Kingdom would be complete without some reference to the partial adoption of the Continental system in 1864–83. In 1864 a Contagious Diseases Prevention Act was passed, providing for the compulsory medical examination of prostitutes, and detention in hospital of those found diseased, in the following garrison towns:—Portsmouth, Plymouth, Woolwich, Chatham, Sheerness, Aldershot, Colchester, Shorncliffe, the Curragh, Cork, and Queenstown. The legal machinery was a justices' order granted on sworn information that the woman named was a common prostitute. "The Act having proved very inefficacious" (Judge Advocate-General in House of Commons, April 1883), it was amended in 1866 and extended to Windsor. Two years later an important memorial was drawn up by the Royal Colleges of Physicians and Surgeons in favour of the Acts and their extended application, and in 1869 they were further amended and applied to Canterbury, Dover, Gravesend, Maidstone, Southampton, and Winchester—eighteen places in all. A popular agitation, based on humanitarian and moral grounds, and continuously carried on against the measure, led to the appointment of a Royal Commission in 1871 and a Select Committee in 1879. The direct evidence was strongly in favour of the Acts, alike with regard to the diminution of disease among the troops in the protected towns, the absence of complaints, and the good effect on public order, to which clergymen and other residents testified. The majority of the Committee reported accordingly after three years' inquiry; but in 1883 the House of Commons passed a resolution, by 182 to 110 votes, condemning the compulsory examination of women. As this would have entailed refusal to vote the money required to carry on the system, it was immediately dropped, and the officers of the metropolitan police to whom its execution had been entrusted were recalled. In 1886 the Acts were repealed.

In *India* the system was introduced for military cantonments in 1865, partially suspended at the end of 1884, and stopped in 1888 on account of the action of the House of Commons. A new Cantonment Act was applied in 1889, and an amending Act in 1893, by which the compulsory or periodical examination of women was prohibited. In consequence of the enormous increase of syphilis which followed, a new Order was made in 1897, which gave power (1) to call on persons suffering from a contagious disease to attend the dispensary, (2) to remove brothels, (3) to prevent the residence or loitering of prostitutes near cantonments.

The foregoing summary of existing laws and regulations sufficiently indicates the present methods of dealing with prostitution. All Western nations broadly follow one or other of the systems described, though the local regulations may vary somewhat in minor details.

Conditions actually existing.

The French system of recognized houses, with registration, *police des mœurs*, &c., obtains in Belgium, Russia, Hungary, Spain, and Portugal; Italy adopted it in 1855, but abandoned it in 1888 for a modified system; in the Dutch towns *maisons de tolérance* are permitted with or without a *service des mœurs*; Norway has abandoned registration, except in Bergen and Trondhjem, but otherwise Scandinavia rather follows the German principle of non-recognition, with more or less vigorous policing; of the Swiss cantons, some have the French, others the German system; while the United States and the British self-governing colonies incline more to the English model of comparative freedom, without a moral police or one possessing arbitrary executive powers independent of the courts of justice. All the systems have their defects; all fail to fulfil their purpose in the great cities. The most modest aim is to preserve public order and propriety. This object is better secured on the Continent than elsewhere, but at the cost of submitting to an arbitrary police rule, intolerable to a free people. There appears to be less prostitution, both visible and actual, in Italy than in other countries. Under the English system the streets can be, and sometimes are, kept orderly in provincial towns by an energetic police; but in London the mass of prostitution is so great that the police seem totally unable to cope with it. Important thoroughfares and centres are frequented by large numbers of prostitutes in broad daylight, and choked by them at night. The law with regard to loitering is a dead letter, for these women do nothing but loiter. Flagrant solicitation is to some extent repressed, but for the most part the police content themselves with preventing positive tumults, and do not always succeed in that. On the other hand, the less obvious but more pernicious nuisance of the brothel prevails to a far greater extent on the Continent.[1] Under the French system it is, of course, encouraged, in preference to "surreptitious" prostitution; but under the German it is forbidden. The facts here afford a proof of the impotence of the law no less striking than the condition of the London streets. By the German and Austrian criminal law, quoted above, brothels are prohibited, yet they abound in both countries. In Austria they are recognized, and perhaps the logic of the law is saved by permissive police clauses. In Germany it is not so. Paragraph 180 absolutely disposes of the question, and in Berlin it is acted on. Elsewhere brothels not only existed, but were recognized by authority for years after the passing of the law against *Kuppelei*. It was not until 1886 and 1889 that they were nominally abolished in Hamburg and Saxony respectively. Yet they still exist in most or all of the large towns, with the knowledge and consent, if not with the permission, of the police. In some they are even authorized. Berlin, which is more severely policed than any town outside Russia, is an exception. There brothels are not openly winked at, but the police have to deal annually with 16,000 or 17,000 charges of *Kuppelei*, and the number remains very con-

[1] Dublin furnishes an exception to the usual practice in the United Kingdom. In that city the police permit open brothels, confined to one street, but carried on more publicly than even in the south of Europe or in Algeria.

stant, from which it may be inferred that the law, even when logically and energetically carried out, is quite ineffective. The Continental system of registration is still more delusive. In Russia, where the authorities have the means of knowing the movements and habits of every individual, it may be possible to compel the registration of the majority of prostitutes, but in other countries it is impossible. The police everywhere complain of the amount of "clandestine" prostitution, which they cannot control, and which tends always to increase, under the system, while the roll of inscribed women dwindles. The numbers alone are sufficient to prove the failure of the procedure; for instance, 311 and 270 in Dresden and Munich respectively (Zehnder, 1891), both capital towns and cities of pleasure containing over 300,000 inhabitants. Cologne, with only half the population, had double the number on the register at the same time. In Paris, which may be called the headquarters of Western vice, the disproportion between registered and clandestine prostitution has reduced the whole system to an absurdity. The number of women on the roll is not a tenth of the estimated number of prostitutes; nor is Berlin, with about 3000 on the register, any better off. In Bordeaux, Brest, Lille, Lyons, and Marseilles the same process is going on (Reuss). It follows that the protection of health, which is the object aimed at by registration, is delusive in an equal degree. There are no means of ascertaining the amount of venereal disease existing in any town or country, except in Norway, and consequently no data for comparing one period or one place with another; but we know that all forms of such disease are still very prevalent in all large Continental towns, in spite of the system. The only exact figures available are the military returns, which are of some value. It is in garrison towns of moderate size that compulsory registration is likely to be most efficiently carried out and to produce the most decided results, because the women with whom soldiers consort are by their character and habits least able to elude the vigilance of the police. The following table gives the proportion of admissions to hospital from all forms of venereal disease in the German, French, Austrian, and British forces since 1876. It may be added that the proportion in the Russian army is almost identical with the French, while the Italian figures are slightly higher than the Austrian. It is therefore unnecessary to give them:—

Admissions per 1000 in European Armies.

Year.	German.	French.	Austrian.	British (Home).	British (India).
1876 . .	28·8	57·0	65·8	146·5	203·5
1877 . .	30·0	57·8	66·9	153·2	224·4
1878 . .	36·0	59·7	75·4	175·5	291·6
1879 . .	38·5	63·7	81·4	179·5	253·3
1880 . .	34·9	65·8	75·7	245·9	249·0
1881 . .	39·2	60·6	79·0	245·5	250·6
1882 . .	41·0	62·0	73·7	246·0	265·5
1883 . .	38·2	58·9	73·3	260·0	271·3
1884 . .	34·5	52·1	73·5	270·7	293·5
1885 . .	32·6	50·7	69·0	275·4	342·6
1886 . .	29·7	49·6	65·8	267·1	385·8
1887 . .	28·6	51·6	64·4	252·9	361·4
1888 . .	26·3	46·7	65·4	224·5	372·2
1889 . .	26·7	45·8	65·3	212·1	481·5
1890 . .	26·7	43·8	65·4	212·4	503·6
1891 . .	27·2	43·7	63·7	197·4	400·7
1892 . .	27·9	44·0	61·6	201·2	409·9
1893 . .	...	42·8	64·5	194·6	466·0
1894 . .	...	40·9	64·8	182·4	511·4
1895 . .	...	...	...	173·8	522·3

The most striking thing in this table is the enormous difference between the Continental and the British figures. To make the comparison more complete, we will add the following, which gives the average admissions per 1000 for the three years 1890–92:—

German.	French.	Russian.	Austrian.	Italian.	U.S.A.	British (Home).	British (India).	Dutch (Indies).
27·2	43·6	43·0	63·5	71·3	77·4	203·6	438·0	455·6

It is clear at once that troops in the East stand upon an entirely different footing from those in the West, the Dutch figures being even higher than the British; we may therefore put them aside for the moment. Comparing the rest, we notice that not only are the British figures enormously higher than the Continental, but the latter also show very large discrepancies; and since all the foreign troops are under the same protective system, we may conclude that other factors must be taken into account. The discipline maintained, the character of the soldiers themselves, and the procedure with regard to admission into hospital, no doubt all affect the returns. Further, a sort of epidemic rise and fall is to be noted. All the returns given in the first table show a simultaneous rise for several years, beginning with 1876; and having reached a maximum, each shows a progressive fall, likewise lasting over several years. This points to another disturbing factor. It is convincingly shown by the figures for the protected districts in the United Kingdom before, during, and after the period of protection. In 1864—that is, just before the first Contagious Diseases Act came into operation—the proportional figure was 260; ten years later it had fallen to 126; but in 1883 it had risen again to 234, in spite of the protection. Then, protection being removed, it rose to 276, but afterwards fell again progressively to 191 in 1895, without any protection. It is therefore evident that in interpreting the statistics allowance must be made for large fluctuations due to causes quite independent of the protective system. The margin of difference, however, between the British and Continental returns is so large that, when all allowances have been made, it is impossible to doubt that a considerable degree of real protection is afforded to soldiers by the system. This conclusion is confirmed by the comparatively high returns for the somewhat exotic army of the United States, and still more by the Indian statistics. They rose gradually, it is true, during the cantonment system, but when that was dropped disease increased with shocking rapidity. Between 1887 and 1895 the admissions for primary syphilis rose from 75·5 to 174·1 per 1000, and those for secondary syphilis from 29·4 to 84·9.

The broad conclusion is that under special conditions, and when rigidly enforced, registration and medical examination do to a considerable extent fulfil the purpose of protecting health. Their failure to do so among the population at large and under the ordinary conditions of life is not surprising when we regard the amount of venereal disease which still occurs even among soldiers protected by the most rigorous measures and under the most favourable conditions.

A general view of the whole subject suggests no pleasant or hopeful conclusions. Prostitution appears to be inseparable from human society in large communities. In different countries and ages it has in turn been patronized and prohibited, ignored and recognized, tolerated and condemned, regulated and let alone, flaunted and concealed. Christianity, the greatest moral force in the history of mankind, has repeatedly and systematically attacked it with a scourge in one hand and balm in the other; but the effect has been trifling or transient. Nor have all the social and administrative resources of modern civilization availed to exercise an effective control. The elementary

laws on which prostitution rests are stronger than the artificial codes imposed by moral teaching, conventional standards, or legislatures; and attempts at repression only lead to a change of form, not of substance. It survives all treatment; and though it may coexist with national vigour, its extravagant development is one of the signs of a rotten and decaying civilization. In Western communities the traffic is not carried on so openly as in the East, nor is it exploited for purposes of public revenue, as among the ancients and in the Middle Ages; a veil of reticence and secrecy, for the most part of a transparently flimsy character, is thrown over it; but whatever is gained in public decency is counterbalanced by other attendant evils. Two, in particular, are fostered by the policing of prostitution. One is the system of blackmail levied by the executive. The scandal has been most notorious in the United States, but it exists everywhere, and is a constant source of profound corruption. The other is the growth of the most degraded class that ever disgraced the name of man—the creatures who live upon the earnings of individual prostitutes, with whom they cohabit. They are called *souteneurs* in France, *louis* in Germany, *cadets* in New York, and by various slang names in Great Britain. They are all criminals. They flourish chiefly on the Continent, where they exist in large and ever-increasing numbers; but they find their way everywhere, and are a dangerous menace to society. They are not altogether new. The Elizabethan drama is full of references to men who took toll of prostitutes in return for protective services in the old days of persecution; but they have been greatly fostered by the modern system, under which women find it necessary or convenient to have the cover of a man, who can pass for a husband and baffle the police. Thus the law is evaded on the one hand by the corruption of those who administer it, and on the other by the appearance of a class of criminal idlers more degraded than any other—both greater evils than the traffic which the law is intended, but fails, to control. There are no data for comparing the extent of profligacy at present existing in Western communities with that in other countries or in former times, but the unmentionable facts which come constantly to the knowledge of the *police des mœurs*, and less frequently to the ear of doctors and lawyers, leave no doubt that in intensity of vice the great centres of modern civilization have nothing whatever to learn from Corinth, imperial Rome, ancient Egypt, or modern China. The classical obscenities dug up and relegated to museums are far surpassed by the photographic abominations prepared to-day in Paris or in Amsterdam. The gross perversion and abuse of the sexual instinct implied by these excesses may be a passing phase, but it is a phase which has always marked the decadence of great nations. It is undoubtedly accompanied by a general tendency towards increase of the volume of prostitution. Improvement in the conditions of life among the poor ought to tend in the opposite direction, by removing one of the most potent causes of the traffic, but it is more than counterbalanced by the rising standard of luxury and comfort which accompanies it, by the aggregation of the people more and more into great cities, and by their craving for amusement. The growth of prostitution has already left its marks on the marriage- and birth-rates of the most highly civilized Western communities.

In 1900 the Prussian Government made an attempt, with the co-operation of the medical corporations, to ascertain the amount of venereal disease prevalent in the kingdom. Circular questions were addressed to all members of the medical profession requesting them to report the number of patients suffering from those disorders in their practice at the date of 1st April. Answers were sent in by 63 per cent., and the aggregate number of patients was 40,902. From this datum it is calculated that the number of persons attacked in the course of a year is at the very least 500,000 in Prussia alone (*vide Hygienische Rundschau*, April 1902).

AUTHORITIES.—AMOS. *State Regulation of Vice.*—COMMITTEE OF FIFTEEN (New York). *The Social Evil.*—CONFÉRENCE INTERNATIONALE (Brussels, 1899). *Comptes Rendus.*—FIAUX. *La Prostitution en Belgique.*—GIBBON. *Decline and Fall of the Roman Empire.*—HENNE-AM-RHYN. *Die Gebrechen der Sitten-polizei.* PARENT-DUCHÂTELET. *De la Prostitution dans la ville de Paris.* —REUSS. *La Prostitution.* — VON RAUMER. *Geschichte der Hohenstaufen.*—SANGER. *History of Prostitution.*—SCHLEGEL. *Histoire de la Prostitution en Chine.*—SCHRANK. *Die Prostitution in Wien.*—STÜRMER. *Die Prostitution in Russland.*—TARNOWSKY. *La Prostitution.* — ZEHNDER. *Die Gefahren der Prostitution.* (A. SL.)

Protection.—Protectionism includes a system of commercial policy and a body of economic doctrine, which in their modern forms are the outgrowth of the commercial and industrial development of the past century. The common definition of protection as a policy is the attempt to develop a manufacturing industry by a system of discriminating duties upon manufactured goods imported from foreign countries. But this is far too narrow a definition to suit the modern use of the term, though the notion of discriminating tariffs is common and, we may say, basal to all definitions. Protection as a policy includes not only discriminating tariffs, but also a large number of other features supplementary to this fundamental one and designed to emphasize its purpose. Thus a scheme of bounties and premiums, of rebates and drawbacks, is everywhere considered an essential element of the protective system. Nor is it any longer limited to the encouragement of manufactures, but includes as well the protection of agriculture, forestry, mining, fishing, shipping, &c. In short, one cannot give a comprehensive and satisfactory definition of protection to-day without giving it a much wider scope than that of a system of protective duties upon manufacturing industry.

National policy.

Many of its advocates claim, and with some show of reason, that the term protection, as now used to describe the commercial policy of a nation, should be so defined as to include all the means by which a country undertakes to secure through the positive efforts of the Government the complete industrial and commercial development of all its resources and of all its parts. As its object is thus comprehensive, its justification is to be found in a series of arguments based upon political, economic, and social considerations. From this point of view the protective policy embraces not merely the system of discriminating import duties in favour of home products—industrial, agricultural, and mining, with which the policy began in the United States, for example—but also the system of bounties offered for the introduction and establishment of new industries; the policy of restricted immigration of the less desirable classes of labourers, combined with the positive inducements to the skilled labour of other countries to transfer itself to the one in question; the system of discriminating or prohibitive tonnage duties, known as Navigation Acts; the system of developing foreign markets by an active policy directed towards securing advantages for home products in foreign countries. In a word, all those pecuniary or other sacrifices which a country may make in order to develop its material resources and establish, develop, and foster industry and commerce. In this wide sense the comprehensive policy adopted by the United States, for example, includes the making of a careful geological and botanical survey of the whole country in order to discover and open up the vast natural wealth of its domain in its mines, forests, and fields; the establishment of experiment stations to test the usefulness of new crops or means of making old crops more valuable; the stocking of its rivers with fish and the afforesting of its mountains; the introduction of new or more valuable

breeds of live stock; the building of railways and canals, and the offering of inducements to private parties to undertake similar enterprises; the deepening of its rivers and harbours, &c.; and, finally, the development, at public expense, of a scheme of technical and commercial education —lower and higher—adapted to discover and train all the talent in the community available for developing the industry and commerce of the country.

If such an account of the features of a protective policy is objected to on the ground that free trade countries like Great Britain have also adopted some of them, it may be replied, that in so far as they have done so, they have adopted the principle of protection, namely, that Government shall adopt a positive policy looking towards the development, by Government aid if necessary, of new branches of commerce and industry and the firmer establishment of old branches. It may further be pointed out that the countries which have adopted the protective policy most fully—the United States, France, Germany, and Russia—have most consistently followed out the policy here indicated, and in all these countries it has been the so-called protectionist party which has identified itself most fully with the comprehensive policy here suggested.

Economic doctrine.

As a doctrine, protection is the set of principles by which this policy of Government aid to industry is justified, and these principles have been elaborated hand in hand with the development of the so-called protective policy, sometimes outrunning its actual application and advocating its further extension, more often lagging behind and seeking for means of explaining and defending what had already been done. The present development of the system and theory of protection is a result of the growing predominance of capitalism in modern society, combined with the tendency of modern politics towards the organization and development of great national states, with the resulting desire to secure their industrial as well as their political independence. It has been further favoured in certain ways by the fact that the financial needs of modern states require a resort to indirect taxation, thus making it easier for the capitalistic forces to exploit the tax system for their own benefit; while the wars of the 19th century have favoured in many ways the tendency towards the adoption of special means, like high discriminating duties, to accomplish this end. Hand in hand with this has gone a steady tendency to see in the state a powerful means of promoting the development of trade and industry, and a growing disbelief in the more extreme forms of the free trade doctrine, such as the type known as Manchesterism, the theory of the *laissez faire, laissez passer* school of economics and politics.

Protection, both as a doctrine and policy, can be best understood by examining the course of its development in those countries adopting it most consistently. Germany and the United States offer the two most striking examples of great modern nations adopting a system of protection and developing under its influence. They may in a certain sense serve as types of the kind of state which in the 19th century has accepted and defended, in its politics at any rate, the so-called protective system. In both cases the high protective system was associated with the development of nationality, of industry, of capitalism, and of a financial system which favoured the growth of certain elements of the protective policy.

United States.

The protective system in the United States began with the adoption of the Constitution in 1789, and found its first formal defence in the celebrated report of Alexander Hamilton on manufactures. The argument and the movement were largely academic. As there was no strong manufacturing interest in existence, so there was no organized capitalistic effort to secure manipulation of the tariff duties in the interest of special industries. There was general agreement, however, that it would be desirable to develop a manufacturing industry in the colonies if it were practicable. A high degree of natural protection was already afforded by the cost of transportation. It was felt, therefore, that a small duty on manufactures would probably serve the purpose, since the development of the manufactures would favour the production of raw material, which would therefore need no special encouragement. It was also felt that a small duty, continued for a few years, would result in the establishment of the industry on such a firm basis that all duties might be abolished. The introduction of this form of protection, *i.e.*, discriminating duties upon imported goods, was greatly assisted, if not originally caused, by the fact that the new Government needed money, which could most easily be obtained by customs duties. Thus all those parties which were opposed to direct taxes joined their efforts with those interested in securing protective duties, in order to commit the Government to the policy of basing its revenue system on a tariff on imports. To these considerations must be added the further one, that the country had just thrown off political dependence on Europe, and felt that it must now become industrially independent also, if it were to be a great nation. These influences, then, namely, firstly, the desire of the statesmen of the time to create a revenue system for the Federal Government which would make it absolutely independent of the states; secondly, the wish to develop an industry which would serve the needs of the new country while it promoted its complete independence of the Old World, conspired to commit the Federal Government from the beginning to a policy of protection based upon a system of discriminating duties. At the same time a system of discriminating tonnage dues and prohibitory regulations relating to foreign shipping in the coasting trade was adopted to promote and foster the shipping interest.

Industry and commerce began to thrive as never before, largely because of the absolute free trade which the constitution had secured among the states of the Union. The long struggle between France and Great Britain, extending from 1806 to 1812, for the possession of the commerce and the trade of the world, combined with the retaliatory measures of the American Government itself, practically destroyed American commerce for a time, and finally led to the British-American war of 1812, which closed in 1815. The financial system of the Federal Government during this war was based on getting the largest possible returns from the customs, so that the duties were screwed up still higher. The ten years period of non-intercourse, while it had seriously injured American commerce, had fostered the growth of American manufacturing; and when the close of the war of 1812 brought with it an enormous influx of foreign goods, particularly from the plethoric warehouses and factories of England, it looked for a time as though the new American industries were destined to vanish as rapidly as they had grown up. And now for the first time appeared a strong, well-developed, capitalistic party, which was, in spite of some drawbacks, destined to grow until it became one of the most characteristic features of the politics of the republic.

The manufacturers of the country determined the tariff policy of the country, and with few reverses pursued a steadily advancing course of victory down to the close of the 19th century. They secured the maintenance of high duties at the close of the war of 1812, and managed to increase them steadily until the reaction of 1830–33, when they were forced to content themselves with a lower rate, which continued, with a slight interruption in 1842–46, until the outbreak of the Civil War in 1861. This was an

opportunity which they knew how to utilize to the greatest advantage. During the war, when the Government was forced to exploit every possible source of revenue, the protectionist party knew how to turn the necessities of the Government to its advantage. The rate of duties was pressed ever higher; and when the war closed, and the taxes could again be lowered, the protectionist managers knew how to lower or remit altogether the non-protective duties, and thus keep high, and even advance to a still higher point, the duties which protected them from foreign competition.

In the meantime the country was turning from agriculture to manufactures at an unprecedented rate. The manufacturing party was becoming ever stronger and more aggressive. As it had also been the national party, it profited by the enormous development of the nationalist sentiment during and after the war. It now became patriotic to favour the development of a national industry. It was treason to advocate free trade—that had been the policy of the slave-holders' party, and the Slave-Holders' Rebellion, as the Civil War was called, had drawn its strength largely from the free trade sentiment. The policy of the protectionist party had expanded with the growth of the country and the necessity of coming to terms with the antagonistic elements. Thus at first the platform of the protectionists had been one of reasonably low duties on manufactured commodities, low duties on half-manufactured, and no duties at all on raw material. But as the country advanced, and it was seen how the interests of manufacturing had been quickened by the policy of discrimination, those engaged in producing raw materials and half-manufactured commodities demanded that they too should be considered. As this concession had to be made by the manufacturers, they were compelled to justify it by other arguments than those used at first. The infant-industry argument gave place to the proposition, that as long as the prices of raw materials and labour were higher in America than abroad, it would be necessary to maintain countervailing duties at least equal to this difference, in order to protect American industry. One branch after another of manufacturing or agriculture was included and given the benefit of protection. In order to have a satisfactory theoretical basis for such a policy, the theory was advanced that foreign trade was a necessary evil, to be diminished as much as possible. The ideas were advanced and spread throughout the country: that the home market should be reserved for home products; that the labourers should be protected against the influx of foreign cheap labour (Chinese Exclusion Acts; restrictive immigration laws); that prices should be kept high, so as to enable employers to pay high wages; that shipping should be encouraged by subsidies, the sugar industries by bounties; that the nation should become ever more independent of foreign nations for all its industrial products, and capable of holding its own against the world in industry as well as in arms.

The protective party has been the national party during a time when the greatest question before the American people was whether it was to be one nation, or two, or twenty, and it naturally profited by the inevitable victory of nationalism; it has always stood for honest payment of national and state debts, if not in the standard according to which they were contracted, in a still better one, and it has profited naturally by this attitude in a country where the development of trade and industry was rapidly and steadily towards a capitalistic state of society in which such policy is favoured; it has stood for a vigorous and active independence in the field of world politics, and it has naturally profited by this fact in a country which was rapidly forging ahead to take its place among the greatest of existing nations, and with an ever-increasing self-consciousness was ready to assert itself among the nations of the world; it has stood for free labour against slave labour, and consequently profited here again in a country whose greatest conflict turned upon the question whether the system of slave labour should be extended or not; it has stood for high wages for American labourers, and in words at any rate has advocated a policy directed to protecting them against competition with the "pauper labour" of the Old World. It has stood for Government activity in the direction of developing railways and canals; of establishing education upon national lines, making it free, in all grades from the kindergarten to the university, to all citizens of the republic, and it has profited by this association in a country where all influences were telling in favour of this tendency. In short, whatever one may think of the wisdom or folly of trying to develop national industry by a system of discriminating duties, the protective party as such in the United States has been on the progressive side of so many of the deep questions of national importance that it has obtained and kept the allegiance of thousands of men who would have been glad to see a change, or indeed a reversal, in the tariff policy of the party.

Germany.

The history of the tariff policy in Germany has been very similar to that of the United States. Beginning with the establishment of absolute free trade among the various German states in the earlier customs union, it extended this policy, by the establishment of the North German Confederation and the new German Empire, to all the states now included in the federation. The long-wished-for political union meant political independence, and when political independence was once achieved, industrial and commercial independence were next desired. Within the empire itself it was necessary, if the new organization were to be strong and vigorous, that the central government should become independent of the individual states; and this could be best effected by giving it a revenue system based upon import duties, which in the long run has enabled the central government to subsidize the state governments, and thus bring them still further under its influence. To develop this system the political support of some strong party was needed. This party was found in the protectionist elements, which have thus again become the national party in a state which was being rapidly nationalized; the industrial party in a society which was rapidly passing from the agricultural to the industrial condition; the capitalistic party in a society which was rapidly becoming capitalistic in all its tendencies. It stood for industrial and commercial, as well as political, independence of other countries, and thus satisfied the longing for national unity and independence of a people which had suffered for centuries from disunion and dependence.

These two examples may serve to explain how the two most powerful industrial nations next to Great Britain have become and remained highly protectionist in sentiment and in action for the last generation, and how they both opened the 20th century with a more openly declared and a more fully developed system of protection than ever before.

Modern advocates and critics.

Protection as a theory or doctrine is to a certain extent an outgrowth or modification of the old doctrines of mercantilism. In its modern form, however, it dates really from the celebrated Report on Manufactures made by Alexander Hamilton when Secretary of the U.S. Treasury in the year 1791. The views there advanced have been further developed by Friedrich List and Henry C. Carey, and have of late years been carried along somewhat different lines to their logical conclusions by Simon N. Patten and George

Gunton. Starting from an argument in favour of temporary duties on manufactured goods imported from abroad until such time as the infant industry might take firm root, the development proceeded through List, who favoured the maintenance of such duties until the country had passed into the manufacturing stage as a whole, and then through Carey to Patten and Gunton, who maintain that a protective policy, extended to cover agriculture, trade, and mining, should be preserved as the permanent policy of the country until the entire world is one nation, or all nations have reached the same level of political, economic, and social efficiency. The protective policy, which a century ago was to be, in the view of its advocates, temporary and partial, has become to-day, in the arguments of its apologists, permanent and comprehensive. We must content ourselves here with a brief statement of the arguments of the leading and most successful defenders of modern protectionism.

Hamilton.

Alexander Hamilton, at that time Secretary of the Treasury, submitted his celebrated Report on Manufactures to the Congress of the United States on the 5th of December 1791. It is in a certain sense the first formulation of the modern doctrine of protection, and all later developments start from it as a basis. It is a positive argument directed to proving that the existence of manufacturing is necessary to the highest development of a nation, and that it may be wisely promoted by various means, of which the most important is a system of discriminating duties upon foreign imports. Among the objects to be attained by the development of a flourishing manufacturing industry are mentioned:—(1) Independence of foreign nations for military and other essential supplies. (2) A positive augmentation of the produce and revenue of society growing out of (*a*) division of labour, (*b*) extensive use of machinery, (*c*) additional employment to classes of the community not ordinarily engaged in business. (3) An increase in the immigration of skilled labourers from foreign countries. (4) A greater scope for the diversity of talents and dispositions which discriminate men from each other. (5) A more ample and various field for enterprise. (6) In many cases a new, and in all a more certain and steady, demand for the surplus produce of the soil. (7) A more lucrative and prosperous trade than if the country were solely agricultural.

Among the feasible means of promoting the development of such an industry he mentions the following:—(1) Protective duties, or duties on foreign articles which are the rivals of the domestic ones, to be encouraged. (2) Prohibition of rival articles or duties equivalent to prohibition. (3) Prohibition of the exportation of the materials of manufactures. (4) Pecuniary bounties. (5) Premiums. (6) Exemption of the materials of manufactures from duty. (7) Drawbacks of the duties which are imposed on the materials of manufactures. (8) The encouragement of new inventions and discoveries at home, and the introduction into the United States of such as may have been made in other countries; particularly those which relate to machinery. (9) Judicious regulations for the inspection of manufactured commodities. (10) The facilitating of the pecuniary remittances from place to place.

The above suggestions contain the outline of a comprehensive scheme for developing the manufacturing resources of the country, and the United States has subsequently adopted, in one form or another, almost all of these propositions. Hamilton considered that the duties, &c., would not have to be very high nor very long continued in order to accomplish their legitimate ends, after which they would become unnecessary, and would naturally be abolished. He conceded that, generally speaking, import duties were taxes on the consumer, and therefore burdens—but burdens which might well be temporarily borne for the sake of the ultimate advantage arising from cheaper goods and diversified industries. He emphasized also the advantage of a home market for agricultural products, and seemed to think that the United States had to pay the cost of transportation both on the agricultural products it exported and the manufactured goods it imported. This report remained the armoury from which the protectionists drew their weapons of offence and defence for two generations, and it has not yet ceased to be the centre around which the theoretical contest is waged even to-day in Germany and France as well as in the United States.

List.

The next great theorist in this field was the German, Friedrich List, who, while an exile in the United States, became imbued with protectionist ideas, and after doing substantial service for them in the country of his adoption, returned to Germany to do battle for them there. He published his *National System of Political Economy* in Germany in the year 1841. It had great and immediate success, and has exercised a wide influence in Europe on theoretical discussion as well as on practical politics. List, like Hamilton, looked on protection as a temporary system designed to facilitate the passage of a country from an agricultural to a manufacturing state. He accepted free trade as generally and permanently true, but suited for actual adoption only in that cosmopolitan era towards which the world is progressing. But in order to prepare for this cosmopolitan period it is first necessary for each nation to develop its own resources in a complete and harmonious manner. A comprehensive group of national economies is the fundamental condition of a desirable world economy; otherwise there would be a predominance of one or of a few nations, which would of itself constitute an imperfect civilization. Protection is a means of educating a nation, of advancing it from a lower to a higher state. He admits that it may involve a loss, but only in the sense that money expended for an education or an educational system is a loss, or that money spent for seed corn is a loss. To the cosmopolitan system of Adam Smith, List opposes the national system as a preliminary and necessary stage. He favours the imposition of duties as the most efficient means of effecting the protection which he has in mind. Agriculture will be sufficiently protected by the constant demand for its products. The essence of his larger work is contained in a pamphlet published in Philadelphia in 1827, entitled *Outlines of American Political Economy*. It is, in fact, a series of letters advocating the further development of the protective system already adopted in the United States.

Carey: Patten.

The third great name in the history of protection is that of Henry C. Carey, an American, in some ways the most distinguished and most influential of the followers of Hamilton and List. He was at first a strong free trader, then a protectionist who believed in protection as a preparation for free trade, and finally an unconpromising advocate of protection in all circumstances and for all nations. In him and in Simon N. Patten, the last, and in many respects the ablest, of the apologists for protection, we have the theoretical development corresponding to the practical outcome of protection as a comprehensive all-embracing scheme extending protection to all branches of industry alike—agriculture, manufacturing, and mining—and aiming to be permanent in its form and policy. As Patten expresses it: "Protection now changes from a temporary expedient to gain specific ends (such as the establishment of manufactures), to a consistent endeavour to keep society dynamic and progressive. Protection has become part of a fixed

national policy to increase the value of labour with the increase of productive power, and to aid in the spread of knowledge and skill, and in the adjustment of a people to its environment." The object of protection has now become, in the view of the theoretical American protectionist, not an approximation to European industrial conditions, but as great a differentiation from them as possible. Carey's works were translated into the leading European languages, and contributed doubtless to the spread of protectionist ideas, though the extreme form in which his views were expressed, and the rambling illogical method of exposition, repelled many who might otherwise have been attracted by the course of his thought.

Economists of other schools, with the exception of the British, have allowed a relative validity to the doctrines of List; and even among British economists, Mill and some of his disciples have conceded the logical possibility of quickening the development of an industry by import duties in such a way as to result in more good than harm, though they have hardly been willing to acknowledge that it is practically possible. The historical school of political economists have generally admitted the reasonableness of protective policies at certain times and places, though usually finding the justification in political and social considerations rather than in economic.

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Protectorates.—"Protectorate," which was a few years ago rarely named in books on international law, is now a common term to describe the relation between two states, one of which exercises control, great or small, direct or indirect, over the other. It is significant of the rare use of the term until recent times, that the word does not occur in Sir G. C. Lewis's book on *The Government of Dependencies.* Yet the relation is very ancient. There have always been states which dominated their neighbours, but which did not think fit to annex them formally. It has always been politic for powerful states to facilitate and hide schemes of aggrandizement under euphemistic expressions; to cloak subjection or dependence by describing it in words inoffensive or strictly applicable to other relations. A common problem has been how to reduce a state to submission or subordination while ostensibly preserving its independence or existence; to obtain power while escaping responsibility and the expenditure attending the establishment of a regular administration. Engelhardt (*Les Protectorats Anciens et Modernes*) and other writers on the subject have collected a large number of instances in antiquity in which a true protectorate existed, even though the name was not used. Thus the Hegemony of Athens as it existed about 467 B.C. was a form of protectorate; though the subject states were termed allies, the so-called "allies" must in all important legal matters resort to Athens (Meyer, *Geschichte der Alterthums*, iii. s. 274).

In dealing with dependent nations Rome used terms which veiled subjection (Gairal, *Les Protectorats Internationaux*, 26). Thus the relationship of subject or dependent cities to the dominant Power was described as that of *clientes* to the *patronus* (Marquardt, *Römische Staatsverwaltung*, 2nd ed., i. 80). Such cities might also be described as *civitates fœderatæ* or *civitates liberæ.* Another expression of the same fact was that certain communities had come under the power of the Roman people; *in deditionem* or *in fidem populi Romani venire* (Marquardt, *Römische Staatsverwaltung*, i. 73, 81). The kingdoms of Numidia, Macedonia, Syria, and Pergamum were examples of protected states, their rulers being termed *inservientes.* The Romans drew a distinction between *fœdera æqua* and *fœdera iniqua.* The latter created a form of protectorate. But the protected state remained free. This is explained in a passage of the Digest, 49. 15. 7: "Liber autem populus est is, qui nullius alterius populi potestati est subjectus, sive is fœderatus est; item sive æquo fœdere in amicitiam venit, sive fœdere comprehensum est, ut is populus alterius populi majestatem comiter conservaret. Hoc enim adjicitur, ut intelligatur alterum populum superiorem esse: non ut intelligatur alterum non esse liberum" (Marquardt, *Römische Staatsverwaltung*, 2nd ed., i. p. 46, and the instances collected by Puffendorf, 8. c. 9. 4).

In mediæval times this relation existed, and the term protection was in use. But the relation of subordination of one state to another was generally expressed in terms of feudal law. One state was deemed the vassal of another; the ruler of one did homage to the ruler of another. In his book *De la République* Bodin treats of *Ceux qui sont en protection* (1. c. 7), or, as the Latin text has it, *de patrocinio et clientela.* In Bodin's view such states retain their sovereignty (1. c. 8). Discussing the question whether a prince who becomes a *cliens* of another loses his *majestas*, he concludes that, unlike the true vassal, the *cliens* is not deprived of sovereignty: "Nihilominus in fœderibus et pacis actionibus, quæ inter principes aut populos societate et amicitia conjunctissimos sanciuntur; eam vim habet, ut nec alter alteri pareat, nec imperet: sed ut alter alterius majestatem observare, sine ulla majestatis minutione teneatur. Itaque jus illud clientelare seu protectionis omnium maximum ac pulcherrimum inter principes censetur" (1. c. 7). Elsewhere Bodin remarks, "le mot de protection est special et n'emporte aucune subjection de celuy qui est en protection." He distinguishes the relation of *seigneur* and vassal from that of *protecteur* and *adherent.* As to whether the protected state or prince is sovereign, he remarks, "je tiens qu'il demoure soverain, et n'est point subject." He makes clear his conception of protection by adding, "l'advoué ou adherant doit estre exempte de la puissance du protecteur s'il contrevient aux traictes de protection. Voila donc la plus grande seureté de la protection, c'est empescher s'il est possible que les protecteurs ne soyent saisis des fortresses," &c. (p. 549, ed. 1580). Sometimes letters of protection were granted by a prince to a weak state; thus Louis XIII. granted in 1641 such letters to the Prince of Monaco (Gairal, 81).

Reverting to the distinction in Roman law, Grotius and Puffendorf, in common with many other writers, treat protection as an instance of unequal treaties; that is, "when either the promises are unequal, or when either of

the parties is obliged to harder conditions" (*De Jure Belli et Pacis*, 1. c. 13. 21; *De Jure Naturæ*, 8. c. 9).

The following are some definitions of "protectorate":—

Definitions of protectorate.

"Principis privilegium, quo ne alicui vis inferatur, cavetur, eumque *in protectionem* suscipit." Ducange: "La situation d'un état à l'egard d'un autre moins puissant auquel il a promis son appui d'une manière permanent" (M. Gairal, 52); a definition applicable only to certain simple forms of this relation. "Pour le protegé, une condition de mi-souveraineté substituée à la pleine independence que comporte le régime de simple protection" (p. 58). "La situation respective de deux états de puissance inégale, dont l'un contracte l'obligation permanente de defendre l'autre, et en outre de le diriger" (p. 62). "Unter einem Protektorat versteht man ein Schutzverhältniss zwischen zwei Staaten des Inhalts, das der eine Staat, der Oberstaat oder schutzherrliche Staat, zum dauernde Schutze des anderen Staates—des Schutzstaates oder Understaates—verpflichtest ist; wofür ihm ein mehr oder weitgehender Einfluss auf die auswärtigen Angelegenheiten desselben und theilweise auch dessen innere Verhältnisse eingeraümt ist" (von Stengel, *Die deutschen Schutzgebiete*, 11). "The mark of a protected state or people, whether civilized or uncivilized, is that it cannot maintain political intercourse with foreign powers except through or by permission of the protecting state" (Hall, *Foreign Jurisdiction of the British Crown*, 218). "A British protectorate is a country which is not within British dominions, but as regards its foreign relations is under the exclusive control of the King, so that its Government cannot hold direct communication with any other foreign Power, nor a foreign Power with that Government" (Jenkyns, *British Rule and Jurisdiction beyond the Seas*, 165).

The term is used very loosely. Often it designates a relation which it is deemed politic to leave indefinite: a state desires to obtain the reality of conquest without the responsibilities attaching thereto. It may mean no more than what it says, "One state agrees to protect or guarantee the safety of another." The term is also employed to describe any relation of a political superior to an inferior state. It is also used as the equivalent of suzerainty. As appears from the article SUZERAINTY, the terms are distinguishable. But both imply a desire to carry out changes without friction and not to break up ancient forms; both proceed on the plan of securing the substance of power while allowing the weaker state a semblance of its old constitution.

Certain protectorates originate in treaties; others have been imposed by force. Some are accompanied by occupation, in which case it is difficult to distinguish them from annexation. Thus the treaty of May 1881, Article 21, between France and Tunis, provides for the occupation of strategical points by the army of the protecting state. The establishment of a protectorate may be akin to a guarantee. Generally, however, the former implies a closer relation than a guarantee; and the two relations may be widely different, as may be seen by comparing treaties of guarantee with the treaty establishing the protectorate of Tunis.

Strictly speaking, a protectorate cannot exist over a domain uninhabited or ruled by no organized state; in such cases the elements of the true protectorates are wanting. But the distinction is not adhered to. The difficulty of defining the relations between the protected and protecting states is greater, because a protectorate may imply a condition of transition: a contractual or limited relation of state to state, more or less rapidly changing into true union.

It has been the policy of the British Government in India to establish on the frontiers, as elsewhere, protectorates. The political advantages of the system are pointed out in Sir A. Lyall's *Rise and Expansion of the British Dominion in India*. It is a system "whereby the great conquering or commercial peoples masked, so to speak, their irresistible advance"; it was much practised by the Romans in Africa and Asia; it has been chiefly applied in modern times in India (p. 326). The Indian states are sometimes described as "Feudatory States," sometimes "Independent and Protected States" (Twiss), sometimes "Mediatized States" (Chesney), sometimes "Half-Sovereign," sometimes as in a position of "subordinate alliance" (Lord Salisbury, *Parliamentary Papers*, 1897 [c. 8700], p. 27). The Interpretation Act, 1889 (52 and 53 Vict. c. 63, c. 18), refers to the Indian native princes as under the "suzerainty" of the British Crown. These states are really *sui generis*, and their precise position can be understood only by a private examination of the treaties affecting them. The following are the chief points as to which Indian states are subject to English law:—(1) the Governor-General is empowered to make laws for servants of the British Government and European and native Indian subjects of his Majesty; (2) British laws are in force in certain parts of the native states, *e.g.*, in cantonments; (3) native princes have adopted certain British laws, *e.g.*, the Indian Penal Code; (4) they have no external relations with foreign states; (5) the king is the donor of honours; (6) Acts of Parliament affect them indirectly by directly affecting the British agent; (7) they receive advice, which may be akin to commands. (See also Ilbert's *Government of India*, 142.)

Indian protectorates.

Among the chief British protectorates are: the African group, consisting of British Central Africa, East Africa, Uganda and Zanzibar, Basutoland, and British Bechuanaland; the Indian group, consisting of the protected chiefs near Aden, and the island of Socotra and Somali; the Malay group, consisting of the Malay States in the Borneo peninsula and in Borneo, the protectorates of North Borneo, Brunei, and Sarawak; the Pacific group, consisting of a few islands, includnig Harvey Islands protectorate and Gilbert Islands. France possesses several protectorates, of which the chief are Tunis, Annam, and Tongking. Her policy appears to be to transform them into French territory. Such change has taken place as to Tahiti and Madagascar, and such in effect is the position of the Indo-China protectorates. The chief German protectorates are South-West Africa, Togoland and Cameroon, German East Africa, Kaiser Wilhelm Island, and Kiaochow.

Existing protectorates.

There are two principal divisions of protectorates; the first being those exercised generally by treaty over civilized countries. Of the first, the chief are: (*a*) that of Cracow, which was recognized by the Treaty of Vienna as a free and independent state, and placed under the protection of Russia. It was incorporated with Austria in 1846. (Calvo, 1. 2. s. 42.) (*b*) Andorra, protected by Spain and France as successor of the Counts de Foix (Freeman's *Historical Geography*, 1.343, 537). (*c*) The Ionian Islands, placed under the protection of Great Britain by the Treaty of Paris of 1815. (*d*) Montenegro, as regulated by the Treaty of Berlin of 1878. (2) The second class of protectorates consists of those exercised by one civilized State over an uncivilized people, sometimes called a "Colonial Protectorate" or "pseudo-protectorate," and usually the preparatory step to annexation. Such protectorates have become common, especially in Africa, since 1878. The second class may be subdivided into two groups: (*a*) protectorates exercised over countries with organized governments and under recognized sovereigns,

such as the Malay States; and (*b*) those exercised over countries possessing no stable or definite governments and rulers. The territories of chartered companies, when not within the dominion of the protecting state, may also for some purposes be regarded as protectorates.

Rights and duties of protecting and protected states.

Attempts have been made to define the reciprocal rights and duties of protecting and protected states. Sometimes the treaty creating the relation defines the obligations. Thus in the treaty with respect to Sarawak the latter is described as an "independent state under the protection of Great Britain." "Such protection shall confer no right on his Majesty's Government to interfere with the internal administration of that state further than is herein provided." The British consular officers are to receive exequaturs in the name of the Government of Sarawak. Foreign relations are to be conducted by that Government, and the raja cannot cede or alienate any part of the territory without the consent of the British Government (Hertslet, 18. 227). In the treaty creating a protectorate over the territories of the king and chief of Opopo (Hertslet, 17. 130) the sovereign undertakes to extend to them, and to the territory under their authority and jurisdiction, his favour and protection. They promise not to enter into "any correspondence, agreement, or treaty with any foreign nation or Power, except with the knowledge and sanction of his Majesty's Government." Some treaties establishing protectorates provide for direct interference with internal affairs; for example, the treaty of 1847 creating a French protectorate over Tahiti, and that of 1883 as to Tunis. Sometimes the *Oberstaat*—to use a convenient expression—is content to insist upon the presence of a resident, who guides the policy of the native ruler. In the case of protectorates over uncivilized countries it is usual to stipulate against alienation of territory without consent of the *Oberstaat.*

Protectorates and international law.

The position of protectorates according to municipal and international law is still undetermined, and there are an old view and also a new view of their nature. The relation may be one of international law, two states having entered into obligations by treaty. Or the relation may be one of public law; one of two states has become subordinate to, and incorporated with, the other. No doubt the general rule is that the protected state does not cease to be a sovereign state, if such was its previous status. Its head is still entitled to all the immunities and dignity of a sovereign ruler. Further, the establishment of a protectorate does not necessarily rescind treaties made between the protected state and other states, at all events when the protectorate is not in reality conquest or cession, or when any modification would be to the injury of third parties (*Parliamentary Papers*, Madagascar, 1897 [c. 8700]; Trione, 187). Nor does the new relation make any change as to the nationality of the subjects of the two states, though by the legislation of some countries facilities are afforded to the subjects of the *Unterstaat* to transfer their allegiance. Nor, speaking generally, does the territory of the protected state become part of the territory of the *Oberstaat;* in this respect it is unlike a colony, which may be regarded as an extension or outlying province of the country. At the same time, the question whether a particular protectorate forms part of the "dominion" or "territory" of the Crown for any purposes or within the meaning of any statute cannot be regarded as wholly free from doubt. In charging the jury in *Reg.* v. *Jameson*, Lord Chief Justice Russell of Killowen directed the jury, with reference to the question whether Pitsani-Pitlogo, situated in the Bechuana Protectorate, formed part of the territory of the Crown, that the circumstance that the latter was described as a "protectorate" was not conclusive that it was not "territory" of the Crown within the meaning of the Foreign Enlistment Act (12 *Times* L.R. 594), and put to the jury the question whether the Queen in fact exercised dominion and sovereignty at Pitsani-Pitlogo; a ruling which has not been generally approved, and which is inconsistent with the practice as to determining such questions. Several writers propose this distinction—the protected country is to be considered a part of the territory as to matters to which sovereignty extends, and as to other matters not. In one view, for the purpose of municipal law, the territory of a protectorate is not, but for the purposes of international law is, within the territory of the protecting state. In another view, such territory is foreign only in the sense that it is not within the purview of the majority of statutes (see Hall's *International Law*, 131, 135, Heilborn, 535; Tupper's *Indian Protectorates*, 336; Laband, 2. s. 70). The older view of the position of a protectorate according to international law is contained in the decision of Dr Lushington in the case of "the Leucade" (8 S.T., N.S. 432), to the effect that, the declaration of war by Great Britain against Russia notwithstanding, the Ionian islands, which were then under the protectorate of Great Britain, remained neutral. The king of Great Britain had the right of declaring peace and war. "Such a right is inseparable from protection." But the Ionian states did not become necessarily enemies of the state with which Great Britain was at war. According to one view, the protected state is implicated in the wars to which the protecting state is a party only when the latter has acquired a right of military occupation over the territory of the former. "Cette solution a été reconnue par la France en 1870, à propos de la guerre contre l'Allemagne pour les îles Taiti alors soumises à notre protectorat; elle s'imposerait pour la Tunisie, l'Annam et Tonkin, et pour le Cambodge, où les traités nous conferent le droit d'occupation militaire" (M. Despagnet). In the event of hostilities between the protecting and protected states, such hostilities would be regarded not as of the nature of an insurrection, but as a regular war (Trione, 149). By the General Act of the Berlin Conference it was agreed that the acquisition of a protectorate should be notified to the signatories to the agreement (Article 34), and it has been the practice to give such notice. It was proposed by some of the Powers represented at the Conference that effective occupation should be a condition to the creation of a protectorate on the coast of Africa. But this was opposed by England, and was not adopted (Laband, ii. 680).

Many writers adhere to the doctrine that there is no impairment of sovereignty of the weaker state by the establishment of a protectorate. They also allege that it is *res inter alios acta.* But the trend of recent policy and purport of much recent legislation are against this view. On the whole, the distinct tendency in recent times, especially as to protectorates over uncivilized countries, is to treat the territory of a protectorate as if it belonged to the protecting state. If France, for example, permitted in Tunis or other protectorates operations which were of an unfriendly character to any Power, say Italy or Germany, the injured Power would no doubt look to France for redress. This view would probably be strongly pressed in the case of protectorates over countries having no well-defined or stable government. The probability is that in such cases governments and courts applying international law would be guided not by technical facts—such, to take the case of British possessions, as the fact that an Order in Council permitted appeals to the Judicial Committee—but would look to the facts of the case.

The tendency is for protecting states to assert jurisdiction over foreigners within the territories of the protected states (Westlake, 187; Ilbert, 434). Mr Hall remarks (*International Law*, p. 131 *n.*) that "all the states represented at the Berlin Conference of 1884–85, with the exception of Great Britain, maintained that the normal jurisdiction of a protectorate includes the right of administering justice over the subjects of other civilized states." The General Act contemplated measures which are scarcely compatible with the exemption of European traders and adventurers from the local civilized jurisdiction. He points out that Great Britain—which until lately took the view that a protected state possesses only delegated powers, and that an Eastern state cannot grant jurisdiction over persons who are neither its own subjects nor subjects of the country to which the powers are delegated—had by the Pacific Order in Council of 1893 and the South African Orders in Council of 1891–94 asserted jurisdiction over natives and foreign subjects. It may be added that "the Orders show a gradual increase of the assumption of internal sovereignty" (Jenkyns, 193).

The fact is that in the case of protectorates over uncivilized or semi-civilized countries a development, more or less rapid, is inevitable: control quickly hardens into conquest, and international law more and more takes note of this fact. The probability is that, in deciding the questions here mooted, regard will be had mainly to the facts of the particular case, and to attribute responsibility to the state which possesses the power of control.

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(J. Mt.)

Protestant Episcopal Church.—This is the official title of the religious body which represents in the United States the Anglican Communion (*q.v.*). The numerical strength of this Church has never borne any due proportion to its historic claims. It never has been the official Church of the American people, though of late it has made great strides both in numbers and in the respect and confidence of all sorts and conditions of men. Even in colonial days it numbered among its adherents only a very small minority of the population, while for many years after the American Revolution even its friends hardly dared to hope that it could survive the shock it had received. From the first settlement a large part of the population of the thirteen colonies had been either indifferent to, or openly hostile to, the Anglican Church. The Dutch in New York, the Swedes in Delaware, the Scots and Irish in New Jersey, the Germans in Pennsylvania, and the Huguenots in New York and the Carolinas, felt little interest in what was to them the national Church of a foreign people; while the Quakers in Pennsylvania and the Puritans in New England both feared and hated it. Even in Virginia, where the Church of England was recognized by law as the established Church, and where for a while it had full sway, there soon sprang up an active and rapidly growing minority bitterly opposed to it. The troublous times in England during and after the Puritan Commonwealth drove large numbers of religious dissenters to the shores of Virginia, and they were soon reinforced by men like minded from the other colonies. In Pennsylvania provision had been made by charter that "on the petition of twenty persons a preacher might be sent out by the Bishop of London"; but the attempt to do this in 1694 aroused a violent opposition, and it was some time before the Quakers laid aside their distrust. In New York the regular services of the Church of England were unknown until after the capture of the colony by the British, and for some years they were confined to the little chapel within the fort, where the English chaplain and the Dutch dominie took turns in officiating. It was 1697 before Trinity Church, the first Episcopal parish in New York, was organized. The first rector was William Vesey, a communicant of King's Chapel, Boston, and a recent graduate of Harvard College. He crossed the sea to obtain orders after his election, and was ordained by the Bishop of London in 1697. He continued as rector until his death in 1746. At the beginning of the Revolution, besides Trinity Church, with its two stately chapels, St Paul's and St George's, the Church had gained a strong foothold in Westchester county and on Long Island, and had established a line of churches up the Hudson as far as Albany and Schenectady. In New England the Church met with the most bitter resistance. King's Chapel, Boston, was the first Episcopal church in New England, and was erected in 1688 through the influence of Sir Edmund Andros and by the exercise of his authority as royal governor; but the building was closed for a time almost immediately, and the first rector driven from the country, on the news of the accession of William and Mary. In Connecticut, as in Massachusetts, "the Standing Order," *i.e.*, Congregationalism, was the established religion, and every citizen was compelled to pay taxes for its support. In 1707 the first Episcopal church was begun at Stratford. This was followed in 1722 by an event which, Quincy in his history of Harvard College says, "shook Congregationalism throughout New England like an earthquake, and filled all its friends with terror and apprehension." This was the public announcement that Cutler, "the rector," or president, of Yale College, with the two tutors, Brown and Johnson, had decided to take orders in the English Church. Dr Cutler became the first rector of Christ Church, Boston, and Dr Johnson, after many years of faithful labour in Stratford, became the first president of King's (afterwards Columbia) College, New York. The greatest obstacle, however, to the healthy growth of the Church was the fact that for the first 200 years it was left without a bishop, and dependent for all episcopal service on the bishop of London. No such makeshift as the sending out of commissaries to investigate and enforce discipline could make amends for this vital defect. The American Church owes much to Dr Bray, and still more to the Society for the Propagation of the Gospel, which for nearly a century gave liberally men and money for the work; but had missionary bishops been sent out to enforce discipline, to give wise direction, and, above all, to raise up and commission a native ministry, history would have had a very different story to record. As it was, at the beginning of the American Revolution there are said to have been in the colonies only about 300 churches and 250 clergy of the Church of England.

The Revolution was a terrible blow to this little body of faithful men. Naturally many among them, especially in New York and New England, were opposed to the popular movement; and after the war was over, the bitter prejudices against everything English were arrayed against the Church, which had been known as the English Church. Keen observers like John Adams in Massachusetts and

Chief Justice Marshall in Virginia did not hesitate to describe it as "an exotic" and "too far gone ever to be revived." The first quickening of its life began in Connecticut, where at a meeting of the clergy, held at Woodbury on the feast of the Annunciation 1783, Samuel Seabury was elected first bishop of Connecticut. After trying in vain to obtain orders in England, he was consecrated at Aberdeen, in Scotland, on 14th November 1784. Meanwhile, in the preceding October, a meeting had been held in New York, at which representatives from seven states were present. Among them were the courtly Parker of Massachusetts, the stately Provoost and the gentle Moore from New York, the scholarly Smith from Maryland, and the saintly White from Pennsylvania. The first General Convention was held in Philadelphia in 1785. On 4th February 1787, at Lambeth, William White was consecrated first bishop of Pennsylvania and Samuel Provoost first bishop of New York, by the archbishops of Canterbury and York; and in 1790 James Madison was consecrated in the same place as first bishop of Virginia. The "succession" having been thus secured, two years later Thomas John Claggett was consecrated first bishop of Maryland by bishops Provoost, Seabury, White, and Madison. Through him—in whom the Scottish and English lines are thus united—every American bishop to-day can trace his succession.

For nearly a generation after the Revolution the Church dragged on a feeble and a starveling life. Then came a new race of bishops. The Church ceased to apologize for her existence, and began to assert openly her claims as a true branch of the Catholic Church. Hobart, bishop of New York, 1811–30, was the pioneer in this movement, and to him more than to any other man were due the hopefulness and the vigour of the new life. In 1835 the General Convention declared that the Church was the missionary society, elected Kemper as the first missionary bishop to the North-West, and sent out the first missionaries to foreign lands. To-day the Church, notwithstanding her marvellous growth since 1850, holds a position and an influence immeasurably greater than her numerical strength. This is due largely to the fact that she stands for these five things: historic continuity, liturgical worship, equal rights for clergy and laity, absolute separation of Church and State, and the carrying of religion into the daily life of the people. The liturgy is substantially that of the Church of England, with additions from the liturgy of the Church of Scotland, or changes suggested by the test of experience. From 1880 to 1892 a work of liturgical revision was carried on by the General Convention with two objects in view, "liturgical enrichment and increased flexibility of use." The American Church, both in its diocesan and in its general conventions, has recognized fully the right of both clergy and laity not only to legislate about temporal matters, but also to settle questions touching the faith and worship of the Church. Her early experience in colonial days helped the Church to realize the advantage of a separation from the State; yet it was long before the older traditions were laid aside. It was not until 1838 that permission was given to divide a state so as to provide for an additional diocese—and it was not until 1898 that the General Convention abandoned civil lines in arranging and distributing its missionary jurisdictions. It had already refused to accept Government aid for its work among the Indians. Since 1850 the growth of this Church has been especially marked in the older states and the larger cities; but throughout the whole country she has more than kept pace with the increase in the population, so that while in 1850 she had one communicant in every 300 of the population, she had in 1900, roughly speaking, one in every 100.

	Population.	Communicants.
1850 . . .	23,347,884	79,987
1860 . . .	31,442,960	146,600
1870 . . .	38,555,983	220,000
1880 . . .	50,152,866	344,789
1890 . . .	62,480,540	509,149
1900 . . .	76,295,220	700,458

This numerical increase represents very inadequately the real change in her position. The years since 1880 have been marked also by great changes within the Church, in her methods of work, and in the multiplication and enrichment of her services; but the greatest of all has been the dying out of the old party spirit, the broadening and deepening of every school of thought, and the coming together of men of many minds to work for great common ends. Side by side with this, and partly as a result of it, has been the upbuilding of the great city parish. Instead of an unwise multiplication of new parishes, there has been seen a judicious strengthening of the old. Nowhere has this been more marked than in New York City. In 1875 there were only five parishes in the old city of New York claiming each over 600 communicants; now there are nearly a score, reporting each over 1000 communicants, while old Trinity has over 7000, and St George's nearly 5000. The organization of the Church covers now every state and territory within the United States, while her missionary work extends to Africa, China, and Japan, and she is lending a helping hand in Porto Rico, Cuba, the Philippines, Mexico, and Brazil. In every organized diocese there is an annual convention or council, presided over by the bishop and composed of the clergy and lay delegates from the various parishes, and having power to legislate on all local matters. Once in three years the General Convention meets as the supreme legislative body. This is composed of two houses, the House of Bishops, in which each bishop has a seat, and the House of Clerical and Lay Deputies, in which each diocese is represented by four clerical and four lay deputies.

The following table will give some idea of the present condition of the Church and its growth since 1880:—

	Diocese and Missionary Jurisdiction.	Bishops.	Clergy.	Parished Missions.	Baptisms.	Confirmations.	Communicants.	Contributions.
1880	61	61	3435	4151	47,063	25,903	345,841	$7,013,782
1890	67	72	4058	5118	59,902	38,958	470,076	11,183,697
1900	80	84	4878	6519	59,908	43,059	700,458	13,878,380

(H. C. P.)

Protoplasm.—The importance of protoplasm, as the physical and material basis of life, has caused it to be the subject in recent years of much minute and laborious research. Mysterious indeed are the powers and activities manifested by the minute speck of matter which circulates within a plant-cell or creeps freely about as an Amœba, or the "microcosmic subtlety" whereby the tiny spermatozoon transmits to the next generation the qualities and peculiarities which go to make up a human personality. It seems obvious that matter so peculiarly endowed must possess a complexity of structure and organization far exceeding that which at first sight meets the eye. Some biologists have attacked the problem of the ultimate constitution of protoplasm from a purely theoretical standpoint, and have framed hypotheses of an ultramicroscopic constitution sufficient, in their opinion, to explain, or at least to throw light upon, the vital activities of the living substance. Others, proceeding by more empirical methods,

have attempted to lay bare the structure of protoplasm by means of the refinements of modern microscopical technique, or to solve the question of its constitution by means of chemical and physiological investigation. Hence a convenient distinction, not always easy, however, to maintain in practice, is drawn between *speculative* and *empirical* theories of protoplasm.

(1) *Speculative theories* have come with the greatest frequency from those who have attempted to find a material explanation for the phenomena of heredity (*q.v.*). As instances may be mentioned more particularly the "gemmules" of Darwin, the "pangenes" of de Vries, the "plastidules" of Haeckel, and the "biophores" of Weismann. These theories have been ably brought together and discussed by Delage, who has included them all under the term "micromerism," since they agree in the assumption that the living substance contains, or consists of, a vast number of excessively minute particles—*i.e.*, aggregates or combinations of molecules, which give to the protoplasm its specific properties and tendencies ("idioplasm" of Nägeli). In other cases the assumption of invisible protoplasmic units has been inspired by a desire either to explain the general vital and assimilative powers of protoplasm, as, for example, the "micellæ" of Nägeli and the "plasomes" of Wiesner, or to elucidate the mechanism of some one function, such as the "inotagmas" of Engelmann, assumed to be the agents of contractility. In general, it may be said of all these speculations, either that they can only be extended to all vital phenomena by the help of so many subordinate hypotheses and assumptions that they become unworkable and unintelligible, or that they only carry the difficulties a step farther back, and really explain nothing. Thus it is postulated for Wiesner's hypothetical plasomes that they possess the power of assimilation, growth, and reproduction by division; in other words, that they are endowed with just those properties which constitute the unexplained mystery of living matter.

(2) *Empirical theories of protoplasm* differ according as their authors seek to find one universal type of structure or constitution common to all conditions or differentiations of the living substance, or, on the contrary, are of opinion that it may vary fundamentally in different places or at different times. From these two points of view protoplasm may be regarded either as *monomorphic* or *polymorphic* (Fischer). The microscopical investigation of protoplasm reveals at the first glance a viscid, slimy, or mucilaginous substance, in which is embedded an immense number of granules, for the most part very tiny. Very rarely are these granules absent, and then only from a portion of the protoplasm, and only temporarily. Hence many authorities have regarded the minute granules—the "microsomes" of Hanstein—as themselves the ultimate living units of protoplasm, in opposition to those who would regard them merely as "metaplastic" substances, *i.e.*, as the heterogeneous by-products of metabolism and vital activity. The *granular theory*, as this conception of the living substance is called, has received its extreme elaboration at the hands of Altmann, whose standpoint may be taken as typical of this class of theories. After demonstrating the universal occurrence of granules in protoplasm, Altmann has compared each individual granule to a free-living bacterium, and thus regards a cell as a colony of minute organisms, namely, the granules or *bioblasts*, as he has termed them, living embedded in a common matrix, like a zooglœa colony of bacteria. Of this theory it may be remarked, firstly, that it brings us no nearer to an explanation of vital phenomena than do the plasomes of Wiesner; secondly, that to consider bacteria as equivalent, not to cells, but to cell granules, is to assume for this class of organisms a position with regard to the cell theory which is, to say the least, doubtful; and, thirdly, that the observations of the vast majority of competent microscopists furnish abundant support for the statement that granules of protoplasm do not lie free in a structureless matrix, but are embedded in the substance of a minute and delicate framework or *morphoplasm*, which in its turn is bathed by a watery fluid or *enchylema* permeating the whole substance. The upholders of the granular theory deny the existence of the framework, or explain it as due to an arrangement of the granules, or as an optical effect produced by the matrix between the granules. Amongst those, on the other hand, who assert the existence of a framework distinct from granules and enchylema, the utmost diversity of opinion prevails with regard to the true structural relations of these three parts and the rôle played by each in the exercise of vital functions. Some have regarded the framework as made up of a tangle of separate fibrillæ (*filar theory*)—a view more especially connected with the name of Flemming—but most are agreed that it represents the appearance of a *reticulum* or network with excessively fine meshes, usually from ½ to 1 μ in diameter. The reticulum carries the granules at its nodal points, and is bathed everywhere by the enchylema. Even with so much in common, however, opinions are still greatly at variance. In the first place, the majority of observers interpret the reticulum as the expression of an actual spongy framework, a network of minute fibrillæ ramifying in all planes. While, however, Heitzmann, following the speculations of Brücke, considered the framework itself to be actively contractile, and the seat of all protoplasmic movement, an opposite point of view is represented by the writings of Leydig, Schäfer, and others, who regard the reticulum merely as a kind of supporting framework or *spongioplasm*, in which is lodged the enchylema or *hyaloplasm*, considered to be itself the primary motile and living substance. Bütschli, on the other hand, has pointed out the grave difficulties that attend the interpretation of the reticulum as a fibrillar framework, in view of the distinctly fluid consistence of, at any rate, most samples of protoplasm. For if the substance of the framework be assumed to be of a firm, solid nature, then the protoplasm as a whole could not behave as a fluid, any more than could a sponge soaked in water. On the other hand, the hypothesis of a fluid fibrillar framework leads to a physical impossibility, since one liquid cannot be permanently suspended in another in the form of a network. Bütschli therefore interprets the universally present reticulum as a meshwork of minute lamellæ, forming a honeycombed or *alveolar* structure, similar to the arrangement of fluid lamellæ in a fine foam or lather, in which the interstices are filled not with air but with another fluid; in other words, the structure of protoplasm is that of an exceedingly fine emulsion of two liquids not miscible with one another.

It may be claimed for the *alveolar theory* of Bütschli that it throws light upon many known facts relating to protoplasm. It interprets the reticulum as the optical section of a minute foam-like structure, and permits the formation of protoplasmic striations and of apparent fibrillæ as the result of linear or radiating dispositions of the alveolar framework; it reconciles with the laws of physics the combination of a framework with a fluid or semifluid aggregate condition, while variations in the fluidity of the framework are compatible with a stiffening of the protoplasm almost to the pitch of rigidity, as seen, for example, in nervous tissue; and, finally, it explains many characteristic structural peculiarities of protoplasm, such as the superficial layer of radiately arranged alveoli, the spherical form of vacuoles, the continuous wall or pellicle which limits both the vacuoles and the protoplasm as a whole, and many other points not intelligible on the theory of a sponge-like structure. Bütschli has succeeded, moreover, in producing artificial foams of minute structure, which not only mimic the appearance of protoplasm, but can be made to exhibit streaming and amœboid movements very similar to those of simple protoplasmic organisms. Incidentally these experiments have shown that many of the

apparent granulations and "microsomes" are an optical effect produced by the nodes of the minute framework. In his most recent works Bütschli has extended his theory of alveolar structure to many other substances, and has tried to prove that it is a universal characteristic of colloid bodies, a view strongly combated, however, by Fischer. While it cannot be claimed that Bütschli's theory furnishes in any way a complete explanation of life, leaving untouched, as it does, the fundamental question of assimilation and metabolism, he at least draws attention to a very important class of facts, which, if demonstrated to be of universal occurrence, must be reckoned with in future treatment of the protoplasm question, and would form an indispensable preliminary to all speculations upon the mechanism of the living substance.

In opposition to the above-mentioned monomorphic theories of protoplasm, all of which agree in assuming the existence of some fundamental type of structure in all living substance, attempts have been made at various times to show that the structural appearances seen in protoplasm are in reality artificial products, due to precipitation or coagulation caused by reagents used in the study or preparation of living objects. These views have been developed by Fischer, who by experimenting upon various proteids with histological fixatives, has shown that it is possible to produce in them a granular, reticular, or alveolar structure, according to treatment, and, further, that granules so produced may be differentially stained according to their size and absorptive powers. Fischer therefore suggests that many structural appearances seen in protoplasm may be purely artificial, but does not extend this view to all such structures, which would indeed be impossible, in view of the frequency with which reticular or alveolar structures have been observed during life. He suggests, however, that such structures may be temporary results of *vital precipitation* of proteids within the organism, and that protoplasm may have at different times a granular, reticular, or alveolar structure, or may be homogeneous. Fischer's conception of living protoplasm is therefore that of a polymorphic substance, and a similar view is held at the present time by Flemming, Wilson, and others. Strassburger also regards protoplasm as composed of two portions: a motile *kinoplasm* which is fibrillar, and a nutritive *trophoplasm* which is alveolar, in structure.

The chemical investigation of protoplasm labours at the outset under the disadvantage that it cannot deal with the living substance as a whole, since no analysis can be performed upon it without destroying the life. Protoplasm consists, to the extent of about 60 per cent. of its total mass, of a mixture of various *nucleo-proteids*—that is to say, of those substances which, in molecular structure and chemical composition, are the most complex bodies known. In association with them are always found varying amounts of fats, carbohydrates, and other bodies, and such compounds are always present in the living substance to a greater or less degree as products of both upward and downward metabolism. Protoplasm also contains a large but variable percentage of water, the amount of which present in any given case affects largely its fluid or viscid aggregate condition. Especial interest attaches to the remarkable class of bodies known as ferments or *enzymes*, which when prepared and isolated from the living body are capable of effecting in other substances chemical changes of a kind regarded as specifically vital. It is from their study, and from that of the complex proteids found in the living body, that the greatest advances towards an explanation of the properties of living matter may be expected at the present time. (See article PHYSIOLOGY; also Buchner, "Alcoholic Fermentation without Yeast Cells," *Ber. d. deutsch. chem. Ges.* vol. xxx., xxxi., and xxxii.; Verworn, *General Physiology*, London, 1891, p. 304; Reynolds Green, *The Soluble Ferments and Fermentation*, Cambridge, 1899.)

The question may be raised how far it is probable that there is one universal living substance, which could conceivably be isolated or prepared in a pure state, and which would then exhibit the phenomena characteristic of vital activity. It is sufficiently obvious, in the first place, that protoplasm, as we know it, exhibits infinite diversity of character, and that no two samples of protoplasm are absolutely similar in all respects. Chemical differences must be assumed to exist not only between the vital fabrics of allied species of organisms, but even between those of individuals of the same species. Kassowitz regards this variability as compatible with the assumption of a gigantic protoplasmic molecule in which endless variations arise by changes in the combinations of a vast number of atoms and atom complexes. It is difficult to conceive, however, of any single substance, however complex in its chemical constitution, which could perform all the functions of life. To postulate a universal living substance is to proceed along a path which leads inevitably to the assumption of biophores, plastidules, or other similar units, since the ultimate living particles must then be imagined as endowed at the outset with many, if not all, of the fundamental properties and characteristic actions of living bodies. Such a conception has as its logical result a vitalistic standpoint, which may or may not embody the correct mental attitude with regard to the study of life, but which at any rate tends to check any further advance towards an explanation or analysis of elementary vital phenomena. We may rather, with Kölliker, Verworn, and others, ascribe the activities of protoplasm to the mutual interaction of many substances, no single one of which can be considered as living in itself, but only in so far as it forms an indispensable constituent of a living body. From this point of view life is to be regarded, not as the property of a single and definite substance, but as the expression of the ever-changing relations existing between the many substances which make up the complex and variable congeries known to us as protoplasm.

AUTHORITIES.—For exhaustive historical summaries of the protoplasm question, with full bibliographical references, the reader may be referred to the following works, especially the first five:—BÜTSCHLI. *Investigations on Microscopic Foams and Protoplasm.* London, 1894; *Untersuchungen über Strukturen.* Leipzig, 1898; "Meine Ansicht über die Struktur des Protoplasmas und einige ihrer kritiken," *Arch. f. Entwickelungsmechanik. d. Org.* xi. pp. 499–584, pl. xx. (1901).—DELAGE. *La Structure du Protoplasme et les Théories sur l'Hérédité.* Paris, 1895.—WILSON. *The Cell.* 2nd ed. London, 1900.—FISCHER. *Fixirung, Färbung, und Bau des Protoplasmas.* Leipzig, 1899.—KASSOWITZ. *Allgemeine Biologie.* Vienna, 1899. (E. A. M.)

Provençal Literature (Modern: 1350–1900).[1] Literature in the South of France never died out entirely. Indeed, we have a link which, though too much importance may easily be attached to it, yet undoubtedly connects the products of the troubadours with the Provençal poetry of the present day. The Academy of Toulouse, founded in 1324, was flourishing in the 14th century, and, after many vicissitudes, is flourishing still. [The poets crowned by this body between 1324 and 1498 stand in the same relation to the troubadours as the *Meistersinger* do to the *Minnesinger*: academic correctness takes the place of inspiration. The institution flourished, even to the extent of establishing branches in Catalonia and Majorca; and in 1484, when its prosperity was threatened, a semi-fabulous person, Clémence Isaure, is said to have brought about a revival by instituting fresh prizes. The town of Toulouse never ceased to supply funds of some kind. In 1513 French poems were first admitted in the competitions, and under Louis XIV. (from 1679) these were alone held eligible. This unfair arrangement, by which some of the leading poets of northern France profited, held good till 1893, when the town very properly transferred its patronage to a new *Escolo Moundino*,[2] but very soon restored its support to the older institution, on learning that Provençal poetry was again to be encouraged.] In the two centuries that followed the glorious mediæval period we have a succession of works, chiefly of a didactic and edifying character, which scarcely belong to the realm of literature proper, but at

[1] In accordance with general usage, we are employing the term Provençal for the whole of the South of France, save where special reservation is made.

[2] *Moundino*, *i.e.*, of Toulouse; a common designation, derived from Raymond, the familiar name of the Counts of Toulouse.

least served to keep alive some kind of literary tradition. This dreary interval was relieved by a number of religious mystery plays, which, though dull to us, probably gave keen enjoyment to the people, and represent a more popular *genre*; the latest that have come down to us may be placed between the years 1450–1515. Not only did the literature deteriorate during this period, but dialects took the place of the uniform literary language employed by the troubadours, while the spoken tongue yielded more and more to French. In 1539 François I. forbade the use of Provençal in official documents—a fact that is worthy of note only as being significant in itself, not as an important factor in the decadence of Provençal letters.

On the contrary, just about this time there are signs of a revival. In 1565 the Gascon, Pey de Garros, translated the Psalms into his dialect, and two years later published a volume of poems. His love for his native tongue is genuine, and his command over it considerable; he deplores its neglect, and urges others to follow his example. Auger Gaillard (*c.* 1530–1595) does infinitely less credit to his province: the popularity of his light pieces was probably due to their obscenity. More in the spirit of Garros is the charming trilingual *Salut* composed by the famous du Bartas in honour of a visit of Marguerite de Valois to Nérac (1579): three nymphs dispute as to whether she should be welcomed in Latin, French, or Gascon, and the last, of course, wins the day. Provence proper gave birth to a poet of considerable importance in Louis Bellaud de la Bellaudière (1532–1588), of Grasse, who, after studying at Aix, enlisted in the royal armies, and was made a prisoner at Moulins in 1572. During his captivity he wrote poems inspired by real love of liberty and of his native country (*Don-Don infernal*, 1584 or 1585). At Aix Bellaud subsequently became the centre of a literary circle which included most of the local celebrities; all of these paid their tribute to the poet's memory in the edition of his works published by his uncle, Pierre Paul, himself the author of pieces of small value, included in the same volume (*Lous Passatens, Obros et rimos*, &c., Marseilles, 1595). Even when Bellaud is wholly frivolous, and intent on worldly pleasures only, his work has interest as reflecting the merry, careless life of the time.

A writer very popular in Provence for the light-hearted productions of his youth was Claude Brueys (1570–1650), remarkable chiefly for comedies that deal largely with duped husbands (*Jardin deys Musos provensalos*, not published till 1628). There is a certain charm, too, in the comedies of Claude's disciple, Gaspard Zerbin (*La Perlo deys musos et coumedies prouvensalos*, 1655); and those critics who have read the plays of Jean de Cabanes (1653–1712) and of Seguin (of Tarascon, *c.* 1640), still in MS., speak highly of them. The most consistently popular form of poetry in the South of France was always the *noël*. There has been no limit to the production of these; but very rarely does the author deserve special mention. An exception must be made in the case of Nicholas Saboly (1614–1675), who produced the best pieces of this class, both as regards beauty of language and the devotion they breathe. They have deservedly maintained their popularity to the present day. In Languedoc four poets have been cited as the best of the age—Goudelin, Michel, Sage, and Bonnet. This is certainly so in the case of Pierre Goudelin (province Goudouli, 1579–1649), of Toulouse, the most distinguished name in South French literature between the period of the troubadours and that of Jasmin. He had a good classical education, traces of which appear in all his poetry, his language and his manner being always admirable, even where his matter is lacking in depth. He is often called "the Malherbe of the South," but resembles that writer only in form: his poetry, taken as a whole, has far more sap. Goudelin essayed and was successful in almost every short *genre* (*Lou Ramelet Moundi*, 1617, republished with additions till 1678), the piece of his which is most generally admired being the stanzas to Henri IV., though others will prefer him in his gayer moods. He enjoyed enormous popularity (extending to Spain and Italy), but never prostituted his art to cheap effects. His influence, especially but not exclusively in Provence, has been deep and lasting. The fame of Jean Michel, of Nîmes, rests on the *Embarras de la foire de Beaucaire*, a poem of astonishing vigour, but deficient in taste. Daniel Sage, of Montpellier (*Las Foulies*, 1650), was a man of loose morals, which are reflected in nearly all his works: his moments of genuine inspiration from other causes are rare. More worthy of being bracketed with Goudelin is the *avocat* Bonnet, author of the best among the open-air plays that were annually performed at Béziers on Ascension Day: a number of these (dated 1616–1657) were subsequently collected, but none can compare with the opening one, Bonnet's *Jugement de Pâris*. Another very charming poet is Nicolas Fizes, of Frontignan, whose vaudeville, the *Opéra de Frontignan* (1670), dealing with a slight love intrigue, and an idyllic poem on the fountain of Frontignan, show a real poetic gift. A number of Toulouse poets, mostly *lauréats* of the Academy, may be termed followers of Goudelin: of these, François Boudet deserves mention, who composed an ode, *Le trinfe del Moundi* (1678), in honour of his native dialect. The classical revival that may be noted about this time is also generally ascribed to Goudelin's influence. Its most distinguished representative was Jean de Valès, of Montech, who made excellent translations from Virgil and Persius, and wrote a brilliant burlesque of the former in the manner of Scarron (*Virgile deguisat*, 1648; only four books published). He also composed a pastoral idyll, which, though too long and inclined to obscenity, contains much tender description. The greatest of the pastoral poets was François de Cortete (1571–1655), of Prades, whose comedies, *Ramounet* and *Miramoundo* (published, unfortunately with alterations, by his son in 1684), are written with such true feeling and in so pure a style that they can be read with real pleasure. A comedy of his dealing with Sancho Panza in the palace of the Duke is being edited. It is difficult to understand the enormous popularity of Daubasse (1664–1727), of Quercy, who belonged to the working classes; he was patronized by the nobility in exchange for panegyrics. Gascony produced two typical works in the 17th century: Ader's *Gentilhomme gascoun* (1610) and Dastros's *Trinfe de la langue gascoune* (1642). The former depicts a regular boasting Gascon, who distinguishes himself in everything; while the latter is a plea in favour of the Gascon tongue, inspired by a genuine love of country. Gabriel Bedout (*Parterre gascoun*, 1642) is chiefly noted for his amorous *solitari*, called forth by the sufferings he endured from a hard-hearted mistress. Louis Baron (b. 1612), living peacefully in his native village of Pouyloubrin, celebrated it with great tenderness.

In the 18th century the number of authors is much larger, but the bulk of good work produced is not equally great in proportion. The priests are mainly responsible for the literary output of Languedoc. Claude Peyrot (1709–1795), one of them, celebrates his county with true rural spirit in the *Printemps rouergat* and *Quatre Sosous*. But the chief of the band is the Abbé Favre (1727–1783), the prior of Celleneuve, whose *Sermoun de Moussu Sistre*, delivered by a drunken priest against intemperance, is a masterpiece. He also wrote a successful mock-heroic poem (*Siège de Caderousse*), travesties of Homer and Virgil, a prose novel depicting the country

manners of the time (*Histoire de Jean l'ont pris*), and two comedies, which likewise give a vivid picture of the village life he knew so well. Two genuine poets are the brothers Rigaud, of Montpellier: Auguste's (1760–1835) description of a vintage is deservedly famous; and Cyrille (1750–1824) produced an equally delightful poem in the *Amours de Mounpèïé*. Pierre Hellies, of Toulouse (d. 1724), a poet of the people, whose vicious life finds an echo in his works, has a certain rude charm, at times distantly recalling Villon. In the Provence Toussaint Gros (1698–1748), of Lyons, holds undisputed sway. His style and language are admirable, but unfortunately he wasted his gifts largely on trivial *pièces d'occasion*. Coye's (1711–1777) comedy, the *Fiancé paré*, is bright and still popular, while Germain's description of a visit paid by the ancient gods to Marseilles (*La Bourrido dei Dious*, 1760) has considerable humour. In Gascony the greatest poet is Cyrien Despourrins (1698–1755), whose pastoral idylls and mournful chansons, which he himself set to music, are imbued with tenderness and charm (most of them were collected at Pau, in 1828).

The Revolution produced a large body of literature, but nothing of lasting interest. However, it gave an impetus to thought in the South of France, as elsewhere; and there, as elsewhere, it called forth a spirit of independence that was all in favour of a literary revival. Scholars of the stamp of Raynouard (1761–1863), of Aix, occupied themselves with the brilliant literary traditions of the Middle Ages; newspapers sprang up (the Provençal *Bouil-Abaisso*, started by Désanat, and the bilingual *Lou Tambourin et le Menestrel*, edited by Bellot, both in 1841); poets banded together and collected their pieces in volume form (thus, the nine *troubaire* who published *Lou Bouquet prouvençaou* in 1823). Much has been written about the *précurseurs du Félibrige*, and critics are sorely at variance as to the writers that most deserve this appellation. We shall not go far wrong if we include in the list Hyacinthe Morel (1756–1829), of Avignon, whose collection of poems, *Lou Saboulet*, has been republished by Mistral; Louis Aubanel (1758–1842), of Nîmes, the successful translator of Anacreon's Odes; Auguste Tandon, "the troubadour of Montpellier," who wrote *Fables, contes et autres pièces en vers* (1800); Fabre d'Olivet (1767–1825), the versatile *littérateur* who in 1803 published *Le Troubadour: Poésies occitaniques*, which, in order to secure their success, he gave out as the work of some mediæval poet; Diouloufet (1771–1840), who wrote a didactic poem, in the manner of Virgil, relating to silkworm-breeding (*Leis magnans*); Jacques Azaïs (1778–1856), author of satires, fables, &c.; D'Astros (1780–1863), a writer of fables in Lafontaine's manner; Castil-Blaze (1784–1857), who found time, amidst his musical pursuits, to compose Provençal poems, intended to be set to music; the Marquis de Fare-Alais (1791–1846), author of some light satirical tales (*Las Castagnados*). While these writers were all more or less academic, and appealed to the cultured few, four poets of the people addressed a far wider public: Verdié (1779–1820), of Bordeaux, who wrote comic and satirical pieces; Jean Reboul (1796–1864), the baker of Nîmes, who never surpassed his first effort, *L'ange et l'enfant* (1828)[1]; Victor Gelu (1806–1885), relentless and brutal, but undeniably powerful of his kind (*Fenian et Grouman; Dix chansons provençales*, 1840); and, greatest of them all, the true and acknowledged forerunner of the *félibres*, Jacques Jasmin (1798–1864), the hairdresser of Agen, whose poems, both lyrical and narrative, continue to find favour with men of the highest culture and literary attainments, as with the villagers for whom they were primarily intended.

While much of this literature was still in the making, an event took place which was destined to eclipse in importance any that had gone before. In 1845 Joseph Roumanille (1818–1891), a gardener's son, of Saint-Remy (Bouches-du-Rhône), became usher in a small school at Avignon, which was attended by Frédéric Mistral (*q.v.*), a native of the same district, then fifteen years of age. The former, feeling the germs of poetry within him, had composed some pieces in French; but, finding that his old mother could not understand them, he was greatly distressed, and determined thenceforth to write in his native dialect only. These poems revealed a new world to young Mistral, and spurred him on to the resolve that became the one purpose of his life—*de remettre en lumière et conscience de sa gloire cette noble race qu'en plein '89 Mirabeau nomme encore la nation Provençale*. There is no doubt that Mistral's is the more puissant personality, and that his finest work towers above that of his fellows; but in studying the Provençal renaissance, Roumanille's great claims should not be overlooked, and they have never been put forward with more force than by Mistral himself (in the preface to his *Isclos d'oro*). Roumanille's secular verse cannot fail to appeal to every lover of pure and sincere poetry (*Li Margaritedo*, 1836–1847; *Li Sounjarello*, 1852; *Li Flour de Sauvi*, 1850–1859, &c.), his *noëls* are second only to those of Saboly, his prose works (such as *Lou mege de Cucugnan*, 1863) sparkling with delightful humour. He it was who in 1852 collected and published *Li Prouvençalo*, an anthology in which all the names yet to become famous, and most of those famous already (such as Jasmin), are represented. In 1853 he was one of the enthusiastic circle that had gathered round J. B. Gaut at Aix, and whose literary output is contained in the *Roumavagi dei Troubaire* and in the shortlived journal *Lou gay saber* (1854). At the same time the first attempt at regulating the orthography of Provençal was made by him (in the introduction to his play, *La Part dou bon Dieu*, 1853). And in 1854 he was one of the seven poets who, on May 21st, forgathered at the castle of Fontségugne, near Avignon, and founded the *Félibrige*. [The etymology of this word has given rise to much speculation: the one thing certain about the word is that Mistral came across it in an old Provençal poem, which tells how the Virgin meets Jesus in the temple, among the seven *félibres* of the law. The outlines of the constitution, as finally settled in 1876, are as follows: The region of the *Félibrige* is divided into four *mantenenço* (Provence, Languedoc, Aquitaine, and Catalonia[2]). At the head of all is a *consistori* of fifty (called *majourau*), presided over by the *Capoulié*, who is chief of the entire *Félibrige*. The head of each *mantenenço* is called *sendi* (who is at the same time a *majourau*); and at the head of each "school" (as the subdivisions of the *mantenenço* are called) is a *cabiscòu*. The ordinary members, unlimited in number, are *mantenèire*. Annual meetings and *fêtes* are organized. The most widely read of the *Félibrige* publications is the *Armana Prouvençau*, which has appeared annually since 1855, maintaining all the while its original scope and purpose; and though unpretentious in form, it contains much of the best work of the school.[3]] The other

[1] One of his chief titles to fame is that, together with Alphonse Dumas, he drew the attention of Lamartine to Mistral's *Mirèio*. Roumanille and Mistral showed their gratitude by republishing the best pieces of these two *précurseurs*, together with those of Castil-Blaze and others, in *Un Liame de Rasin*, 1865.

[2] One of the most pleasing features of the movement is the spirit of fraternity maintained by the *félibres* with the poets and literary men of northern France, Spain, Italy, Rumania, Germany, and other countries.

[3] In common with so many other productions of the *Félibrige*, this Almanac is published by the firm J. Roumanille, Libraire-Éditour, Avignon.

six were Mistral, Aubanel, A. Mathieu (a schoolfellow of Mistral's at Avignon), E. Garcin, A. Tavan, and P. Giera (owner of the castle). Of these, Théodore Aubanel (1829–1886, of Avignon, son of a printer and following the same calling) has alone proved himself worthy to rank with Mistral and Roumanille. "Zani," the girl of his youthful and passionate love, took the veil; and this event cast a shadow over his whole life, and determined the character of all his poetry (*Lou mióugrano entre-duberto*, 1860; *Li filho d'Avignoun*, 1883). His is, without a doubt, the deepest nature and temperament among the *félibres*, and his lyrics are the most poignant. He has a keen sense of physical beauty in woman, and his verse is replete with suppressed passion, but he never sinks to sensuality. His powerful love drama *Lou pau dou peccat* was received with enthusiasm at Montpellier in 1878, and successfully produced (some years later in Arène's version) by Antoine at his Théâtre Libre—no mean criterion. It is the only play of real consequence that the school has yet produced.

We need not do more than glance at the work of the fourth of the group of poets who alone, amidst the numerous writers of lyrics and other works that attain a high level of excellence, appear to us to have so far secured permanent fame by the magnitude of their achievement. Félix Gras (1844–1891) settled at Avignon in his youth. His rustic epic, *Li Carbounié* (1876) is full of elemental passion and abounds in fine descriptions of scenery, but it lacks proportion. The heroic *geste* of *Toloza* (1882), in which Simon de Montfort's invasion of the South is depicted with unbounded vigour and intensity, shows a great advance in art. *Li Roumancero provençal* (1887) is a collection of poems instinct with Provençal lore, and in *Li Papalino* (1891) we have some charming prose tales that bring to life again the Avignon of the popes. Finally, the poet gave us three tales dealing with the period of the Revolution (*Li Rouge dou Miejour*, &c.); their realism and literary art called forth general admiration.[1]

A few lines must suffice for some of the general aspects of the movement. It goes without saying that all is not perfect harmony; but, on the whole, the differences are differences of detail only, not of principle. While Mistral and many of the best *félibres* employ the dialect of the Bouches-du-Rhône, others, who have since seceded as the *Félibrige latin* (headed by Roque-Ferrier), prefer to use the dialect of Montpellier, owing to its central position. A third class favour the dialect of Limousin, as having been the literary vehicle of the troubadours; but their claim is of the slenderest, for the *félibres* are in no sense of the word the direct successors of the troubadours. Nearly all the leaders of the *Félibrige* are Legitimists and Catholics, their faith being the simple faith of the people, undisturbed by philosophic doubts. There are exceptions, however, chief among them the Protestant Gras, whose *Toloza* clearly reflects his sympathy with the Albigenses. Yet this did not stand in the way of his election as *Capoulié*—a proof, if proof were needed, that literary merit outweighs all other considerations in this artistic body of men. Finally, it may be noted that the *félibres* have often been accused of lack of patriotism towards northern France, of schemes of decentralization, and other heresies; but none of these charges holds good. The spirit of the movement, as represented by its leaders, has never been expressed with greater terseness, force, and truth than in the three verses set by Félix Gras at the head of his *Carbounié*: "I love my village more than thy village; I love my Provence more than thy province; I love France more than all."

[1] Gras was *Capoulié* from 1891 till 1901, succeeding his brother-in-law, Roumanille, who held the office from 1888 till 1891. The first *Capoulié* was, of course, Mistral (1876-1888). Gras's successor was Pierre Devolny, of Die (appointed in April 1901), who has done good work, but has yet to prove himself worthy of the supreme distinction conferred on him by his fellow-poets.

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(H. O.)

Providence, a city of the United States, capital of the state of Rhode Island, is situated at the head of Narragansett Bay, in 41° 49′ 22″ N. and 71° 24′ 48″ W. Its area is 18·29 square miles. Its surface is hilly, rising to the height of 204 feet on the "East Side." The park area is 542 acres. Roger Williams Park (102 acres) is the largest. Its population in 1900 was 175,597, of whom 55,855 were foreign-born and 4817 were negroes. Among 53,131 adult males 3830 were illiterate (unable to write), of whom 3384 were foreign-born. The death-rate in 1900 was 19·9; in 1890 it was 21·1. Brown University, seventh in age of the colleges of the United States, is the chief educational institution. Other institutions are the Rhode Island School of Design, the Rhode Island Normal School, four high schools, the Friends' Boarding School, and the Roman Catholic Academy of the Sacred Heart. The University Library and the Providence Public Library number about 125,000 volumes each. The Providence Athenæum contains 70,000 volumes. Most noteworthy is the library of Americana, now the property of Brown University, begun by John Carter Brown—the most complete collection in the world of books relating to early American history. Of benevolent institutions the most noted are the Dexter asylum for the poor, the Butler hospital for the insane, and the Rhode Island hospital. The oldest edifice for religious purposes is the First Baptist Meeting House, erected in 1775 "for the public worship of Almighty God, and also to hold Commencements in." The largest is the Roman Catholic Cathedral. There are in all 129 places of worship. Of these, 21 are Baptist, 10 Congregational, 14 Episcopal, 18 Methodist, 16 Roman Catholic, 4 Unitarian, 3 Universalist, and 4 Presbyterian. Of public buildings there are the City Hall, the Providence County Court House, and the Rhode Island Normal School. The old State House (1762) is a fair specimen of colonial architecture. The finest building in the city is the State Capitol. With its approaches it cost about $3,500,000. Seven railways, all controlled by one corporation, enter the city. Besides steamboats plying upon Narragansett Bay and to New York, steamships sail regularly to Philadelphia, Baltimore, Norfolk, Savannah, and Kingston, Jamaica. The city is a great distributing centre for central New England.

Providence is one of the great manufacturing centres of the Union. It is the leading city in the manufacture of jewellery, the total product of which in 1900 was valued at $12,719,124. In all industries in 1900 there were 1933 manufacturing establishments, having a capital of $83,513,679, and employing an average number of 42,693 wage-earners, who received wages amounting to $19,998,362. The total products were valued at $88,168,897. Among these products the most important, apart from jewellery, were: worsted goods ($16,603,252), silver ware ($8,884,408), foundry and machine-shop products, rubber and elastic goods,

cotton and woollen goods, and oleomargarine. It is the growth of manufacturing which accounts for the fact that the population, once almost wholly native-born, has received an element of foreigners amounting to almost one-third. In 1899 the valuation placed upon real estate was $146,701,900. Upon personal property the valuation was $41,799,880. The revenue of the municipality was $3,878,439. The net debt 1st April 1900 was $14,008,484. It is a banking centre for a region of mammoth factories. There are nineteen national banks, with a total capital of $15,113,523 and deposits of $14,609,832 ; two state banks, with a capital of $320,000 and deposits of $446,743 ; five trust companies, with a capital of $4,150,000 and deposits of $27,745,108, make a total capital for all banking and trust companies of $19,583,523 and total deposits of $42,801,684. There are five savings banks, with deposits of $38,855,589. The clearings for the year ending 30th June 1900 were $338,132,500. (W. H. MU.)

Provo, a city of Utah, U.S.A., capital of Utah county, at the west base of the Wasatch mountains, on the Provo river, and on the Oregon Short Line and the Rio Grande Western railways, near the east shore of Utah Lake, north of the centre of the state, at an altitude of 4532 feet. It has a level site and a regular plan, and is divided into five wards. It contains the insane asylum of Utah. Population (1880), 3432; (1890), 5159; (1900), 6185, of whom 1176 were foreign-born.

Prussia, the principal state of Germany, ranking first in both area and population, though only twentieth in respect of density of population. More than 5 per cent. of the entire surface of Prussia consists of moorland, some of it high (heathy) moors, some of it (the smaller portion) low boggy moors. Hanover—more particularly the districts of Osnabrück, Stade, Lüneburg, and Aurich (East Friesland) —and Schleswig-Holstein possess between them nearly 3000 square miles of this variety of surface. Another 1100 square miles are in East Prussia; and the rest, about 1500 square miles in all, occur chiefly in the provinces of Pomerania, Brandenburg, Posen, and Saxony. Since 1870 the Prussian Government, as well as the authorities of the province of Hanover, and various private persons, have started several more or less successful schemes for the reclamation of these waste tracts. The region to which the Prussian Government has principally directed its attention is the great Bourtanger Moor, between the Ems and the Dutch frontier, in the north-west of the province of Hanover. There colonies were established as long ago as the first half of the 17th century—Papenburg, for example (1630)—chiefly for the purpose of cutting turf for fuel; and in East Friesland, in the first place at the instigation of Frederick the Great, over eighty similar colonies, aggregating in all 20,000 persons, were planted between 1765 and 1800, but nothing effective was done for the real reclamation of the moorland. But in 1870 the Prussian Government turned its attention to the matter, and proceeded to cut navigable canals through the moorland, and appointed a special commission to deal with its reclamation generally. These efforts received a further impulse from the founding of an experimental station near Bremen in 1877. In consequence of the work done in the laboratory attached to this station, as well as of experiments conducted on the moors themselves, the province of Hanover organized a new system of colonization in 1887. Having bought some 1100 acres beside the main canal which traverses the Bourtanger Moor from north to south, they drained the land and divided it into 25-acre plots, which they granted to occupiers free, with the option of purchase, the principal condition being that the grantees should first reclaim 5 acres. This project proving successful, induced the Prussian Government in 1899 to embark in similar enterprises on the Wiesder Moor (Marcardsmoor) along the line of the Ems-Jade canal, between Aurich and Jade Bay. In 1902 Prussian estimates embraced an item of over £131,000 for these and similar improvements. Other private ventures of some importance have been made at Friedrich-Wilhelmsdorf near Loxstedt, a few miles south-east of Bremerhafen, on the Kehdinger Moor, on the west side of the estuary of the Elbe, in Schleswig-Holstein, and in East Prussia. In 1883 a national society was founded for the reclamation and cultivation of the moorlands of Germany.[1]

Population.—The following table gives particulars of the area and population of the several provinces of the kingdom in the years 1890, 1895, and 1900, as well as the chief religious statistics for 1895 :—

Provinces.	Area in sq. miles.	Population, 1890.	Population, 1895.	Population, 1900.	Density per sq. mile, 1900.	Protestants, 1895.	Roman Catholics, 1895.	Jews, 1895.
East Prussia	14,278	1,958,663	2,006,689	1,996,626	139	1,724,374	266,641	14,364
West Prussia	9,852	1,433,681	1,494,360	1,563,658	159	715,581	758,168	20,238
Berlin (city)	25	1,578,794	1,677,304	1,888,848	75,554	1,426,591	155,363	86,152
Brandenburg	15,376	2,541,783	2,821,695	3,108,554	202	2,681,637	118,265	18,394
Pomerania	11,625	1,520,889	1,574,147	1,634,832	140	1,530,003	31,739	11,661
Posen	11,181	1,751,642	1,828,658	1,887,275	168	561,201	1,227,197	40,019
Silesia	15,561	4,224,458	4,415,309	4,668,857	300	1,980,552	2,384,754	47,593
Saxony	9,747	2,580,010	2,698,549	2,832,616	290	2,498,748	187,559	7,850
Schleswig-Holstein	7,335	1,219,523	1,286,416	1,387,968	189	1,257,454	24,184	3,702
Hanover	14,865	2,278,361	2,422,020	2,590,939	174	2,094,604	311,457	15,065
Westphalia	7,801	2,428,661	2,701,420	3,187,777	409	1,298,852	1,378,676	19,359
Hesse-Nassau	6,058	1,664,426	1,756,802	1,897,981	313	1,224,021	482,752	45,725
Rhine Province	10,420	4,710,391	5,106,002	5,759,798	552	1,434,715	3,610,142	49,018
Hohenzollern	441	66,085	65,752	66,780	151	2,566	62,608	576
Total	134,565	29,957,367	31,855,123	34,472,509	256	20,430,899	10,999,505	379,716

Between 1880, when the total population numbered 27,279,111, and 1900 there was an increase of 7,193,398 persons, or at the rate of 26·4 per cent. per annum. For the period 1890–99 the marriage-rate averaged 8·2 per 1000 inhabitants, the birth-rate 38·1 per 1000, and the death-rate 23·3 per 1000. In respect of illegitimacy, while for the same period the percentage of illegitimate births to total births was as much as 14·25 in the city of Berlin, and between 10 and 11 per cent. in each of the provinces of Pomerania, Brandenburg, and Saxony, the average for the whole kingdom was only 7·76. The densely-peopled manufacturing and mining provinces of Westphalia and the Rhineland have by far the best record in this respect, their averages being 2·61 and 3·87. The present population is concentrated most densely (300 to 552 inhabitants per square mile) in the manufacturing districts of Rhenish Prussia, Westphalia, the adjacent Hesse-Nassau, and in the extreme south-east of the kingdom, the coal and zinc and iron region of Silesia. The average density in the

[1] See the annual *Mitteilungen* of this society (published at Berlin); Fleischer, *Die Besiedelung der nordwestdeutschen Hochmoore* (Berlin, 1894); Rimpau, *Die Bewirthschaftung des Rittergutes Cunrau* (Berlin, 1887); and F. P. Koenig, *Agriculture in Germany* (*Brit. Cons. Report*, Misc. Series, No. 452, 1898).

agricultural provinces of East and West Prussia, Posen, Pomerania, Brandenburg, Saxony, Hanover, and Schleswig-Holstein varies between 139 and 290 inhabitants per square mile, or, roughly, one-half of the density in the manufacturing provinces. According to the census returns of 1900, there were 1031 females for every 1000 males, as compared with 1037 females in 1880. In 1900 there were in Prussia one city with a population exceeding one million inhabitants, seven towns between 200,000 and 500,000; fourteen between 100,000 and 200,000; twenty-four between 50,000 and 100,000; and eighty-nine between 20,000 and 50,000. The emigration decreased from 145,679 in 1881 to 50,461 in 1886; then, after going up to 76,196 in 1892, it rapidly declined to 12,471 in 1900. The number of suicides varies from 5000 to 6500 annually, the average being 19 for every 100,000 inhabitants, or one less than the average for all Germany. In 1890 the island of Heligoland was ceded by Great Britain to Germany, and in the following year it was administratively attached to the Prussian province of Schleswig-Holstein.

Of the total population in 1900, 55·6 per cent. were classed as urban and 44·4 as rural, *i.e.*, as living in places of less than 2000 inhabitants each. In 1895 the foreign residents embraced 63,289 natives of Austria-Hungary, 47,715 natives of Holland, 18,998 of Russia, 24,389 of Denmark, 10,062 of Switzerland, 8120 of Great Britain, 7327 Armenians, 6564 of Belgium, 6301 of Norway and Sweden, and 2127 of France. Adverting to the religious statistics, it will be seen that 64·14 per cent. of the entire population belonged (1895) to the Protestant State Church, 34·53 per cent. to the Roman Catholic Church; and 1·19 were Jews. Of races other than Teutonic the population of Prussia embraced 2,922,475 Slavs (Masurians, Cassubians), 117,637 Lithuanians, 64,254 Wends, and 74,069 Bohemians and Moravians. In 1895, 11,113,794 persons, or 34·9 per cent. of the population, were engaged in agriculture, cattle and sheep breeding, &c.; 12,196,352, or 38·3 per cent., in mining and industry; 3,585,430, or 11·3 per cent., in commerce and trade; 1,671,827, or 5·2 per cent., in the learned professions; 658,896 in domestic service; 261,302 in forestry, fishing, &c.; and 2,002,714, or 6·3 per cent., had no profession.

Agriculture.—Out of the total area of cultivable land in the German empire, fully 66 per cent. belongs to Prussia, namely, 53,002,600 acres (1895). Of this total less than 5 per cent. was divided into farms of less than 5 acres each, 32·14 per cent. amongst farms ranging from 5 to 50 acres, 32·01 per cent. amongst farms ranging from 50 to 250 acres, and the rest amongst farms exceeding 250 acres. The provinces in which large estates (up to 2500 acres and more) are the rule, are Pomerania, Posen, Silesia, East Prussia, Brandenburg, West Prussia, and Saxony, in the order named. The estates of the old landed gentry (*Rittergüter*) of Prussia, taking the estates above 500 acres each, aggregate in all some 13,428,000 acres. Small estates (peasant holdings) prevail principally in the Rhine province, Hesse-Nassau, and Westphalia, and to some extent also in Hanover, Silesia, and Saxony; but large peasant holdings (50 to 250 acres) exist only in Schleswig-Holstein, Hanover, East Prussia, Westphalia, Saxony, and Brandenburg. Notwithstanding the continuous decline in prices, and other drawbacks from which agriculture suffered in all the older countries of Europe during the last quarter of the 19th century, the Prussian farmers have on the whole fairly well maintained their position, owing mainly to the fact that they have been both eager and skilful in availing themselves of the opportunities offered by the progress of agricultural knowledge. One of the latest departures in this field has been the establishment of central stations for the distribution of electric power to the estates in its neighbourhood, the power to be used for driving both fixed and movable machinery (mills, chaff-cutters, threshing machines, ploughs, &c.), for lighting buildings and houses, for cooking and heating, and on large estates for giving signals and conveying orders. The cultivation of the beetroot for sugar has had a far-reaching effect upon Prussian agriculture, especially in the provinces of Saxony, Silesia, Posen, Hanover, West Prussia, Pomerania, Brandenburg, the Rhine Province, and other parts of the kingdom, where the beetroot is extensively cultivated. Owing to the deep cultivation of the soil and the incessant hoeing which the beet crop requires, the three or four crops which follow it are invariably good, and the liability to failure of the immediately succeeding crop is reduced to a minimum. Moreover, the fiscal policy of the Prussian Government has been of first-rate assistance to the Prussian farmer. And hand in hand with the cultivation of the beetroot has gone the cultivation of barley and chicory, crops of scarcely inferior value from the cultivator's point of view. Barley is grown on more than 11¼ million acres. The Prussian province of Saxony produces one-half of the total quantity of chicory yielded every year throughout the empire; the principal centres for its manufacture in Prussia are Magdeburg, Berlin, and Breslau.

The Prussian Government, in conjunction with the provincial authorities, also gives encouragement to the breeding of live stock, which it endeavours to improve by subsidizing and maintaining stud-farms. It is, however, the breeding of horses to which it especially devotes itself, supporting about two dozen stud-farms for this end, of which the most famous are at Trakehnen in East Prussia, at Graditz near Torgau in the province of Saxony, and at Beberbeck between Cassel and Hoxter. The only stud, however, where thoroughbred stallions are kept is at Graditz. The most noticeable features in connexion with the live stock of Prussia are the altogether unusual diminution in the number of sheep (caused in large part by the fall in the price of wool), the even greater relative increase in the number of pigs, and the increase, though at a much smaller rate, in the numbers of the cattle and horses. For instance, sheep in 1873 numbered 19,666,800, but in 1900 not more than 6,989,400. Pigs, however, increased from 4,294,900 in the former year to 10,954,000 in the latter; cattle from 8,639,500 to 10,865,300; and horses from 2,282,400 to 2,913,000.

In the matter of freights also the Government renders material assistance to the Prussian farmer. The State owns the railways, and carries agricultural produce, especially such as is destined for export, at lower preferential rates. See further under *Communications* below.

The crops chiefly grown are potatoes (5,477,095 acres in 1900), hay (8,025,230 acres), beetroot, rye (11,277,340 acres), oats (6,710,930 acres), wheat (2,999,860 acres), and barley (2,205,625 acres). In 1900 some 11,500 acres were planted with tobacco, the yield of which (about 10,000 tons) was valued at £420,000; about 5500 acres were planted with hops. In 1899–1900 there were 308 sugar factories at work, their total production being 1,339,270 tons of sugar; 5103 breweries produced 690,250,000 gallons of beer, and 6331 distilleries produced 67,598,900 gallons of pure alcohol. Wheat is grown more especially in Silesia, Saxony, the Rhine Province, East Prussia, and Hanover; barley in Silesia and Saxony; oats in Silesia, East Prussia, Hanover, the Rhine Province, and the northern provinces generally; potatoes in Silesia, Brandenburg, and Posen; and rye commonly in every province of the kingdom. Brandenburg produces about one-half of the tobacco; the hops are chiefly grown in Posen. Of the entire area about 23 per cent. is covered with forests.

Viticulture.—The principal wine-growing districts of Prussia are the Rheingau and the Rhine Province, though wine is also produced in Silesia, Westphalia, and a few other districts. The valleys of the Nahe, Saar, Moselle, and Ahr all produce excellent wine. The total area planted with vines in 1900 was 45,400 acres, and on this the yield was 6,752,000 gallons, valued at £767,235, as compared with an average of 50,000 acres planted and a yield of 5,500,000 gallons during the period 1880–90. The Prussian State owns several vineyards in the Rhine district, including 240 acres of the choicest vineyards in the Rheingau—Rauenthal, Eltville, Marcobrunn, Steinberg, Erbach, Rüdesheim, and Assmannshausen; and it has also bought several acres of vineyards along the Moselle. During the last two or three years of the 19th century the German vine-growers suffered, in common with vine-growers in other countries of Europe, from the attacks of diseases and insect pests—*e.g.*, *Peronospora viticola*, *Oïdium Tuckeri*, and *Phylloxera vastatrix*. The last named alone has already cost the Imperial Government £400,000 in efforts to stamp it out. This industry, being so near the great mining and manufacturing districts of western Prussia, naturally suffers from the increasing scarcity and dearness of manual labour. These hindrances the vintagers counteract to some extent by forming associations for the co-operative manufacture, storage, sale, and advertising of their wine. The principal school of viticulture in Prussia is at Geisenheim in the Rheingau. The best wines of the Rhine and Moselle region which come into commerce are largely sold by public auction.

Mining and Metal Industries.—Prussia still retains her pre-eminence as the largest producer of coal, zinc, salt, lead, and copper amongst the states of the German empire, though in respect of iron she comes second to Alsace-Lorraine. Of the aggregate German output of coal Prussia now supplies over 93 per cent., namely, the huge total of 101,966,158 tons, valued at £43,912,500 in 1900, as compared with some 47,000,000 tons in 1882, representing an increase of about 117 per cent. Westphalia produces the largest quantity, namely, 42,557,146 tons, valued at £17,958,000,

in 1900; next comes the Rhine Province, that is, the Saar, Aachen, Düsseldorf, and Roer coal-fields, with 29,010,089 tons, of the value of £14,149,500; and then the Silesian coal-field, with 29,596,738 tons, valued at £11,420,500. Since the high prices of 1900 the Prussian Government has spent £1,250,000 in the purchase of coal-fields so as to be independent of market fluctuations, temporary scarcity, and the manipulations of middlemen. The Prussian State is a large owner of mines and salines; these in 1902 were estimated to yield a revenue of 9½ millions sterling. An extremely important *rôle* is played in the coal industry of Prussia by the Rhenish-Westphalian Coal Syndicate, which has its headquarters at Essen, and which from the bulk of its output (about 40 per cent. of the total German output) has succeeded in regulating the production and price of the coal-fields generally. Out of a total output of lignite for the entire German empire of 40,498,019 tons in 1900, Prussia yielded no less than 84 per cent., or a total of 34,007,542 tons, valued at £4,012,900, showing an annual increase of over 24 million tons and of 3½ millions sterling since 1882. Almost the whole of the zinc produced in Germany comes out of the Silesian mines, the amount being 636,068 tons in 1900, valued at £1,279,600, or nearly six times the amount mined in 1882. The iron production of Prussia amounted in 1900 to only 33 per cent. of the aggregate production of Germany, or a total of 4,268,069 tons, valued at £1,884,300, the increase over the output in 1882 being little more than a quarter of a million tons. The chief iron-producing regions are the Rhine Province, Westphalia, Hesse-Nassau, and Silesia. But in the production of lead Prussia enjoys almost an unchallenged monopoly, in that in 1900 she produced 147,042 tons out of 148,257, the value being £890,000; in 1882 the output amounted to 88,300 tons. And the Prussian output of manganese occupies an exactly analogous position, amounting to 58,016 tons, valued at £33,000, out of 59,204 tons. In the same year 169,447 tons of pyrites, valued at £60,750, and some cobalt were mined. Salt, one of the most valuable of the mineral products of the country, was in its various forms, but principally in the form of rock-salt, obtained to the extent of 2,476,867 tons, valued at £1,410,650, in 1900, as compared with some 550,000 tons in 1882. Ordinary salt is mined principally in the province of Saxony (Stassfurt, Aschersleben, Erfurt, Halle, Merseburg, Sangerhausen), the kali salts near Magdeburg, and Glauber salts in the Rhine Province and Hesse-Nassau. The furnaces, forges, salt-works, and similar establishments for the conversion of the raw ores into manufactured or semi-manufactured products yielded in 1900 5,781,892 tons of pig iron, valued at £19,118,400, as compared with a yield of 2,467,500 tons, valued at £7,490,000, in 1882; 155,760 tons of zinc, valued at £3,102,600; 112,170 tons of lead, of the value of £1,880,300; copper to the extent of 27,157 tons and the value of £2,069,700; silver to the extent of 6,920,150 oz., valued at £1,084,350, approximately equivalent in value to the output twenty years earlier; and 566,368 tons of sulphuric acid, valued at £727,350. The iron was worked principally in the districts of Arnsberg, Düsseldorf, Oppeln in Silesia, Treves, and Coblenz, and gave employment to 25,686 hands; the zinc, for the most part near Oppeln in Silesia, the number of hands employed being 10,779; the lead and the silver near Aachen, Oppeln, and Wiesbaden, the hands employed numbering 2716; and the sulphuric acid in all the mining districts, as well as near Potsdam, Breslau, Magdeburg, and Merseburg, and the number of hands 2969. Further, a total of 203,700 persons were employed in some 1000 foundries, puddling-mills, rolling-mills, and so forth, and they produced iron and steel materials to the weight of 1,612,000 tons and a combined value of £13,383,150. Petroleum (27,731 tons in 1900) is extracted to a limited extent at a couple of places in the province of Hanover. Down to 1899, in which year the monopoly was bought out by the Prussian Government, 150 to 250 tons of amber were mined in East Prussia. A little is also collected on the coast near Pillau.

Other Manufacturing Industries, Commerce.—During the last quarter of the 19th century Prussia developed into a great manufacturing country. Between 1882 and 1895 it was estimated that the number of persons employed in manufacturing and kindred pursuits increased in the aggregate at the rate of 34¼ per cent., but the number employed in trade and commerce increased at a vastly greater rate, namely, 60½ per cent., or from 771,323 in the first-mentioned year to 1,237,882 in 1895. Amongst the causes which have been mainly instrumental in fostering the industrial development in Prussia are those which have also contributed to the progress of Prussian agriculture, such as the fostering care of the Government (at once energetic, comprehensive, and watchful), co-operation and organization, which has been immensely facilitated by the habits of prompt obedience and order learnt in the course of the military training; the generally high intellectual level and technical and artistic skill of the workmen, due in part to the enforcement of sound elementary education and in part to the fostering care of the excellent technical high schools, trades "continuation schools," and hosts of special schools in which the arts and crafts are thoroughly and systematically taught; the use made of scientific discoveries and the power of taking advantage of scientific progress generally; the national aptitude for giving conscientious attention to minutiæ, and for thoroughness and mastery of detail; the extensive employment of commercial travellers, having command of languages, in all parts of the world; and an earnest desire to find out and meet the wants and tastes of customers. Moreover, the social and economic conditions of the people have been in their favour. Wages have on the whole been lower than, for example, in England, though since 1896 they have shown a strong upward tendency, and the standard of comfort, and even in many cases the standard of living, has been lower. Litigation, too, is more expeditious and less costly. But the Prussian manufacturer has derived no small measure of advantage from the fact that he has come into the field somewhat later than his foreign rivals. He has been enabled to utilize their experience, to profit from their drawbacks, faults, and deficiencies, and to make a clean start in the light of this extremely valuable acquired knowledge. And his interests have also been materially promoted by the commercial and fiscal policies of his Government.

The chief industrial districts are, of course, those which yield coal, with, in addition, the great cities—Berlin, Magdeburg, Hanover, Breslau, Görlitz, Stettin, Essen, Dortmund, Elberfeld-Barmen, Düsseldorf, Cologne, Aix-la-Chapelle, Crefeld, Halle, Hanover, Frankfort-on-the-Main, Saarbrücken, Höchst, Solingen, Remscheid, Hagen, Königsberg, Danzig, and many others. The iron and metal industries, especially the making of machinery, electrical plant, tramway plant, and the production of articles in wrought copper and brass, rank in the very forefront, not only in virtue of their magnitude, but also because of the remarkable rate at which they have increased and grown. In these branches Berlin, and more lately its suburbs, as well as Magdeburg and Cologne, have played an active *rôle*, though the old centres of the metallurgical and iron and steel industries in the Rhine Province and Westphalia have also expanded in an extraordinary degree. The growth of the chemical industries, which are essentially a German speciality, must also be mentioned in the front rank. The genius of men like Liebig, Wöhler, Bunsen, Runge, Hofmann, Böttiger, Kekulé, Fischer, and their pupils has made the German chemical manufacturer pre-eminent in his own special lines throughout the world. The branches in which his supremacy stands unrivalled are those which produce aniline dyes, artificial indigo, illuminants (acetylene gas, Welsbach mantles, &c.), explosives, various chemical salts, pharmaceutical preparations, cellulose, glycerine, artificial (chemical) manures, and perfumes.[1] A third branch of industry in which German genius has won triumphs of the very highest kind is shipbuilding. Here the advance has been materially assisted by the admission free of duty of materials needed for the building of ships, preferential low railway rates for the carriage of materials of native German origin, and by an indirect bounty on shipments made to the Levant, East Africa, and elsewhere, in German-built, or at least German-owned, vessels.

Communications.—Between 1880 and 1886 the State-owned lines of railway increased by 9240 miles, the increase being principally due to the policy of buying up private lines; and since 1886 there has been a further increase of 6000 miles. By law the Prussian State enjoys the right to buy up lines privately constructed after an interval of 30 years, though in many cases the interval has been shortened to 15 or even 10 years. In 1900 the State lines amounted to a total of 18,859 miles, with about 950 in process of construction; and the private lines to 1872 miles. The former total includes 590 miles in Hesse-Darmstadt, the railways of this grand-duchy having been incorporated with the Prussian railways in 1896. The building of the railways in Prussia has in almost every case been determined, or at any rate influenced, by military requirements; and this applies also to the making of private lines. The most important trunk line of Prussia is that which enters the western frontier at Herbesthal, and runs through Cologne, Düsseldorf, Hanover, Berlin, Dirschau, and Königsberg, and leaves the eastern boundary at Eydtkuhnen for St Petersburg. Generally speaking, the principal lines of the country either radiate from Berlin or run alongside the frontiers and boundaries. To the former category belong the lines which connect the capital with Hamburg and Kiel, with Stettin, with Danzig and Königsberg, with Posen and Breslau (dividing at Frankfort-on-Oder), with Dresden, with Leipzig and Bavaria, with Frankfort-on-the-Main *viâ* Halle and Erfurt, with Coblenz *viâ* Cassel, and with Cologne *viâ* Magdeburg and Brunswick. The second category embraces lines from Hamburg to Stettin, from Stettin to Posen and Breslau, and from Breslau to Halle; the ring is again taken up at Frankfort-on-the-Main, and continues up the Rhine (on both banks) to Cologne, and thence through Münster and Bremen to Hamburg. Besides these there are two other

[1] See Dr Frederick Rose, "Chemical Instruction and Chemical Industries in Germany, 1901–02," being Nos. 561 and 573 of the *Miscellaneous Series of British Diplomatic and Consular Reports.*

important lines, one connecting Hamburg with Frankfort-on-the-Main *viâ* Hanover and Cassel, the other linking Hanover with Halle. The capital invested in the State railways of Prussia increased from £7,211,150 in 1854 to £311,878,540 in 1889, and to £390,550,100 in 1899 (including £12,369,800 for the Hessian railways). In the last-mentioned year the expenditure amounted to £38,816,820 and the revenue to £66,987,740, showing a net profit of £28,170,920, or sufficient to pay interest at the rate of 7¼ per cent., as compared with 2¼ per cent. in 1854 and 6¼ per cent. in 1889. The estimated revenue from the State railways for the year 1902–03 was put at £70,602,000, against which there were expected to rank an ordinary expenditure of £44,188,000, and an extraordinary expenditure of £4,582,000. Besides these, "light railways" have been built in increasingly greater numbers since 1892. In this year they totalled 643 miles, but in 1900 reached a length of about 4350 miles, the capital invested in them amounting to nearly 30¼ millions sterling. Prussia possesses also an extensive and admirably arranged system of natural and artificial waterways, and the latter are being constantly extended and improved. For instance, in the period 1880–93 the Prussian Government spent no less than £11,677,750 upon the maintenance and construction of locks, canals, canal buildings, bridges, roadways, &c. Besides this there was a special vote of £6,197,600 for the construction of the Dortmund-Ems Canal and the improvement of the navigation of the Oder, Vistula, Spree, and other waterways in Brandenburg. The most important of the canals recently constructed, or still under construction, are the North Sea and Baltic Canal (officially the Emperor William Canal), the Trave-Elbe Canal (to give Lübeck access to the Elbe), the Dortmund-Ems Canal, and its continuation, the Dortmund-Rhine Canal, both intended to serve the coal and iron districts of Westphalia and the Rhineland; and there are also projects, which have not yet taken definite shape, for constructing a canal between Stettin and Berlin, another between Kiel and the Elbe *viâ* the Plon lakes, and a gigantic scheme known as the Midland Canal for connecting the rivers Rhine, Elbe, Weser, and Oder. The object of this last is avowedly to facilitate the transmission of the corn and other agricultural food products of the east of the kingdom to the populous manufacturing districts of the west. The mercantile marine of Prussia amounted in 1900 to 2074 vessels of an aggregate of 406,657 register tonnage. The largest ship-owning ports are Flensburg, Stettin, Kiel, Rostock, and Danzig; and Geestemünde owns the largest deep-sea fishing fleet. (Compare also HAMBURG.) The harbours of the kingdom were in 1898 entered by 61,329 sea-going vessels of 7,310,013 tons. The bulk of this traffic belonged to the ports of Danzig, Königsberg, Stettin, Rostock, Kiel, Altona, and Geestemunde. Sassnitz, Norddeich, Heligoland, Norderney, and Warnemünde all have heavy passenger traffic.

Education.—All fees are now entirely abolished in the elementary schools. The subjoined table gives statistics of the schools and universities of the kingdom in the years named:—

Institution.	No.	Teaching Staff.	No. of Students or Pupils.
Universities (1900)	11	1,503	17,407
Classical and pro-classical schools (1897–98)	327	4,994	95,196
Mixed classical and modern schools, and higher modern schools (1897–98)	145	2,170	46,214
Modern schools (1897–98)	106	1,139	27,820
Elementary schools (1896)	36,138	82,182	5,236,826
Private elementary schools (1896)	404	...	17,876
Middle schools (1896)	1,703	5,615[1]	225,497
Normal schools (1897)	126	929	11,782

The total number of children of school age (six to fourteen years) in 1896 was returned as 5,654,918. The number of public elementary schools increased from 32,613 in 1878 to 36,138 in 1896. The steady progress of education is attested by the decrease in the percentage of illiterates amongst the military and naval recruits in the annual levy, the decrease going from 2·33 per cent. in 1880 to 0·1 per cent. in 1900.

Finances.—As in all civilized countries, the national accounts of Prussia expand by leaps and bounds, and they do this in spite of the advantage which the State derives from the possession of valuable revenue-yielding properties. Of these the most important are the railways. Next in point of revenue come the mines and salines, with an estimated yield in 1902–03 of 9½ millions sterling. Then follow the State forests, yielding over 4 millions sterling in the same year, and the landed domains, yielding about £1,300,000, though the income from this source is rapidly decreasing as agriculture declines. For 1902–03 the public revenue was estimated at £130,708,360 and the expenditure at the same, as compared with a revenue and expenditure of £86,981,000 in 1890, equivalent to an increase of 66½ per cent. in 12 years. The principal sources of revenue are the railways, £70,816,400 (1902); domains and forests, £5,354,000; State lottery, £4,413,200; mines, £9,529,700; direct taxes (principally income-tax), £10,705,000; indirect taxes, £4,360,850; administrative receipts, £6,995,350; and from the general financial control, £18,806,500. The chief items of the expenditure consist of payments for religion and education, £9,529,700; for justice, £6,061,700; expenses of administration, including £44,188,000 for working the State railways, £67,050,900; interest, &c., on public debt, £13,923,170; the matricular contribution to the imperial exchequer, £17,395,600; the ministry of finance, £5,771,750; and the ministry of the interior, £3,880,300. The minimum of income upon which income-tax is levied was raised from £21 to £45 in 1883, and the sum total of incomes liable for income-tax increased from £286,200,000 in 1892–93 to £338,750,000 in 1898–1899, and the number of income-tax payers from 2,435,858 in the former year to 2,907,000 in the latter. The public debt grew from £64,363,000 in 1872 to £329,584,000 in 1900. The greater part of this debt has been incurred in the purchase of the State railways. In 1898–99 there were in all 8,024,928 savings bank books, the number having doubled since 1883; and the deposits standing to their credit amounted to £15,757,000, or an average of £1 19s. 3d. per head.

[1] In the public middle schools only.

AUTHORITIES.—In addition to the sources already quoted, see *Landeskunde Preussens*, Berlin, 1901, edited by BEUERMANN.—Various volumes of *Forschungen zur Deutschen Landes- und Volks-Kunde*, edited by KIRCHHOFF.—*British Diplomatic and Consular Reports*, especially Nos. 452, 454, 490, 559, 561, 573, and 574 of the Miscellaneous Series; and JAMES BAKER, *Report on Technical and Commercial Education in East Prussia*, &c. London, 1900.

(J. T. BE)

Prussia, Rhenish, a province of Prussia, with an area of 10,423 square miles and a population of 5,759,798 (1900), ranking seventh in point of area, but first in point of population, amongst the provinces of the kingdom. The density works out at 552 inhabitants to the square mile. Like Westphalia, it is a great producer of coal and other minerals. The chief seats of the coal-mining are the vicinity of Düsseldorf, Saarbrücken and the valley of the Saar, and Aix-la-Chapelle. The total number of hands employed is 111,444 (1900). The statistics of the mines production in 1900 were as follows:—29,010,100 tons of coal, valued at £14,149,500; 5,162,400 tons of lignite, valued at £590,500; 1,158,120 tons of iron ore, valued at £659,050; 62,470 tons of zinc, valued at £275,150; 41,740 tons of lead, valued at £303,400; 51,330 tons of manganese, valued at £26,400; and 3660 tons of copper, valued at £6650: or, in all, 35,489,820 tons of minerals, valued at £16,010,650. The salt-works and smelting furnaces yielded 5131 tons of salt, valued at £3850; 24,660 tons of Glauber salts, valued at £29,850; 2,915,614 tons of iron, valued at £955,060; 38,709 tons of zinc, valued at £810,400; about 47,484 tons of lead, valued at £799,000; 1,986,730 ounces of silver, valued at £312,850; and 136,426 tons of sulphuric acid, valued at £168,050; and the forges, foundries, &c., turned out iron bars, ingots, pig-iron, &c., to the value of £25,222,100. Vines are extensively cultivated, approximately 300,000 acres being planted with vineyards, and the produce amounts annually to 5 or 6 million gallons of wine. The live stock in the same year numbered 1,156,388 cattle, 892,522 pigs, 174,201 sheep, and 190,294 horses. The sugar factories and refineries produced 53,504 tons of sugar, and the breweries, 127,182,000 gallons of beer. Co-operation is made extensive use of by the cultivators of the soil in this province, there being in 1898 some 65 farmers' associations, besides nearly 200 special associations for horse-breeding, gardening, bee-keeping, viticulture, &c. There are also nearly 120 co-operative farming societies, and 700 "co-operative casinos" for supplying their members with feeding stuffs, artificial manures, machinery, and seeds. (See further under PRUSSIA.) See *Brit. Cons. Reps.*, Nos. 452 and 454 (1898).

Prussia, East, the most north-easterly province of Prussia, with an area of 14,282 square miles, and population (1900), 1,996,626, giving 139 inhabitants to the square mile. (See further under PRUSSIA.) The live stock in 1900 numbered 1,061,221 cattle, 839,934 pigs, 622,236 sheep, and 458,063 horses. The sugar factories in the same year produced 10,440 tons of sugar; the iron foundries, goods to the value of £29,000; the breweries, 26,884,000 gallons of beer; and the distilleries (including those of West Prussia), 8,971,200 gallons of pure alcohol. The mercantile marine consisted in 1900 of 33 sea-going vessels of 15,135 tons.

Prussia, West, a north-easterly province of Prussia, with an area of 9854 square miles, and population (1900), 1,563,658. In 1899–1900 the sugar factories produced 102,670 tons of sugar; the breweries, 17,644,000 gallons of beer. (For the distilleries, see PRUSSIA, EAST.) The live stock in 1900 numbered 618,423 sheep, 637,667 cattle, 626,828 pigs, and 243,118 horses. The mercantile marine of the province in 1900 consisted of 57 vessels of 29,045 tons. (For further particulars, see under PRUSSIA, above.)

Przemyśl, a strongly fortified town in Galicia, Austria. There is a strong garrison of 8514 men, composed of all arms, including 4 regiments of artillery. The industries comprise the manufacture of machinery, liqueurs, and spodium or tutty, the refining of naphtha, corn-milling, and the sawing of timber. The trade is chiefly in timber, corn, leather, and linen. Population (1890), 35,209; (1900), 46,349.

Pskoff, a government of north-west Russia, lying to the south of St Petersburg. It has an area of 17,069 square miles, and a population of 895,710 in 1881 and of 1,136,540 in 1897, when there were 584,931 women in the province, and the urban population numbered only 72,623. With the exception of some 10,000 Esthonians, the inhabitants are almost entirely Great Russians. They mainly belong to the Greek Orthodox Church, but Nonconformity is widely spread, the official number of Nonconformists, 32,066, being far below the mark. There are also about 12,000 Lutherans and 4000 Catholics. The government is divided into eight districts, the chief towns of which are Pskoff (see below), Kholm (5899 inhabitants), Novorzheff (2847), Opochka (5658), Ostroff (6252), Porkhoff (5573), Toropets (7489), and Velikiya Luki (8481). There were in 1896 only 518 schools, attended by 22,601 boys and 6236 girls. In 1887 the peasantry owned 4,114,400 acres of land, and 5,312,000 acres belonged to private owners, 366,100 acres to the Crown, 108,200 acres to the clergy, and 78,000 to various institutions. Since that time the conditions have considerably changed; between 1875 and 1896 the peasantry increased their possessions by 91 per cent., and the merchants bought considerable areas from the nobles, who altogether sold 43 per cent. of their estates. Although the soil is far from fertile, no less than 3,670,600 acres were under crops in 1900, and 1,359,600 acres were under meadows; the average annual yield from 1895 to 1899 was 97,000 cwt. of wheat, 4,003,000 cwt. of rye, 1,963,000 cwt. of oats, 756,000 cwt. of barley, and 4,160,000 cwt. of potatoes. Grain has to be imported, but oats are exported. Owing to the efforts of the *zemstvos*, there has been a notable improvement in agriculture, especially as regards dairy-farming. Flax is an important crop, producing on an average 86,200 quarters of linseed and about 48,000 tons of flax annually. Live stock in 1897 included 190,090 horses, 412,220 horned cattle, and 328,700 sheep. Fishing in Lake Pskov and the smaller lakes is a source of income, yielding about £40,000 annually. The manufacture of wooden goods for local needs, shipbuilding, the timber trade, and the weaving of linen and woollens for local requirements are additional sources of income; but factories are few, giving employment to less than 10,000 persons, and having an annual output valued at about £1,000,000.

Pskoff, the capital of the above government, situated on Velikaya river, 171 miles by rail south-west of St Petersburg. It has a lyceum for boys and another for girls, a cadets' school, a normal school for teachers, and a few lower technical schools, attended in 1896 by 2344 boys and 1138 girls, as also a few scientific societies. Its industries are insignificant, and its chief trade is in flax. In 1897 it had a population of 30,424.

Psychical Research.—"Psychical research" may be defined, partially, as an examination into the amount of truth contained in world-wide superstitions. Thus when Saul disguised himself, before his seance with the Witch of Endor, and when Crœsus scientifically tested the oracles of Greece (finding clairvoyance or *lucidité* in the Delphic Pythoness), Saul and Crœsus were psychical researchers. A more systematic student was the Neo-platonist philosopher Porphyry. In his letter to Anebo, answered by Iamblichus, we find Porphyry concerned with the usual alleged phenomena—prophecy; the power of walking through fire unharmed; the movements of inanimate objects, untouched; the "levitation" of "mediums"; apparitions of spirits, their replies to questions, the falsehood of those replies; and so forth. Similar phenomena fill the lives of the saints, and the records of witch trials. Apparitions, especially of the dying or the dead; the stereotyped disturbances in haunted houses; and the miraculous healing of diseases, are current in classical and mediæval records. The exhibition of remote or even future events, to gazers in mirrors, crystals, vessels full of water, or drops of ink or blood, are equally notorious in classical, Oriental, mediæval, and modern literature, while the whole range of these phenomena is found in Chinese, Japanese, Hindu, ancient American, Red Indian, and savage belief.

At various periods, and in proportion to the scientific methods of the ages, attempts have been made to examine these things scientifically. St Augustine wrote on the whole topic with remarkable acuteness and considerable scepticism; his treatment of miracles of healing is especially noteworthy. After Thyræus, S. J. Wierus, Lavater, and other authors of the 16th century, came the labours of Glanvil, Henry More, Richard Baxter, Boyle, Cotton Mather, and others in England and America, during and after the Restoration. Attempts were made to get first-hand evidence, and Glanvil investigated the Knocking Drummer of Tedworth *in situ* (1663). The disturbances in the house of the Wesleys at Epworth (1716 and later) were famous, and have copious contemporary record. David Hume believed himself to have settled questions which, when revived by the case of Swedenborg and the experiments of Mesmer and his pupils, puzzled and interested Kant. The influence of Mesmer has never died out; the fact of "animal magnetism" (with such examples as the "divining rod," and the phenomena in general) was accepted, in his manner, and explained, by Hegel. The researches of Braid (*circa* 1840–50) gave a new name, "hypnotism," to what had been called "mesmerism" or "animal magnetism," a name conveying no theory of "magnetic" or other "fluids." "Mesmerism" implies a theory of "emanations" from the operator to the patient; "hypnotism" implies no such hypothesis. In the middle of the 19th century Dr Gregory and Dr Mayo published their entertaining but unsystematic works on *Animal Magnetism* and *The*

Truths in Popular Superstitions. Esdaile and Elliotson were practical pioneers. The epidemic of "spiritualism" and of "turning tables" then invaded Europe from America, and was discussed by Dr Carpenter, Faraday, Gasparin, De Morgan, and many others. The adventures of Daniel Dunglas Home excited all Europe, and his effects were studied by Sir William Crookes with especial attention. Home disappeared after a law-suit; his arts seemed to have induced a wealthy widow to endow him with funds which a jury obliged him to restore. His successes remain an unsolved enigma. Believers explained them by the agency of the spirits of the dead, the old savage theory. He had many followers, most of whom, if not all, were detected in vulgar impostures. Of the books of this period those of Mr Richard Dale Owen are the most curious, but exact method was still to seek.

In 1882 the Society for Psychical Research, under the presidency of the late Mr Henry Sidgwick, professor of moral philosophy in the University of Cambridge, was founded, expressly for the purpose of introducing scientific method into the study of the "debatable phenomena." Other early members were the late Mr Edmund Gurney, the late Mr F. W. H. Myers, Professor Barrett, Mrs Sidgwick, Mr Podmore, Lord Tennyson, Lord Rayleigh, and Professor Adams, while among presidents were Professor Balfour Stewart, Mr A. J. Balfour, Professor William James of Harvard, and Sir William Crookes. The society has published many volumes of *Proceedings;* it has an American branch; in France is L'Institut Psychologique; and in Germany and Italy many men of distinguished scientific position have examined the Italian "medium" Eusapia, and have contributed experiments, chiefly in the field of hypnotism and "telepathy." That study has been introduced into official experimental psychology and medicine with some success.

It is plain that the range of psychical research is almost unlimited. It impinges on anthropology (with its study of the savage theory of spirits—animism—and of diabolical possession), and on the usual province of psychology, in the problems of the hallucinations both of morbid patients and of people in normal mental health. The whole topic of the unconscious or subconscious self is made matter not of mere metaphysical speculation (as by Kant and Hamilton), but of exact observation, and, by aid of hypnotism and automatism, of direct experiment. The six original committees of the society undertook the following themes:—

1. An examination of the nature and extent of any influence which may be exerted by one mind upon another, apart from any generally recognized mode of perception.
2. The study of hypnotism and the forms of so-called mesmeric trance, clairvoyance, and other allied phenomena.
3. A critical revision of Reichenbach's researches into certain organizations called "sensitive."
4. A careful investigation of any reports, resting on strong testimony, regarding apparitions at the moment of death or otherwise, or regarding disturbances in houses reputed to be haunted.
5. An inquiry into the various physical phenomena commonly called spiritualistic, with an attempt to discover their causes and general laws.
6. The collection and collation of existing materials bearing on the history of these subjects.

To these themes we might now add the study of "crystal gazing," and of the hallucinatory visions which a fair percentage of people observe when staring into any clear deep, usually a glass ball; but ink (with some experimenters) does as well, or a glass water-jug. Of these themes, the third has practically led to nothing. The experiments of Reichenbach on the perception of flames issuing from magnets have not been verified, though quite recently a hopeful case is reported. The collection of historical examples, again (6), has not been much pursued by the society, except in Mr Gurney's studies of witchcraft in *Phantasms of the Living*, by himself, Mr Podmore, and Mr Myers. On the other hand, a vast number of experiments were made in "thought transference." (1) Diagrams drawn by A were reproduced by B; cards thought of, numbers, and so forth, were also reproduced in conditions that appeared to make the normal transference of the idea by sound, sight, or touch impossible, and to put chance coincidence out of court. In one or two instances collusion was detected ingeniously. In others two explanatory theories have been broached. People may accidentally coincide in their choice of diagrams, or the "unconscious whispering" of a person fixing his mind hard on a number, card, or what not may be heard or seen. But coincidence in diagrams does not apply when a ship, dumb-bells, a candlestick, or a cat is drawn by both experimenters; nor can "unconscious whispering" be heard or seen when the experimenters are in different rooms. On the whole, the inquirers convinced themselves that one mind or brain may influence another mind or brain through no recognized channel of sense. This is, of course, an old idea (see Walton's *Life of Donne*, and his theory of the appearance of Mrs Donne, with a dead baby, to Dr Donne in Paris). The method of communication remains a problem. Are there "brain waves," analogous to the X-rays, from brain to recipient brain, or does mind touch mind in some unheard-of way? The former appears to be the hypothesis preferred by Sir William Crookes and Professor Flournoy (*Des Indes à la Planète Mars*, pp. 363–365). On this showing there is nothing "supranormal" in "telepathy," as it is called. The latter theory of "a purely spiritual communication" is argued for by Mr Myers (*Proceedings of the Society for Psychical Research*, vol. xv. pp. 407–410). If we accept telepathy as experimentally demonstrated, and regard it as a *physical* process, we reduce (4), "apparitions at the moment of death or otherwise," to a normal though not very usual fact. Every one would admit this in the case of mere empty hallucinations. A, in Paisley, sees P, in London, present in his room. P is neither dying nor in any other crisis, and A is, as both continue to be, in his normal health. Such experiences are by no means very uncommon, when there is nothing to suggest that P has exercised any telepathic influence on A. On the other hand, in *Phantasms of the Living*, and in the Report on the Census of Hallucinations (*Proceedings*, vol. x.), the society has published large numbers of "coincidental" hallucinations, the appearance of P to A coinciding with the death or other crisis of the distant P. That such "wraiths" do occur is the popular and savage belief. But, it may be urged, many hallucinations occur and many deaths. People only remember the hallucinations which happened, or were made by erroneous reckoning to seem to happen, coincidentally with the decease of the person seen. This is not quite true, for a hallucination so vivid as to be taken for a real person, and addressed as such, is not easily forgotten by a sober citizen, even if "nothing happened" afterwards. None the less, the coincidental hallucinations have certainly a better chance of being remembered, while fancy is apt to exaggerate the closeness of the coincidence. Nothing can demonstrate that coincidences between death and hallucination occur more frequently than by the doctrine of chance they ought to do, except a census of the whole population. In the present indifference of Government to psychical science

no party is likely to institute such a census, and even if it were done, the frivolity of mankind would throw doubt on the statistics. It would be necessary to cross-examine each "percipient," and to ask for documentary or other corroborative evidence in each case.

The Society for Psychical Research collected statistics in proportion to its resources. More than 17,000 answers were received to questions rather widely circulated. The affirmative respondents were examined closely, their mental and physical health and circumstances were inquired into, and collectors of evidence were especially enjoined to avoid selecting persons likely to return affirmative replies. There were eighty cases at first hand in which the death of the person seen coincided, within twelve hours, with the visual hallucination of his or her presence, out of 352 instances of such hallucinations. By way of arriving at the true proportions, the hallucinations which coincided with nothing were multiplied by four. In this way allowance was made for obliviousness of non-coincidental hallucinations. The verdict of the committee was that, on the evidence before them, hallucinations coincided with deaths in a ratio of 440 times more than was to be expected by the law of probabilities. The committee came to the conclusion that a relation of cause and effect does exist between the death of A and the vision of A beheld by P. The hallucination is apparently caused from without by some unexplained action of the mind or brain of A on the brain or mind of P. This effect is also traced, where death does not occur, for example, in the many instances of false "arrivals." A is on his way to X, or is dreaming that he is on his way, and is seen at X by P, or by P, Q, and R, as may happen. These cases are common, and were explained, in Celtic philosophy, by the theory of the "Co-Walker," a kind of "astral body." The facts are accounted for in the same way by Scandinavian popular philosophy. Doubtless in many instances such hallucinations are the result of expectancy in the beholder. Where the arrival is not expected, this explanation fails. In "second sight," even among savages, these occurrences are not infrequent, and doubtless admit of an explanation by telepathy. In two instances, known at first hand to the present writer, persons dreamed, at a distance, that they entered their own homes. In one the person was seen, in the other distinctly heard, by the inmates of his or her house. In several of these examples knocks are heard, as in spiritualist seances. In fact, if we accept the evidence, living but remote persons may, unconsciously, produce effects of sound and of phantasms exactly like those which popular belief ascribes to the spirits of the dead.

If we admit the evidence, of which a great body exists, and if we attribute the phenomena to telepathy, curious inferences may be drawn. Thus if the phenomena are such as only the spirits of the dead could be credited with producing—if the dead were frequently recognized by various good witnesses—it would follow (on the hypothesis of telepathy) that telepathy is not a *physical* process caused by material waves or rays from living brain to brain, the dead having no brains in working order. On the other hand, if living brains may thus affect each other, the subjective hallucination of the living A may conceivably be "wired on" to the living P. Thus A, in a given house, may have a mere subjective hallucination of the presence of the dead P, and may, unconsciously, infect with that hallucination other persons who come to the house. Thus once admit that any living brain may infect any other, and it becomes practically impossible for a spirit of the dead to prove his identity. Any information which he may give in any way must either be known to living people, however remote, or unknown. If known to a living person, he may, unconsciously, "wire it on" to the seer. If wholly unknown to everybody, the veracity of the information cannot be demonstrated, except later, when it refers to the unknown future. Thus the theory of telepathy, with a little goodwill, puts the existence and activity of the souls of the dead beyond possibility of proof.

These remarks apply to the researches of the society into alleged isolated phantasms of the dead, and into "haunted houses." As to the former cases, it is admitted on all hands that sane and sober people may have subjective hallucinations of the presence of living friends, not dying or in any other crisis. Obviously, then, the appearance of a dead person may equally be an empty hallucination. Thus, a member of the House of Commons, standing at the entrance of a certain committee-room, saw another member, of peculiar aspect and gait, pass him and enter the room, his favourite haunt. Several hours passed before the percipient suddenly recollected that the other member had been dead for some months. Even superstition cannot argue that this appearance was a ghost. In the same way Hawthorne, the celebrated novelist, frequently saw a dead club-man in his club. But suppose, for the sake of argument, that at intervals members of the House kept seeing these appearances of dead Members of Parliament, and suppose that they had never seen the prototypes in their lifetime, but yet correctly described them: then it might be said that their hallucinations had merely been "wired on" from the brain of some living Member of Parliament who knew the deceased.

Thus telepathy cuts two ways. It is, if accepted, a singular discovery, but it throws an enormous burden of proof on a "ghost" who wants to establish his identity. In the same way telepathy cuts at the root of "clairvoyance," or lucid view of events remote in space or distant in time. The vision may have been "wired on" telepathically by a living person who knew the remote event. The "supranormal" can only be proved if the information conveyed by the hallucination is verified in the future, or is proved by the finding of documents not known to exist at the time of the hallucination, but afterwards discovered. A curious possible instance was the discovery, in 1856, of a MS. inventory of the jewels of Mary Stuart (1566), verifying in some degree a clairvoyant vision about the jewels published some years earlier (see "Queen Mary's Jewels" in the writer's *Book of Dreams and Ghosts*). For the same reasons, the information nominally given by "spirits" of the dead through the mouth or by the automatic writing of Mrs Piper (Boston, U.S.) and other mediums may be explained by telepathy from the living who know the facts. This theory is rejected, for example in the case of Mrs Piper, by Mr Myers and Dr Hodgson, who have devoted much time to the examination of the lady (see *Proceedings*, vols. vi., viii., xiii., xiv., with criticisms by Mrs Sidgwick and the present writer in vol. xv. part xxxvi.). In Dr Hodgson's present opinion, the dead do communicate through the automatic writing or speaking of Mrs Piper. The published evidence (much is unpublished) does not seem to justify the conclusion, which is not accepted by Mrs Piper herself!

This leads us to the chief field of research in "automatisms," or actions of the subconscious or "subliminal" self. The prototype of such things is found in the performances of natural somnambulists, who in all ages have seemed to exhibit faculties beyond their power when in a normal condition. The experiments of Mesmer, and of those who followed in his track, down to the psychologists of to-day, proved (what had long been known to savages and conjurers) that a state of somnambulism could be induced from without. Moreover, it is proved that certain persons can, as it were, hypnotize themselves and pass into

trance. In these *secondary* conditions of trance, such persons are not only amenable to "suggestion," but occasionally evolve what are called secondary personalities: they speak in voices not their own, and exhibit traits of character not theirs, but in harmony with the impersonation. The popular, savage, and ancient theory of these phenomena was that the people thus affected were inspired by a god or spirit, or "possessed" by a demon or a dead man. Science now regards the gods or demons or spirits as mere exhibitions of the secondary personality, which wakens when the normal personality slumbers. The knowledge and faculties of the secondary personality, far exceeding those exhibited in the normal state, are explained to a great extent by the patient's command, when in the secondary state, of resources latent in the memory. The same explanation is offered for other phenomena, like those of automatic writing, knocking out answers by tilting tables, or discovering objects by aid of the "divining-rod." The muscular actions that tilt the table, or wag the rod, or direct the pencil or planchette, are unconsciously made, and reveal the latent stores of subconscious knowledge, so that a man writes or knocks out information which he possessed, but did not suspect himself of possessing. These processes were familiar to the Neoplatonists, and in one form or other are practised by Chinese, Tibetans, Negroes, Malayans, and Melanesians. A similar kind of automatism is revealed in the inspirations of genius, which often astonish the author or artist himself. An interesting example has been studied by Mr Myers in the feats of arithmetic recorded about "calculating boys," who are usually unconscious of their methods. The whole of this vast field of the unconscious, or subconscious, or subliminal self has been especially examined by Mr Myers, and by such psychologists as Ribot, Janet Richet, and many others.

The general result is a normal explanation, not yet complete, of the phenomena hitherto attributed to witchcraft, inspiration, possession, and so forth. Probably the devils, saints, angels, and spirits who have communicated with witches, living saints, demoniacs, and visionaries are mere hallucinatory reflections from the subconscious self, endowed with its store of latent memories and strangely acute percipient faculties. Thus a curious chapter of human history is at last within possible reach of explanation. Men regard phenomena as "supranormal" or "supernatural," or reject them altogether, till their *modus* is explained. But it would not be candid to say that the explanation is complete, or nearly complete. The nature of the hypnotic trance itself remains matter of dispute. The knowledge automatically revealed can by no means always be accounted for, either by latent memory or by the sharpening of the normal faculties of perception, while the limits of telepathy (if it be accepted) are vaguely conjectured. Even the results of simple experiments in "crystal-gazing" are often very perplexing. In all ages and countries it has been believed that certain persons can see visions in water, glass, ink, and polished surfaces generally. Experiment has proved, beyond the possibility of doubt, that this is actually the case. But when the visions are not mere fancy pictures, but correctly represent remote persons and events, unknown to the gazer, and perhaps unknown to all present, but later (in the case of the events) verified, the explanation is rather to seek. Further experiment may reveal some normal explanation, while scepticism (which seldom takes the trouble to examine the alleged facts with any care) can always repose on a theory of malobservation and imposture. These, of course, are *veræ causæ*, while in this, as in all provinces of human evidence, bad memories and unconscious errors distort the testimony. Psychical research encourages, or ought to encourage, the cool impartiality in examining, collecting, and recording facts, which is usually absent, in greater or less degree, from the work even of eminent historians. Men of equal honesty and acuteness may believe or disbelieve in the innocence of Mary Queen of Scots, or in the "spirits" which control Mrs Piper. As to alleged "physical phenomena" of unknown nature, one, the power of passing without lesion with naked feet over fire, has recently been attested by numerous competent observers and experimenters in the ritual of Fijians and other South Sea Islanders, Japanese, Bulgarians, natives of southern India, and other races. (The evidence has been collected by the present writer in *Proceedings S.P.R.* vol. xv. part xxxvi. pp. 2–15. Compare a case examined and explained, more or less, by Mr S. P. Langley, *Nature*, August 22, 1901.) The much more famous tales of movements of objects untouched have been carefully examined, and perhaps in no instance have professional performers proved innocent of fraud. Yet the best known living medium, Eusapia Paladino, though exposed at Cambridge, has been rehabilitated, after later experiments, in the opinion of many distinguished Continental observers, who entirely disbelieve in the old theory, the action of "spirits," and venture no other hypothesis.

The results of psychical research, after several years of work, are not really less than could be expected from toil in a field so difficult. The theory of alternating, or secondary, personalities is the key, as we have said, to a strange chapter in "The History of Human Error." The provisional hypothesis of telepathy puts a meaning into the innumerable tales of "wraiths" and of "second sight." It is never waste of time to investigate the area of human faculty; and practical results, in the medical treatment of abnormal intellectual conditions, have already been obtained. The conduct of our witch-burning ancestors now becomes intelligible, a step on the way to being pardonable. With their methods and inherited prejudices, they could scarcely have reasoned otherwise than they did in certain cases of hysteria and autohypnotization. Many "miracles" of healing, and of "stigmatization," become credible when verified in modern experience and explained by "suggestion"; though to "explain the explanation" is a task for the future. Such as it is, the theory was accepted by St Francis de Sales in the case of St Theresa. Results of wider range and of more momentous interest may yet be obtained. The science of electrical phenomena was not developed in a quarter of a century, and it would be premature to ask more from psychical research than it has achieved in a shorter period. The subject is not readily capable of exact experiment, human faculty being, as it were, capricious, when compared with ordinary physical processes. Imposture, conscious or unconscious, is also an element of difficulty. But already phenomena which are copiously reported throughout the whole course of history have been proved to possess an actual basis in fact, have been classified, and to some extent have been explained. Even if no light is ever to be cast on spiritual problems, at least the field of psychology has been extended.

The literature of psychical research is already considerable, and a complete bibliography would occupy much space. Readers who care to pursue the study will find their best guide in the *Proceedings* of the Society for Psychical Research, which contain a catalogue of the society's collection, including the Gurney Library (Hypnotism), with reviews of modern books in many languages—French, German, Italian, Russian—as they appear. Among modern English books may be recommended *Phantasms of the Living*, by Messrs Gurney, Podmore, and Myers; *Studies in Psychical Research*, by Mr Podmore, with his *Apparitions and Thought-Transference*; and *Principles*

of Psychology, by Professor William James, of Harvard. The historical side of the subject, especially as regards the beliefs of savages and of classical antiquity, may be studied in Mr E. B. Tylor's *Primitive Culture* (under "Animism"), in Mr Myers's *Classical Essays* (under "Greek Oracles"), and in the present writer's *Cock Lane and Common Sense*, and *Making of Religion*. Mr Myers's work, *Human Personality*, contains collections of facts, with a provisional theory. M. Th. Flournoy's *Des Indes à la Planète Mars* is a penetrating study of pseudo-spiritual "messages." A criticism making against the notion of telepathy may be found in Herr Parish's *Hallucinations and Illusions* (English translation). Some errors and confusions in this work (due in part to the expansion of the original text) are noted in the author's *Making of Religion*, Appendix A. (A. L.)

PSYCHOLOGY.

The science of Psychology has made unwonted strides since 1885. First of all, it has entered upon an experimental stage, and a well-equipped laboratory is now an adjunct of almost every important psychological school. A bewildering mass of detail has been accumulated relating to such processes as sensation, perception, memory, association, and attention (see PHYSIOLOGY, *Special Senses*). But there must be a thorough scrutiny of methods and a careful elimination of such results as have really only a physiological import, before we can decide how much of this material can be safely or systematically incorporated into the science itself. In the next place—and largely through the influence of Darwin—we have now the beginning of a new Comparative Psychology to replace the old repertories of anecdote collected by uncritical admirers of animal instinct and intelligence. Further, important additions to our psychological knowledge have resulted from the observations of the mental physician, particularly in cases of aphasia and cognate diseases, and in hypnotic and other abnormal states.

So impressive altogether are these extensions of psychology by objective methods of experiment and observation, that the older and more fundamental method of introspective reflection is nowadays often scouted not merely as more difficult—this has always been acknowledged—but as now at length altogether obsolete and superfluous. Thus, whereas the old psychology was closely related to the philosophical or moral sciences and sharply contrasted with the natural sciences, the new assumes very much the position long ago assigned to psychology by Comte: it becomes "mental physiology" or "physiological psychology." The distinction of natural and moral science only serves, on this view, to mark different stages of evolutional complexity: it ceases to be a distinction of kind.

But meanwhile, and from another side, the old psychology still shows signs of life. Here, too, great progress has been made, and several new lines of advance may be distinguished. The relation of psychology to epistemology, for example, has been very much under discussion of late. A generation ago it was common—except in Germany—to lump psychology and philosophy together under the common title of Mental Philosophy or Metaphysics.[1] Since then the growth of physiological psychology on the one hand, and the increasing influence of the Kantian philosophy on the other, have led to the undue severance of the two subjects, which is now in course of correction. But the psychologist no longer essays to solve the problem of objective knowledge by looking—after Locke's fashion—into the individual mind. Nowadays it is the epistemologist endeavouring to analyse and connect the forms, categories, and ideas (to use the Kantian phrases) by means of which objective knowledge is organized, who is led to demand, or perhaps himself to provide, a genetic psychology of Kant's *Bewusstsein überhaupt*—*i.e.*, of the general or collective mind, to which the universal and necessary syntheses of experience are referred.

To Kant at the close of the 18th century it seemed obvious that the so-called pure forms of knowledge and practice were original and ultimate faculties of the human mind, and therefore quite beyond elucidation by psychological methods, whether genetic or analytic. The hard and fast distinctions which he drew between *à priori* and *à posteriori*, between matter and form, cut off psychology from any part or lot in the deliberations of philosophy. But to Kant's followers at the opening of the 20th century it seems equally obvious, (1) that if the human mind is the result not of a special creation but of a continuous development, it cannot be, as he maintained, "perfectly futile labour" to investigate how those epistemologically *à priori* or transcendental forms were acquired; and (2) that, if acquired, those forms cannot be, as he supposed, elementary and ultimate in such wise as to render any analysis of them impossible. For the perceptual forms of space and time such analysis has been in the main accomplished already, and the result seems to entail important changes in the Kantian epistemology, especially in relation to mathematics.[2] As regards the categories, Kant's derivation of them from the forms of judgment is allowed to be little better than wasted ingenuity; while his admission of an *acquisitio originaria*, if not meaningless, brings them within the range of a genetic psychology dealing with objective experience, as our latter-day Kantians for the most part acknowledge.[3]

Again, two problems, that have vexed most philosophic thinkers since Descartes, are now brought into conjunction in a way that makes psychological revision inevitable: they are the question concerning the perception of an external world and the question as to the relation of body and mind. The solutions in vogue may be summarized as follows:—(1) "The face to face acquaintance with the real world which Common Sense assumes is illusory: the coloured, tangible, sonorous world is not the external world at all, not even a copy of it. Our sensations are but symbols or indications of external reality; the most we can say is that there is correspondence between the two." (2) "States of mind and states of brain run parallel, but do not interact: brain changes, both as to the causes that produce them and the effects that they produce, belong entirely to the physical world of matter and motion." The deadlock here becomes palpable and evident on a very slight examination. On the physical side it cannot be known that psychical changes shadow neural changes, for there can be no physical evidence that psychical change occurs at all. And on the psychical side, though one sensation may serve as index to another *sensation*, it is as impossible that sensory experience should give any clue to what is, *ex hypothesi*, wholly beyond it, as that sounds, for example, should apprise a blind man of colours or colours a deaf man of sounds. In fact, according to these theories the physical and the psychical standpoints are comparable to the positions of the blind and deaf relatively to each other. A way out of the difficulty is sought in a surreptitious use of the notion of causality. Sensations, it is assumed, are not merely indications, but effects, of the external world in the one case; and mental states generally are not merely concomitants, but "collateral," non-physical, products of neural states in the other. The justification of these assumptions must, in part at all events, be referred to psychology.

In this supplementary article the attempt will be made to discuss the various new topics just described, on the old lines as far as possible and as fully as the limits allow.

[1] Cf., *e.g.*, Hamilton's *Lectures on Metaphysics*, or the article "Metaphysics," by Mansel, in the 8th edition of this Encyclopædia.

[2] Cf. B. Erdmann, *Die Axiome der Geometrie*, 1877, and Russell, *An Essay on the Foundations of Geometry*, 1897.

[3] On this whole topic, cf. Stumpf, *Psychologie und Erkenntnisslehre*, 1891; O. Schneider, *Die psychologische Entwickelung des Apriori*, 1883.

STANDPOINT; RELATION TO EPISTEMOLOGY; GENERAL ANALYSIS.

In defining psychology the propriety of avoiding the term *Mind*, on account of its implication of the disastrous dualism of mind and matter, is widely acknowledged. But the term *Consciousness*, which is the most frequent substitute, is liable to an opposite objection, that of laying undue stress on the subjective as opposed to the objective. Experience is, it is maintained, a more fundamental and less ambiguous conception. We must start, of course, from individual human experience; and we must endeavour from this standpoint to determine the "irreducible minimum" involved, so that our conception may apply to all lower forms of experience as well. Etymologically *experience* connotes practical acquaintance, efficiency, and skill as the result of trial—usually repeated trial—and effort. Many recent writers on comparative psychology propose to make evidence of experience in this sense the criterion of psychical life or "mentality." The ox knoweth his owner and the ass his master's crib, and so would pass muster; but the ant and the bee, who are said to learn nothing, would, in spite of their marvellous instinctive skill, be regarded as mere automata in Descartes' sense. That this criterion is decisive on the positive side will hardly be denied; the question how far it is available negatively we must examine later on. But it will be well first briefly to note some of the implications of this positive criterion: *Experience is the process of becoming expert by experiment.* The chief implication, no doubt, is that which in psychological language we express as the duality of subject and object, already strenuously insisted on in the article in the earlier volumes of this Encyclopaedia. Looking at this relation as the comparative psychologist has to do, we find that it tallies in the main with the biological relation of organism and environment. The individuality of the organism corresponds to, though it is not necessarily identical with, the psychological subject, while to the environment and its changes corresponds the objective *continuum* or *totum objectivum* already described (p. 45).[1] This correspondence further helps us to see still more clearly the error of regarding individual experience as wholly subjective, and at the same time helps us to find some measure of truth in the naïve realism of Common Sense. As these points have an important bearing on the connexion of psychology and epistemology, we may attempt to elucidate them more fully. Though it would be unwarrantable to resolve a *thing*, as some have done, into a mere meeting-point of relations, yet it is perhaps as great a mistake to assume that it can be anything determinate in itself apart from all relations to other things. By the physicist this mistake can hardly be made: for him action and reaction are strictly correlative: a material system can do no work on itself. For the biologist, again, organism and environment are invariably complementary. But in psychology, when presentations are regarded as subjective modifications, we have this mistake in a glaring form, and all the hopeless difficulties of what is called "subjective idealism" are the result. Subjective modifications no doubt are always one constituent of individual experience, but always as correlative to objective modifications or change in the objective *continuum*. If experience were throughout subjective, not merely would the term subjective itself be meaningless, not merely would the conception of the objective never arise, but the entirely impersonal and intransitive process that remained, though it might be described as absolute becoming, could not be called even solipsism, least of all real experience. Common Sense, then, is right in positing, wherever experience is inferred, (1) a factor answering to what we know as self, and (2) another factor answering to what each of us knows as the world. It is further right in regarding the world which each one immediately knows as a coloured, sounding, tangible world, more exactly as a world of sensible qualities. The assumption of naive realism, that the world as each one knows it exists independently of him, is questionable. But this assumption goes beyond individual experience, and does not, indeed could not, arise at this standpoint.

There is one further characteristic of individual experience involved in the preceding that is worth noting here. Answering to the individuality and unity of the subjective factor, there is a corresponding unity and individuality of the objective. Every Ego has its correlative Non-Ego, whence in the end such familiar sayings as *Tot mentes quot sententiæ*, and the like. The doctrine of Leibnitz, that "each monad is a living mirror . . . representative of the universe according to its point of view," will, with obvious reservations, occur to many as illustrative here. In particular, Leibnitz emphasized one point on which psychology will do well to insist. "Since the world is a plenum," he begins, "all things are connected together, and every body acts upon every other, more or less, according to their distance, and is affected by their reaction; hence each monad is a living mirror," &c.[2] Subject and Object, or (as it will be clearer in this connexion to say) Ego and Non-Ego, are then not merely logically a universe, but actually *the universe*, so that, as Leibnitz put it, "He who sees all could read in each that which passes everywhere else" (*Monadology*, § 61). Though every individual experience is unique, yet the more Ego_1 is similar to Ego_2 the more their complementaries $Non\text{-}Ego_1$, $Non\text{-}Ego_2$ are likewise similar; much as two perspective projections are more similar the more adjacent their points of sight, and more similar as regards a given position the greater its distance from both points. No doubt we must also make a very extensive use of the hypothesis of subconsciousness, just as Leibnitz did, before we can say that *the universe* is the objective factor in each and every individual's experience. But we have in any case to allow that, besides the strictly limited "content" rising above the threshold of consciousness, there is an indefinite extension of the presentational *continuum* beyond it. And the Leibnitzian Monadology helps us also to clear up a certain confusion that besets terms such as "content of consciousness," or "finite centre of experience"—a barbarous but intelligible phrase that has recently appeared—the confusion, that is, with a mosaic of mutually exclusive areas, or with a scheme of mutually exclusive logical compartments. Consciousnesses, though in one respect mutually exclusive, do not limit each other in this fashion. For there is a sense in which all individual experiences are absolutely the same, though relatively different as to their point of view, *i.e.*, as to the manner in which for each the same absolute whole is sundered into subjective and objective factors.

This way of looking at the facts of mind helps, again, to dispel the obscurity infecting such terms as subjective, intersubjective, transsubjective, and objective, as these occur in psychological or epistemological discussions. For the psychologist must maintain that no experience is merely subjective: it is only epistemologists, and notably Kant, who so describe individual experience, because for them objects experienced in their concrete particularity pertain, like so many idiosyncrasies, to the individual alone. In contrast with this, epistemologists then describe universal

[1] References to pages in the text without further qualification are to pages of the earlier article in this Encyclopædia, vol. xx. (ninth edition).

[2] *Principles of Nature and Grace*, § 3.

experience, the objects in which are the same for every experient, as objective experience *par excellence*. And so has arisen the time-honoured opposition of Sense-knowledge and Thought-knowledge: so too has arisen the dualism of Empiricism and Rationalism, which Kant sought to surmount by logical analysis. It is in the endeavour to supplement this analysis by a psychological genesis that the terms intersubjective and transsubjective prove useful. The problem for psychology is to ascertain the successive stages in the advance from the one form of experience or knowledge to the other. "When ten men look at the sun or the moon," said Reid, "they all see the same individual object." But according to Hamilton this statement is not "philosophically correct, . . . the truth is that each of these persons sees a different object. . . . It is not by perception but by a process of reasoning that we connect the objects of sense with existences beyond the sphere of immediate knowledge."[1] Now it is to this "beyond" that the term *transsubjective* is applied, and the question before us is: How do individual subjects thus get *beyond* the immanence or immediacy with which all experience begins? By a "process of reasoning," it is said. But it is at least true in fact, whether necessarily true or not, that such reasoning is the result of social intercourse. Further, it will be generally allowed that Kant's *Analytik*, before referred to, has made plain the insufficiency of merely formal reasoning to yield the categories of Substance, Cause, and End, by which we pass from mere perceptual experience to that wider experience which transcends it. And psychology, again, may claim to have shown that in fact these categories are the result of that reflective self-consciousness to which social intercourse first gives rise (cf. pp. 75 n^1, 84).

But such intercourse, it has been urged, presupposes the common ground between subject and subject which it is meant to explain. How, it is asked, if every subject is confined to his own unique experience, does this intersubjective intercourse ever arise? This objection—formidable though it seems when the discrete alternatives, "either . . . or," are alone considered as in logical analysis[2]—disappears in the region of continuous development with which genetic psychology deals. If *no* progress towards intellective synthesis were possible before intersubjective intercourse began, such intercourse, as presupposing something more than immediate sense-knowledge, obviously never could begin.[3] Let us illustrate by an analogy which Leibnitz's association of experience with a "point of view" at once suggests. If it were possible for the terrestrial astronomer to obtain observations of the heavens from astronomers in the neighbouring stars, he would be able to map in three dimensions constellations which now he can only represent in two. But unless he had ascertained unaided the heliocentric parallax of those neighbouring stars, he would have no means of distinguishing them as near from the distant myriads besides, or of understanding the data he might receive; and unless he had first of all determined the still humbler geocentric parallax of our sun, those heliocentric parallaxes would have been unattainable. So in like manner we may say "intersubjective parallax" presupposes what we may call "subjective parallax," and even this the psychological duality of object and subject. But such subjective parallax or acquaintance with other like selves is the direct outcome of the extended range in time which memory proper secures; and when in this way self has become an object, resembling objects become other selves or "ejects," to adopt with slight modification a term originated by Professor W. K. Clifford. We may be quite sure that his faithful dog is as little of a solipsist as the noble savage whom he accompanies. Indeed, the rudiments of the social factor are, if we may judge by biological evidence, to be found very early. Sexual union in the physiological sense occurs in all but the lowest *Metazoa*, pairing and courtship are frequent among insects, while "among the cold-blooded fishes the battle of the stickleback with his rivals, his captivating manœuvres to lead the female to the nest which he has built, his mad dance of passion around her, and his subsequent jealous guarding of the nest, have often been observed and admired."[4] Among birds and mammals we find not merely that these psychological aspects of sexual life are greatly extended, but we find also prolonged education of offspring by parents and imitation of the parents by offspring. Even language, or at any rate "the linguistic impulse," is not wholly absent among brutes.[5] Thus as the sensorimotor adjustments of the organism to its environment *generally* advance in complexity and range, there is a concomitant advance in the variety and intimacy of its relations *specially* with individuals of its kind. It is therefore reasonable to assume no discontinuity between phases of experience that for the individual are merely objective and phases that are also ejective as well; and once the ejective level is attained, some interchange of experience is possible. So disappears the great gulf fixed betwixt subjective or individual and intersubjective or universal experience by rival systems in philosophy.

One other implication of the psychological conception of experience calls for brief mention, for it is one that of late years has gained many adherents. Experience as the psychologist deals with it, living experience, is primarily and pre-eminently practical. Obvious as this must appear to those who look at the facts of life in the light of the theory of evolution, yet it is a truth that was for the most part overlooked so long as psychology was studied mainly by philosophers, and studied therefore mainly in its bearing on philosophical problems. But the notion of an independent realm of truth existing *sub specie æternitatis* has literally no place within the purview of a psychology that knows its business. Here we find no such thing as mere cognition: the uninteresting is not known but ignored, and the interesting leads at once to response, and sooner or later to adjustment—in the race, at all events. Success is then completed experience or expertness, and in general prepares the way for a new advance. So far the true is the useful, and the criterion is not theoretical but practical. Looking broadly at the progress of life, as it ascends through the animal kingdom and onwards through the history of man, it seems safe to say that knowledge is always a means to ends, is never an end by itself—till at length it becomes interesting and satisfying in itself. Psychologically, then, the sole function of perception and intellection is to guide action and subserve volition—more generally, to promote self-conservation and betterment. Knowledge, from this point of view, may even be regarded as the joint product of natural selection and subjective selection: it emerges tainted, as some may think, at all events permeated, by a teleological colouring.[6]

Sensation, Movement, and the External World.

On the view of experience just described, we are led to challenge the physiological method of describing sensations as due to physical stimuli, which is still widely current. The following definition, given by Dr Bain, may be taken as a type:—"By sensations, in the strict meaning, we understand the mental impressions, feelings, or states of consciousness following on the action of external things on some part of the body, called on that account, sensitive."[7] It is true, no doubt, that what the psychologist calls sensibility has as its invariable concomitant what physiologists call sensibility, or what the more careful of them call irritability; and, true again, that this irritability is invariably preceded by a physical process called stimulation. But the converse statements are not true: there may be stimu-

[1] *Lectures on Metaphysics*, ii. p. 153.

[2] It is amazing how often this type of argument has occurred since Zeno's famous paradoxes about motion, where it first appears.

[3] And it is precisely for want of this mediation that Kant's "two stems of human knowledge, which *perhaps* may spring from a common but to us unknown root," leave epistemology still more or less hampered with the old dualism of sense and understanding.

[4] *Evolution of Sex*, by Geddes and Thomson, 1st ed., p. 265.

[5] Cf. Darwin, *Descent of Man*, i. p. 56.

[6] Cf. especially Simmel, "Ueber eine Beziehung der Selectionstheorie zur Erkenntnisstheorie," *Arch. f. syst. Philosophie*, 1895, pp. 34-45; W. James, *Philosophical Conceptions and Practical Results*, 1898; J. Ward, *Naturalism and Agnosticism*, 1899, vol. ii. pp. 133 f., 245 f., 253 f., &c. The view above described, which doubtless is substantially an indirect result of the philosophy of Schopenhauer, has been called Voluntarism (Paulsen, Wundt), and again Pragmatism (James).

[7] *Senses and Intellect*, 4th ed., 1894, p. 101.

lation and no consequent irritation, irritation and no concomitant sensation. It is then certain that the three processes are distinct, and it is equally certain that the last alone enters into immediate experience. Nevertheless, it is urged, why not recognize a connexion that actually obtains, since otherwise sensation must remain unexplained? Well, in the first place, such "psychophysical" connexion is not a psychological explanation: it cannot be turned directly to account in psychology, either analytic or genetic. Next, the psychological fact called sensation always is, and at bottom always must be, independently ascertained; for, as said, the physiological "neurosis" or irritation has not necessarily a concomitant "psychosis" or sensation and, strictly dealt with, affords no hint of such. Finally, this inexplicability of sensation is a psychological fact of the utmost moment: it answers to what we call reality in the primary sense of the term. The psychophysicist, in setting out to explain sensation, has—unawares to himself—left this fundamental reality behind him. For it belongs essentially to individual experience, and this—in assuming the physical standpoint—he has of course transcended. Nevertheless the mistake of method that here reveals itself was perhaps inevitable, for the facts of another's sense-organs and their physical excitants must have obtruded themselves on observation long before the reflective attitude was advanced enough to make strictly psychological analysis possible. The psychophysical standpoint, that is to say, was attained before the purely psychological; and the consequent bias is only now in process of correction. A series of physical processes, first without and then within the organism—ethereal or aërial vibrations, neural and cerebral excitations—was the starting-point. What comes first, immediately, and alone, in the individual's experience, and is there simply and positively *real*, was then misinterpreted as subjective modification, mental impression, *species sensibilis*, or the like. For from the days of Democritus down to our own the same crude metaphor has prevailed without essential variation. And here the saying holds: *Nulla vestigia retrorsum.* Into the man's head the whole world goes, including the head itself. Such thoroughgoing "introjection" affords no ground for subsequent "projection." Thus the endeavour to explain sensation overreaches itself: the external object or thing that was supposed to cause sensations, and to be therefore distinct from them, was in the end wholly resolved into these and regarded as built out of them by association (Mill) or by apperceptive synthesis (Kant). But no "mental chemistry," no initial alchemy of "forms," can generate objective reality from feelings or sense-impressions as psychophysically defined.[1] A's experience as it is for B is not real but inferential; and if the grounds of the inference, which are realities only for B, are to be regarded as the causes of which A's experiences are merely the effects, then the two experiences are on a wholly different footing. When A treats B in the same fashion we get the world in duplicate: (1) as original and outside, *i.e.*, as *cause*, and (2) as copied within each percipient's head, *i.e.*, as *effect*. But when B interprets his own experience as he had interpreted A's, we seem to have lost the real world altogether. In presence of this dilemma, the philosophers of our time, as already said, are feeling it needful to revise their psychology. The question of method is vital. If the psychophysical standpoint were the right one, psychology would be based on physiology, and the old conception of sensation might stand. If, on the other hand, it is the exclusive business of psychology to analyse and trace the development of individual experience as it is for the experiencing individual, then—however much neurological evidence may be employed as a means of ascertaining psychological facts—the facts themselves must be scrupulously divested of all physical implications, the psychophysical method takes a secondary place, and the objective reality of "sensory" presentations stands unimpeached.

Motor presentations have been constantly under discussion since 1875, and at length it may perhaps be said that clearer views begin to prevail. Auxilio-motor presentations (now called kinæsthetic), by means of which bodily equilibrium and locomotor *taxis* are regulated, were commonly allowed to be purely sensory, the concomitants of centripetal excitations: hence the older name of "muscular or sixth sense" applied to them by Sir Charles Bell, Weber, Sir William Hamilton, and others. But concerning motor presentations proper (more commonly called feelings of innervation or feelings of effort), the view first tentatively advanced by the great physiologist Johannes Müller, and adopted by Helmholtz, Wundt, and especially by Professor Bain, is now generally discredited, if not completely overthrown.[2] According to this view, "the characteristic feeling of exerted force" must be regarded, Dr Bain maintains, "not as arising from an inward transmission . . . . but as the concomitant of the *outgoing* current by which the muscles are stimulated to act" (*op. cit.*, p. 79).

The necessity for this assumption has certainly not been established on physiological grounds, nor apparently does Dr Bain rely primarily on these, for at the very outset of his discussion we find him saying "that action is a more intimate and inseparable property of our constitution than any of our sensations, and enters as a component part into every one of our senses" (*op. cit.*, p. 59). But this important psychological truth is affirmed as strenuously by some at any rate (*e.g.*, Prof. James) of Dr Bain's opponents as it is by Dr Bain himself. Unhappily many, under the same psychophysical bias and so induced, like the upholders of this innervation theory, to look for evidence of subjective activity in the wrong place, have been led to doubt or to deny the reality of this activity altogether. In fact, this theory, while it lasted, tended to sustain an undue separation of so-called "sensory" from so-called "motor" presentations, as if living experience were literally an alternation of two independent states, one wholly passive and the other wholly active, corresponding to the anatomical distinction of organs of sense and organs of movement. The subject of experience or Ego does not pass to and fro between a *sensorium commune* or intelligence department and a *motorium commune* or executive, is not in successive intervals receptive and active, still less always passive, but rather always actively *en rapport* with an active Non-Ego, commonly called the External World.

Experience at this level—experience, that is to say, confined to sensation and movement—may be described as perceptual, and as consisting of the differentiation and redintegration of a presentational continuum (cf. pp. 51 f.). Space and time, as "forms" of this perceptual experience, have, it is important to note, certain concrete characteristics not pertaining to the ideal conceptions of pure space and pure time afterwards elaborated from them. Both psychology and epistemology gain by the recognition of these differences, which, owing to the influence of Kant, have till recently been quite ignored. Only the barest reference to these characteristic differences is here possible.[3]

[1] Nothing shows this more plainly than the newly-coined term *epiphenomenon* now applied in this connexion. As to this, see below, p. 68.

[2] Cf. Bastian, *The Brain as an Organ of Mind*, 1880, pp. 691 ff.; Ferrier, *The Functions of the Brain*, 2nd ed., 1886, pp. 382 ff.; James, *Principles of Psychology*, 1890, ch. xxvi.

[3] Cf. Ward, *Naturalism and Agnosticism*, 1899, vol. ii. pp. 136–149, for fuller treatment.

(1) "Here" and "now" are for the individual percipient absolute positions, and have no counterpart in the thoroughgoing relativity of abstract space and time. (2) Again, they refer not to a mathematical "point" and "instant," but imply a certain "restricted ubiquity." This, in the case of space, answers to the primitive extensity of what may be called the body-sense, the fundamental importance of which for the further elaboration of spatial experience is now at length widely recognized.[1] In the case of time, such "ubiquity" answers to that "sensible present" or "enduring now," within which change is directly apprehended: the reduction of this to an instant would render experience impossible.[2] (3) In this perceptual experience of the temporal and spatial in the concrete there is nothing of that homogeneity which science attributes to space and time in the abstract. The "body-sense," in contrast with what may be called "the projecting senses,"[3] yields the vital distinction of internal and external, marking off the bodily self from its environment. The environing space, again, varies in character, intimacy, and even in dimensions as we recede from the foreground towards the background, from objects to which we can adjust by changes of posture to objects only to be reached by locomotion. A similar perspective is characteristic of temporal perceptions, but is confined almost entirely to the "psychical present" till experience advances to the ideational stage. To this stage we may now turn.

Growth and Development of Ideation.

We find ourselves sometimes engrossed in present perceptions, as when tracing, for example, the meanderings of an ant; at other times we may be equally absorbed in reminiscences; or, again, in pure reverie and "castle-building." Here are three well-marked forms of conscious life: the first being concerned with what is, the second with what has been, and the third with the merely possible. Again, the first involves definite spatial and temporal order, though the temporal order, as just said, is in the main restricted to the "sensible present"; the second involves only definite time-order; and the last neither in a definite way. Thus analytically regarded, perception, memory, imagination, show a steady advance. In infancy the first predominates, while senility lapses back to the second; in the third, where similarities suggest themselves and the contrast of actual and possible is explicit, we have at length the groundwork of logical comparison. Nevertheless, since imagination plays a conspicuous part in child-life before much personal reminiscence appears, it would seem probable that ideas do not first arise as definite memory-images or reminiscences. On the other hand, in the so-called homing instincts of the lower animals we have evidence of isolated "memories" of a simpler form than ours. Altogether it will be best, therefore, to lay aside the analytical distinction of a memory continuum or "thread," and of an ideational continuum or "texture"[4] (supposed to be formed by reduplication of the thread upon itself), in here taking up anew the question of the genesis of ideas, very inadequately dealt with in the earlier article (p. 60).

The subject is as difficult as it is interesting and important, and we can hardly hope at present for a final solution. One chief obstacle, as is so often the case in psychology, lies in the unsettled connotation of such leading terms as *memory*, *association*, and *idea*. Even what is most fundamental of all, that "plasticity" which we have analysed into retentiveness, differentiation, and integration, is sometimes described as if it already involved memory-ideas and their association. Ideas, that is to say, are identified with mere "residua" of former "impressions," and yet at the same time are spoken of as "copies" of these: which is much like saying the evening twilight is a *replica* of the noonday glare as well as its parting gleam. Again, the continuous differentiation and redintegration of the presentational continuum which mark the progress of perceptual experience are resolved into an original multiplicity of presentational atoms which are associated by "adhesion" of the contiguous. Yet before the differentiation there was no plurality, and after the integration there is only a complex unity, comparable perhaps with a group of segregated cells or other organic whole, but certainly not with a mosaic stuck together with cement. This mistaken identification by the Associationist psychology of later processes with simpler and earlier ones, by which they are only partially explained, has not only obscured the science with inappropriate conceptions but has prevented the question on which we are entering—that concerning the genesis and development of ideas—from being ever effectually raised. The discussion of this question will incidentally yield the best refutation of those views.

Experience, we say (cf. above, p. 56), is the acquisition of practical acquaintance and efficiency as the result of repeated opportunity and effort. This means that strangeness on the cognitive side gives place to familiarity, and that on the active side clumsiness is superseded by skill. But though analytically distinct, the two sides are, as we have already insisted, actually inseparable: to the uninteresting we are indifferent, and what does not call for active response is ignored. If the original presentations, whether sensory or motor, be A, B, C, we find then that they gradually acquire a new character, become, let us say, A^γ, B^γ, C^γ, γ representing the eventual familiarity or facility, as the case may be. We find, again, a certain sameness in this character, however various the presentations to which it pertains, a sameness which points to the presence of subjective constituents, and to these we may assign the "feelings" that enter into accommodation and adjustment. This factor is important as evidence of a subjective co-operation which may enable us to dispense with the mutual "adhesions" and "attractions" among presentations, on which the Associationists rely. But it is obvious that there must be an objective factor as well; and it is this objective factor in the process giving rise to γ that now primarily concerns us. We have described that process as assimilation or immediate recognition: the older psychology described it as association of the completely similar, or as automatic association. That the two views have something in common is shown by the juxtaposition of "automatic" and "immediate," "similarity" and "assimilation." To prepare the way for further discussion, let us first ascertain these points of agreement. "When I look at the full moon," says Dr Bain, "I am instantly impressed with the state arising from all my former impressions of her disc added together." This we may symbolize in the usual fashion as $A + a_n \cdot \cdot \cdot \cdot \cdot + a_3 + a_2 + a_1$. Now, it will be granted (1) that the present occurrence (full moon) has been preceded by a series of like occurrences, enumerable as 1, 2, 3, . . . n; (2) that the present experience (A^γ) is what it is in consequence of the preceding experiences of those occurrences; and (3) that it "arises instantly" as the joint result of such preceding experiences. But it is denied (1) that this present experience is the mere sum, or even the mere "fusion," of the experiences preceding it; or (2) that they were qualitatively identical; or (3) that they persist severally unaltered, in such wise that experience "drags at each remove a lengthening chain" of them. In the case of dexterities, where γ answers to facility, it is obvious that there is no such series of identicals (a_1, a_2, . . . a_n) at all. From the first rude beginning—say the schoolboy's pothooks—up to the finished performance of the adept there is continuous approximation: awkward

[1] Cf. especially James, *Principles of Psychology*, 1890, ch. xx.

[2] Cf. James, *op. cit.*, vol. i. pp. 608 ff.; L. W. Stern, "Psychische Präsenzzeit," *Zeitschrift f. Psychologie u.s.w.*, 1897, Bd. xiii. pp. 325 ff.

[3] For the suggestion of these terms see Flechsig, *Gehirn und Seele*, 1896, p. 21.

[4] Terms suggested, of course, by the Herbartian *Reihe* and *Gewebe*; cf. vol. xx. pp. 58 and 61.

and bungling attempts, passing gradually into the bold strokes of mastery. Nor is the case essentially different in cognition where γ answers to familiarity, if we attend, as it is plain we ought, not to the physical fact but to the individual's percept. This too is an acquisition, has entailed activity, and is marked by gradual approximation towards clearness and distinctness. The successive experience of n identical occurrences does not then result in an accumulation of n identical *residua*. The ineptness of the atomistic psychology with its "physical" and "chemical" analysis is nowhere more apparent than here. Considering the intimate relation of life and mind, and the strong physiological bias shown by the Associationists from Hartley onwards, it is surely extraordinary how completely they have failed to appreciate the light-bearing significance of the conceptions of function and development. Facility and faculty (or function) are much the same, both etymologically and actually. As the perfected structure is not so many rudimentary structures "added together," but something that supersedes them completely, must we not say the same of the perfected function? The less fit is not embodied in the fittest that finally survives. Development implies change of form in a continuous whole: every growth *into* means an equal growth *out of*: thus one cannot find the caterpillar in the butterfly. Between organic development and mental development there is then more than an analogy.

But though assimilation cannot be analysed into a series of identical ideas ($a_1, a_2, \cdot \cdot \cdot a_n$), either "added together" or "instantaneously fused," yet it does result in an a which may *provisionally* be called an idea. Such idea is, however, neither a memory-idea in the proper sense nor an idea within the meaning of the term implied in imagination or ideation. For it is devoid of the temporal-signs indicated by the subscript numerals in $a_1, a_2 \cdot \cdot \cdot$, and it does not yet admit of reproduction as part of an ideational continuum, one, that is, divested of the characteristics belonging to the actual and sensibly present. It is, so to say, embryonic, something additional to the mere sensation assimilated, and yet something less than a "free or independent idea." It is, as it has been happily called,[1] a tied (*gebundene*) or implicit idea. We have clear evidence of the sense-bound stage of this immature "idea" in the so-called "memory after-image" already described (pp. 59 f.). There is, however, nothing in this of memory, save as the term is loosely used for mere retentiveness; and *after-percept* would therefore be a less objectionable name for it. This after-percept is entirely sense-sustained and admits of no ideal recall, though—*in minds sufficiently advanced*—it may persist for a few moments, and so form the basis of such comparison with a second sensation as we find in the experiments of Weber, Fechner, and others.[2] At a still lower level, or in actual perception, we cannot assume even this amount of partial independence, though continuity clearly points to something beyond the bare sensation, which is a pure abstraction, as we may presently see.

It is saying too little to maintain, as some do, that this "something" is subconscious, on the ground that it is not discoverable by direct analysis. Yet it is saying too much, regardless of this defect, to describe a percept as a presentative-representative complex, if representation is to imply the presence of a free or independent idea. To call this "something" a tied or nascent idea on the ground of its possible later development into an independent representation seems, then, nearest the truth. The same meaning is sometimes expressed in a wholly different, and designedly paradoxical, way, by saying that all cognition (perception) is *recognition*. This statement has been met by elaborate expositions of the difference between knowing and knowing *again*, the irrelevance of which any lexicon would show; and, further, by the demand: How on such a view is a *first* cognition possible, or how is an indefinite regress of assimilation to be avoided? We may confidently reply that it cannot be avoided: an absolute beginning of experience, whether phylogenetically or ontogenetically, is beyond us. Assimilation means further assimilation; in this sense all cognition is further cognition, and a bare sensation is, as said, an abstraction representing a limit to which we can never regress.

We find evidence, again, of ideas in the making in what Lewes called preperception. Of this instances in plenty are furnished by everyday illusions, as when a scarecrow is hailed by the traveller who mistakes it for a husbandman, or when what is taken for an orange proves to be but an imitation in wax. In reality all complex percepts involve preperception; and so far, it must be allowed that such percepts are directly analysable into presentative-representative complexes. Nevertheless the representative element is not yet, and may never become, an idea proper. The sight of ice yields a forefeel of its coldness, the smell of baked meats a foretaste of their savour. Such prepercepts differ from free ideas just as after-percepts do: they are still sense-bound and sense-sustained (cf. p. 57). Nor can this complication be with any propriety identified either with the association pertaining to memory or with that specially pertaining to ideation; though, no doubt, the two processes—complication and association—are genetically continuous, as are their respective constituents, nascent and free ideas.[3] The whole course of perceptual integration being determined and sustained by subjective interest, involves from the outset, as we have seen, concurrent conative impulses; and thus the same assimilation that results in familiarity and preperception on the subjective side results in facility and purpose on the conative. Knowing immediately *what to do* is here the best evidence of knowing *what there is* to do with; the moth that flies into the candle has assuredly no preperception of it, and does not act with purpose. Bearing this in mind, we may now see one way, and probably the earliest, in which tied ideas become free.

The contrast between the actual and the possible constitutes, as we have seen, the main difference between experience at the perceptual and experience at the ideational stage. A subject confined to the former level knows not yet this difference. Such knowledge is attained not through any quasi-mechanical interaction of presentations, but usually through bitter experience. The chapter of accidents is the Bible of fools, it has been said; but we are all novices at first, and get wisdom chiefly by the method of trial and failure. Things are not always different in what to us are their essential properties, but they so differ from time to time. Resemblances are frequent enough to give us familiarity and confidence; yet uniformity is flecked by diversity, and thwarted intentions disclose possibilities for which we were not prepared. What was taken for sugar turns out to be salt; what was seized as booty proves to be bait. We catch many Tartars,

[1] Cf. Höffding, "Ueber Wiederkennen, Association und psychische Activität," in *Vierteljahrsschr. f. wissenschaftl. Philosophie*, Bd. xiii. and xiv. To Höffding we are also indebted for the term *Bekanntheitsqualität*, which has suggested the γ character used above. Cf. also Ward, "Assimilation and Association," *Mind*, 1894–95.

[2] Recent experiments, however, seem to prove that the after-percept is not the sole factor, and often is not a factor at all in such successive comparison (so-called); but that what is now termed "the absolute impression" may supplement it or even replace it altogether. As to what is meant by absolute impression, cf. earlier article, vol. xx. p. 50, col. *a*, *fin*.

[3] Hence the earlier process has been named "impressional association" (Stout, *Analytic Psychology*, 1896, ii. pp. 27–29), and again "animal association" (Thorndike, *Animal Intelligence, an Experimental Study of the Associative Processes in Animals*, 1898, pp. 71, 87, and *passim*). But it seems preferable to confine the term "association" to the later process, in which alone the component presentations have that amount of distinctness and individuality which the term properly connotes.

and so learn wariness in a rough school. In such wise preperceptions displaced by the actual fact yield the "what" severed from the "that," the "ideal" freed at length from the exclusive hold of the real. In a new situation after such adventures the attitude assumed—if, for brevity, we describe it in terms of our own still more advanced experience—is of this sort:—"It is possibly sugar, in which case I eat; possibly salt, and then I don't. It may be a weasel, if so, I back; it may be a rabbit, if it is, I spring." Instead of unquestioned preperception that "makes the mouth water," we have the alternative possibilities present as "free ideas," and action is in suspense, the alternative courses, that is to say, again present only in idea. It is easy to see how in such situations one free idea, a "what" sundered from its "that," will tend to loosen the sensory ties of alternative, still implicit ideas. On the cognitive side, from immediate assimilation an advance is made towards mediate cognition, towards comparison; on the active side there is advance from impulsive action towards deliberate action.[1]

We conclude, then, that implicit ideas—the products of assimilation, and integrated as such in complex percepts and the motor co-ordinations to which they lead—are more likely to emerge as free ideas the more this perceptual complexity increases. Perception in the lower animals, who give no signs of either memory or ideation, has apparently no such complexity. A fish, for example, can feel, smell, taste, see, and even hear, but we cannot assume solely on that account that it has any percepts to which its five senses contribute, as they do to our percept, say, of an orange or a peppermint. Taking voluntary movements as the index of psychical life, it would seem that the fish's movements are instigated and guided by its senses not collectively but separately. Thus a dog-fish, according to Steiner, seeks its food exclusively by scent; so that when its olfactory bulbs are severed, or the fore-brain, in which they end, is destroyed, it ceases to feed spontaneously. The carp, on the other hand, appears to search for its food wholly under the guidance of sight, and continues to do so just as well when the fore-brain is removed, the mid-brain, whence the optic nerves spring, seeming to be the chief seat of what intelligence it has.[2] Again, Bateson observes: "There can be no doubt that soles also perceive objects approaching them, for they bury themselves if a stroke at them is made with a landing-net; yet they have no recognition of a worm hanging by a thread immediately over their heads, and will not take it even if it touch them, but continue to feel for it aimlessly on the bottom of the tank, being aware of its presence by the sense of smell."[3] To this inability to combine simple percepts into one complex percept of a single object or situation we may reasonably attribute the fish's lack of true ideas, and consequent lack of sagacity. The sagacity even of the higher animals does not amount to "general intelligence," such as enables a child "to put two and two together," as we say, whatever "two and two" may stand for. So far as life consists of a series of definite situations and definite acts, so far the things done or dealt with together, the contents of the several *foci* or concentrations of attention, form so many integrated and comparatively isolated wholes. Round the more complicated of these, and closely connected with them, free ideas arise as sporadic groups, making possible those "lucid intervals," those fitful gleams of intelligence in the very heat of action, which occasionally interrupt the prevailing irrationality of the brutes. And as we cannot credit even the higher animals with general trains of ideas, just as little can we credit them with a continuous memory: indeed, it is questionable how far memory of the past, as past, belongs to them at all. For they live entirely in an up-stream, expectant attitude, and it is in this aspect that "free ideas" arise when they arise at all. We cannot imagine a dog regretting, like one of Punch's heroes, that he "did not have another slice of that mutton."[4]

The free idea (a) then at its first emergence has neither an assignable position in a memory-record, as a_1 or a_2, nor has it a definite relation as a "generic idea" to possible specializations such as a' or a''. These further developments have been dealt with in the earlier article (cf. pp. 60–63), the former as "contiguous association" determined by the successive movements of attention, the latter as so-called "association of similars," the joint result of assimilation and contiguity.

Two or three supplementary remarks seem, however, called for. First, the exclusively successional character of contiguous association has recently been denied, and its exclusively simultaneous character maintained instead. It is at once obvious that this opposition of succession and simultaneity cannot be pressed so as to exclude duration and reduce the whole process to an instantaneous event. Nor is there any ground for saying that there is a fixed and even distribution of attention to whatever is simultaneously presented: facts all point the other way. Still, though we cannot exclude the notion of process from consciousness, we may say that presentations attended to together become *pro tanto* a new whole, are synthesized or complicated. Such primary synthesis leads not to an association of ideas, but rather to the formation of one percept, which may become eventually a free idea. The disconcerted preperception which sets this free may likewise liberate a similar or contrasting idea, but it will not resolve either complex into the several "ideas" of its sensory or motor constituents, with which only the psychologist is familiar. The actual recurrence of some of these constituents may again reinstate the rest, not, however, as memories or as "thoughts," but only as tied ideas in a renewed perception.

Secondly, it has become usual to distinguish the association of contiguous experiences and the so-called association of similars or opposites as respectively external and internal *forms* of association. The new terminology is illuminating: the substitution of *forms* for *laws* marks the abandonment of the old notion that association was by "adhesion" of the contiguous and "attraction" of the similar. We are thus left to find the cause of association in interested attention; and that, we may safely say, is an adequate, and apparently the sole adequate, cause for the two commonly recognized forms of external association, the so-called simultaneous and the successive. But these two are certainly not co-ordinate; and if our analysis be sound, the former—for which we would retain the Herbartian term complication—yields us not members of an association but a member for association. So far, then, we should have but one form of association, that of the successive contents of focalized attention; and but one result, which in the earlier article was called the representation or memory continuum,[5] in contrast to the primary or presentation continuum, whence its constituents arise (cf. p. 60). Turning now to the distinction of external and internal, it at once strikes the unprejudiced mind that "internal association" is something of an anomaly, since the very notion of association implies externality. Also, on closer inspection what we find is not an association of similars or opposites as such, but—something quite distinct—a similarity or contrast of associates; of ideas, that is to say, which are contiguous members of the memory (or experience) continuum, or of ideas which have become contiguous through its reduplication.

Experimental Investigations concerning Memory and Association.

Of the vast mass of experimental work undertaken in recent years, that relating to memory and association is

[1] Some light is perhaps here thrown on the reciprocal relation of "association by contrast" and "association by similarity" as severally the differentiation of partial similars and the integration of partial dissimilars.

[2] J. Steiner, *Die Functionen des Centralnervensytems u.s.w.*, 2te Abth. Die Fische, 1888, pp. 50, 126, 19 f., 101.

[3] W. Bateson, "The Sense-Organs and Perceptions of Fishes," *Journ. of the Marine Biol. Assoc.*, 1890, p. 239.

[4] Cf. Stout, *Manual of Psychology*, 1899, vol. ii. ch. i.; also F. H. Bradley, "Memory and Inference," *Mind*, 1899, pp. 145 ff.; and especially Thorndike, *Animal Intelligence*, cited above, a most original and important contribution to comparative psychology.

[5] Experience-continuum would perhaps be a better name, since it is only a preliminary to a true memory-record, as we shall presently see.

probably the most important. A brief account of some of it is therefore offered at this point, by way of illustrating the character of the "new psychology."

The learning and retaining of a stanza of poetry, say, is obviously a function of many variables, such as the mode of presentation (whether the words are heard only, or heard and seen, or both heard, seen, and spoken aloud), the length, familiarity with the words and ideas used, the number of repetitions, the attention given, &c. Familiarity of course implies previous learning and retaining; the first essential, therefore, in any attempt to study these processes from the beginning, is the exclusion of this factor. Accordingly Ebbinghaus, the pioneer in experiments of this kind,[1] devised the new material, which is now regularly employed, namely, closed monosyllables, not themselves words, and strung together promiscuously into lines of fixed length so as never to form words: *ban, rit, por, sig, nef, gud*, &c., is an instance of such "senseless verses." With very slight attention most persons would be able to reproduce three or four such syllables on a single reading or hearing; and by greater concentration six or seven might be so reproduced. This maximum, called sometimes the "span of prehension," has been repeatedly made the subject of special inquiry. In idiots it is found, as might be expected, remarkably low; in school children it increases rapidly between the ages of eight and fourteen, and then remains almost stationary, individual differences being small compared with the striking differences that appear when longer lines make repetitions necessary.[2] This comparatively constant span of prehension is doubtless closely connected with certain other psychical constants, such as the duration of the psychical present and of the primary memory-image, the *tempo* of movements of attention (p. 65), &c. There are isolated investigations of these several conditions, but the subject as a whole still awaits systematic treatment.[3] That it is not wanting in interest is evident when we consider that if our span of prehension were enlarged, a corresponding increase in the variety and range of metre and rhyme in poetry, of "phrase" in music, and of evolution in the dance would be possible. The limits at present imposed on these and like complexities find their ultimate explanation in the constants just mentioned.

With lines of greater length than seven syllables some repetition is requisite before they can be said correctly: the number of such repetitions was found by Ebbinghaus to increase very rapidly with the number of syllables to be learnt. In his own case, for lines of 12, 16, 24, 36 syllables the repetitions necessary were on the average 16·6, 30, 44, 55 respectively. Thus for a line exceeding in length that of the span of prehension only about five times, he required fifty-five times as many repetitions, if we may call the single presentation of the syllables a "repetition." Substituting poetry for gibberish of equal amount, Ebbinghaus found that one-tenth the number of repetitions sufficed; the enormous saving thus effected showing how numerous and intimate are the ready-made associations that "rhyme and reason" involve. But at one and the same time to memorize five verses even of sense requires more than five times as many repetitions as the memorizing of one. Two or three lines of inquiry here present themselves, *e.g.*, (i.) as to the comparative value of successive repetitions when several are taken together; (ii.) as to retention after an interval, as (*a*) a function of the number of repetitions previously made, and as (*b*) a function of the time; (iii.) as to the respective effects of more or less cumulating, or more or less distributing, the repetitions, on the number of these required.

(i.) It is at once obvious that beyond a certain point exhaustion of attention renders further repetition for a time futile; thus Ebbinghaus found 64 repetitions at one sitting of six 16-syllable nonsense verses, a task lasting some three-quarters of an hour, "was apt to bring on asthenia, a sort of epileptic *aura*, and the like"! But keeping well within this heroic limit, a certain "law of diminishing return," to use an economic analogy, discloses itself. Thus taking a line of 10 syllables, the number of syllables reproduced correctly and in their proper order, after 1, 3, 6, 9, and 12 "repetitions," were 2·2, 2·5, 2·8, 3·4, 3·9 respectively, as the averages of a series of experiments with each of eight persons.[4] "The first repetition is undoubtedly the best," assuming, of course, that the subjects start with their attention fully concentrated. Some persons naturally do this, many do not; the experimenter has therefore to take special precautions to secure uniformity in this respect.

(ii.) (*a*) On relearning a line after an interval of twenty-four hours there was in Ebbinghaus's case an average saving of one repetition for every three made the day before. A line of 16 syllables, for example, required some 30 repetitions, and could then be said off correctly. If only 8 repetitions were taken at first, the line being "underlearnt," it probably appeared quite strange the next day, yet the *proportional* saving was no less; on the other hand, if an additional 30 repetitions followed immediately on the first, the line being "doubly learnt," in spite of the familiarity next day apparent, the proportional saving was no greater. The *absolute* saving would, of course, be less. We are so far led to infer that the stronger associations effected by many repetitions at one time fall off more rapidly than weaker associations effected by fewer repetitions in the same way. Herbart in his "psychical dynamics"—influenced probably by physical analogies—conjectured that the "sinking" or "inhibition" of presentations generally was proportional to their intensity: the less there was to sink, the slower the sinking became. Recent experiments certainly point in this direction. (*b*) As to retention as a function of the time—we all know that memories fade with time, but not at what precise rate. Ebbinghaus, by a series of prolonged experiments, ascertained the rate to be proportional to the logarithm of the time—a result already implied in that connecting retention and intensity; albeit in inquiries of this kind independent confirmation is always of value.

(iii.) Had the proportional saving just described held good indefinitely, some 100 repetitions of the 16 syllables at one time should have dispensed with any further repetition twenty-four hours afterwards; whereas, in fact, this result seemed never attainable. Beyond a certain degree of accumulation, an ever-diminishing return was manifest, and that apparently short of the stage at which exhaustion of attention began to be felt. But, contrariwise,

[1] H. Ebbinghaus, "Ueber das Gedächtniss; Untersuchungen zur experimentellen Psychologie," 1885.

[2] Cf. J. Jacobs and F. Galton on the "Span of Prehension," *Mind*, 1887, pp. 75 ff.; Bourdon, "Influence de l'âge sur la mémorie immédiate," *Rev. Phil.* xxxviii., 1894, pp. 148 ff.

[3] Cf. Dietze, "Untersuchungen über den Umfang des Bewusstseins u.s.w.," *Phil. Studien*, 1885, pp. 362 ff.; L. W. Stern, "Psychische Präsenzzeit," *Ztschr. f. Psychologie*, xiii. 1897, pp. 325 ff.; Daniels, "Memory Afterimage and Attention," *Am. J. of Psychology*, vi., 1893, pp. 558 ff.

[4] W. G. Smith, "The Place of Repetition in Memory," *Psychological Rev.*, 1896, pp. 20 ff. The figures given are unquestionably low, partly, as the writer points out, in consequence of the method employed, but partly, as his detailed tables show, in consequence of the lax attention of three out of his eight subjects. Objections have been taken to the plan of this investigation, but it is doubtful if they invalidate the result here mentioned. Cf. Jost, "Die Associations-festigkeit in ihrer Abhängigkeit von der Vertheilung der Wiederholungen," *Ztschr. f. Psychologie*, xiv. pp. 455 ff.

when the repetitions were distributed over several days, an ever-increasing efficiency was then the result. Thus, for Ebbinghaus, 38 repetitions spread over three days were as effective as 68 taken together. The results of careful experiments by Jost with two different subjects, using G. E. Muller's "method of telling" (to be described later on), are still more conclusive. Comparing 8 repetitions on three successive days with 4 repetitions on six, and 2 on twelve, the efficiencies, tested twenty-four hours later, were respectively as 11·5, 35, and 54; and probably, as Jost surmises, the effect of the maximum distribution—single "repetition" on twenty-four successive days—would have been more advantageous still, securing in fact the superiority of a first impression (cf. i. above) on every occasion. This result, again, is in part explained by the law of sinking already found. For if the sinking were simply proportional to the time, or were independent of the intensity, there would so far be no reason why one mode of distributing a given number of repetitions should be more economical than another. There is, however, another reason for this superiority, less clearly implied, to which we shall come presently.

Invariably, and almost of necessity, a more or less complex rhythmical articulation becomes apparent as the syllables are repeated, even when—as in the improved methods of G. E. Müller and his *collaborateurs*—they are presented singly and at regular intervals. A series of twelve syllables, for example, would be connected into six trochees, with a cæsura in the middle of the verse; while in each half of it the first and last accented syllables would be specially emphasized; thus:

bām fĭs | lūp tŏl | *gēn* kĕr || *dūb* năf | &c.

In trying to suppress this tendency and to repeat the syllables in a monotonous, *staccato* fashion, just as they were presented, the *tempo*, though really unchanged, seemed to be distinctly quickened, a consequence, doubtless, of the greater effort involved. Moreover, the attempt, which was seldom successful, about doubled the number of repetitions required for learning off, thereby showing how much is gained by this psychical organization of disconnected material. But the gain thus ensured was manifest in other ways. Each foot, whether dissyllabic or trisyllabic, became a new complex unit, the elements to be connected by successive association being thereby reduced to a half or a third, and the whole line seemingly shortened. The varied intonation, again, helped to fix the place of each foot in the verse, thus further facilitating the mind's survey of the whole. Such a transformation can hardly be accounted for so long as retention and association are regarded as merely mechanical and passive processes.

Psychical rhythm, upon which we here touch, has also been experimentally investigated at great length, alike in its physiological, psychological, and æsthetical aspects. The topic is far too intricate and unsettled for discussion here, yet two or three points may be noted in passing. We are not specially concerned with *objective* rhythms, recurring series of impressions—that is to say, in which there are actually periodic variations of intensity, interval, and the like. What is remarkable is that even a perfectly regular succession of sounds (or touches), qualitatively and quantitatively all alike, a series therefore devoid of all objective rhythm, is nevertheless apprehended as rhythmically grouped, provided the rate lies between the limits of about 0·8″ and 0·14″. The slower of these rates leads to simple groups of two, replaced by groups of four or eight as the rate increases; groups of three and six also occur, though less frequently. The average duration of the groups, whether these are large or small, is comparatively constant, measuring rather more than one second. The subject usually keeps time by taps, nods, or other accompanying movements; the pulse and respiration are also implicated. These organic rhythms have even been regarded as the prime source of all psychical rhythm and of its manifold æsthetic effects. Some connexion there is unquestionably. As the decimal system corresponds to our possession of ten fingers, and our movements to the structure of our limbs, so here we may assume that physiological processes fix the limits within which psychical rhythm is possible, but yet may be as little an adequate cause of it or its developments as fingers are of arithmetic, or legs of an Irish jig. In motor rhythms, such as the last, the initiative is obviously psychical, and the respiratory and other periodic organic processes simply follow suit. And even sensory rhythms can often be varied at the subject's own choice, or on the suggestion of another; and then again the breathing is altered in consequence. Familiar instances of such procedure are to be found in the "tunes" so readily attributed to the puff of a locomotive, to the churning of a steamer's screw, and the like. Psychical rhythm, then, we may conclude, is due to attention or apperception, but the conditions determining it are many, and their relations very complex. If the presentations to be "rhythmized" (the *rhythmizomenon*, as the Germans say) succeed each other slowly, the length (or shall we say the breadth?) of the "psychical present" tells one way: the first impression is below the threshold when the third appears. If they arrive rapidly, their intensity and duration and the span of prehension tell another way; for it is essential that they retain their individual distinctness, and only so many can be grasped at once. But if the series continue long enough or be frequently experienced, sub-groups may be treated as individuals; and indeed till some facility is acquired, the subject attending is aware of no rhythm. In the act of attention itself there are phases, in so far as expectation involves preadjustment to what is coming: usually the first members of a tact are predominant, and the rhythm tends to "fall"; several alternations of accent within a complex rhythmic whole are of course still compatible with this. But it is important to note that, whether simple or complex, the rhythm is an intuited unity as truly as a geometrical figure may be. Unlike a geometrical figure, however, it rarely or never has symmetry. We cannot reverse a tune and obtain an effect comparable with that obtained by reprinting the score backwards in line with the original. We now pass to a question in which the psychological bearing of this fact becomes apparent.[1]

But first a new method of dealing with memory-problems must be mentioned, in which the connexion between rhythmizing and memorizing has been turned to account by the Göttingen psychologists. The method of Ebbinghaus consisted in ascertaining the repetitions saved in consequence of previous repetitions, when the verse was relearnt some fixed time later. Hence this method is called the learning method or the method of saving. When, a given time after a certain number of repetitions (say) in trochaic measure, the subject is confronted with one of the accented syllables and asked to name the unaccented syllable that belongs to it, he will answer sometimes rightly, sometimes wrongly, and sometimes be unable to answer at all. This, the new, method is therefore named *Treffer-methode*, the method of "shots," or, let us say, the telling method. It enables the experimenter to obtain far more insight into details than was possible before, for the "misses" as well as the "hits" are instructive. Moreover, by measuring the time of each answer (*Trefferzeit*) and comparing these times together, much can be learnt; in stronger or recent associations, for example, the answers being quicker than in weaker or older ones.

Does association work forwards only or backwards also, as the middle link of a chain, when lifted, raises the contiguous links on either side of it? This is certainly not the case when the forward direction makes sense, but with nonsense verses, if the mechanical analogy is a sound one, such reversal is to be expected. For here there are none of the obstructing associations which "rhyme and reason" imply. In learning a verse backwards Ebbinghaus found a saving of 12·4 per cent. of the time originally taken up in learning it forwards. A saving almost as great (10·4 per cent.) was effected by relearning a like verse forwards, but skipping one syllable: the order of syllables, that is to say, being 1, 3, 5, . . . 15, 2, 4 . . . . 16. Even when learning backwards and skipping one syllable, Ebbinghaus found a saving of 5 per cent. But the number of his experiments (four) was too few to give this result much value, as he fully admits. These experiments as a whole, then, might incline us to suppose

[1] The following are among the more important papers on rhythm:—J. L. Bolton, "Rhythm," *Am. J. of Psychology*, 1894, pp. 145 ff.; E. Meumann, "Untersuchungen z. Psychologie u. Aesthetik des Rhythmus," *Phil. Studien*, x., 1894, pp. 249 ff., 393 ff.; M. K. Smith, "Rhythmus und Arbeit," *Phil. Studien*, xvi., 1900, pp. 71 ff., 197 ff.; *Arbeit und Rhythmus*, 1899, by K. Bucher, a well-known economist, bringing out the teleological aspects of rhythm.

that association does work in both directions, though the connexions backwards are considerably weaker. But if so the associations both ways should be alike at least in form —continuous, that is to say, backwards, *d c b a*, as well as forwards, *a b c d*. The facts at present available are, however, against this. In two or three hundred experiments by Müller and Pilzecker, verses of twelve syllables were repeated a set number of times in anapæstic measure —accented, that is to say, on the 3rd, 6th, 9th, and 12th. After a fixed interval the subject, confronted with one of the accented syllables, mentioned any of the other syllables which it called to mind. Now the cases in which the syllable *immediately* preceding was revived were only about half as frequent as those in which the syllable *next but one preceding* was revived; the time of telling (*Trefferzeit*) for the latter was also *shorter*. This result is incompatible with the theory of continuous backward association, but it is readily explained by the fact that the group of three syllables had become one complex whole, and it shows that the tendency to reinstate the initial member of the group is stronger than that to reinstate the middle. The saving effected in Ebbinghaus's experiment is also thus explained.[1]

A somewhat paradoxical situation is brought to light when the method of saving and the method of telling are used together. In the experiments by Jost, mentioned above, two series of verses were repeated thirty times; after an interval of twenty-four hours one series was tested by the first method and the other by the second. Two new series were then taken: the first repeated four times, and after an interval of a minute tested by the first method; the other was then repeated in like manner, and tested after the same interval by the second method. The old series was found (by the method of saving) to require on an average 5·85 repetitions for relearning, and the new 9·6; yet on the method of telling, the new series yielded 2·7 "hits," with an average time of about $1\frac{3}{4}$ second for each, while the old yielded only ·9 "hits," with an average time of $4\frac{1}{2}$ seconds for each. Thus one may be able to reproduce relatively little of a given subject-matter, and yet require only a few repetitions in order to learn it off anew; on the other hand, one may know relatively much, and still find many more repetitions requisite for such complete learning. The "age" of the associations is then important. Other things being equal, we may conclude that each fresh repetition effects more for old associations than for recent ones. It might be supposed that the strength of the old associations was more uniform and on the average greater than the strength of the new; so that while none of the old were far below the threshold, few, if any, were above it; whereas more of the new might be above the threshold though the majority had lapsed entirely. And the latter would certainly be the case if the subject of experiment tried to make sure of a few "hits," and paid no attention to the rest of the series. Due care was, however, taken that the ends of experiment should not in this way be defeated. Also, there is ample evidence to show that the supposed greater uniformity in strength of old associations is not, in fact, the rule. We seem left, then, to conjecture that the difference is the effect of the process of assimilation working subconsciously, that psychical aspect of nervous growth which Professor James has somewhere aptly characterized by saying that "we learn to skate in summer and to swim in winter." It continually happens that we can recognize connexions that we are quite unable to reproduce. To the diminished "strength" of an association, as tested by the method of telling, there may then quite well be an equivalent set-off in more developed assimilation. As a seed germinates it has less latent energy, but this is replaced by growth in root and stem: similar relations may obtain when an old association is said merely to lose "strength." On the other hand—within the range of the primary memory-image—we can often reproduce what after a longer interval we should fail to recognize. We seem warranted, then, in concluding that this conception of "association-strength," so freely used by G. E. Müller and his co-workers, requires more analysis than it has yet received. The two factors which their methods disclose in it appear to confirm the distinction we have already made between impressions and free ideas. They help us also to understand, further, the superiority of distributed over cumulated repetition, of "inwardly digesting" over "cram."

[1] There are still other forms of what seems at first sight to be regressive association, but none that do not admit of explanation without this assumption.

Objects of Higher Order: their Analysis and Genesis.

By transposing a tune from one key to another we may obtain two entirely diverse aggregates of notes, and yet the melody may remain unchanged. On the other hand, by varying the order of the notes two distinct tunes may result from the same collection of tones. Sense furnishes merely the parts: whence, then, this identity of the whole in spite of their diversity, this diversity of the whole in spite of their identity? From the sameness or difference of the several "intervals," it is replied. But the answer is insufficient; for the tune is a unity, not a mere series, and, further, with every interval the same problem recurs. For the interval, too, is a whole, though a simple one: it does not necessarily change with a change of its constituents, nor remain the same as long as their distance is unaltered. Feelings and "associations," again, cannot account for the result, inasmuch as such accompaniments are not invariably present: moreover, they obviously presuppose the melody instead of producing it. Of such complex wholes or combinations—as distinct from mere aggregates or collections—there are many forms; as, for example, geometrical figures and patterns, motions and other changes, numbers, logical connexions, &c. In view of this variety it seems to strike the unprejudiced as wild to expect that "the progress of psychophysics" may disclose an explanation of such combinations conforming to the old scholastic maxim, *Nihil est in intellectu quod non fuerit prius in sensu.* Yet hopes of such a *generatio æquivoca* are entertained![2] Meanwhile the "old psychology," at any rate, is content to regard such complex wholes as we have already done (pp. 79, 80)—as new presentations, that is to say: the products, not of a quasi-mechanical interaction of their constituents, but of intellectual synthesis.

What is here said of the combinations whereby the items of an aggregate are construed as parts of a whole holds equally of the comparisons whereby such items are related, as like or unlike, compatible or incompatible. Before either combination or comparison is possible, such items or particulars must be "given." But it is conceivable that they should be given and no intellectual synthesis ensue; such a consciousness has been happily named *anoetic*.[3] Whether or no it actually exists is another matter: it is a conceivable limit, and has the theoretical usefulness of limiting conceptions generally. But relative *anoesis* suffices here. Suppose, then, we have: (*a*) *item*, a sound; *item*, ditto; *item*, ditto; or (*b*) *item*, blue; *item*, green. The sensationalist, from Hume onwards, has complained that he does not find in the one case a

[2] Cf. *e.g.*, F. Schumann, "Zur Psychologie der Zeitanschauung," *Ztschr. f. Psychologie*, xvii. pp. 130, 136.

[3] G. F. Stout, *Analytic Psychology*, i. pp. 50 f.

further item: *total three;* nor in the other a further item: *unlikeness.* After vainly seeking the living whole among the dead particulars, he next surmises that they generate it by their conjoint action! But whence this notion of "action"; and how, if such *disjecta membra* suffice, do they so often fail of their effect, so that we cannot "see the wood for the trees"? Combinations and comparisons then, we conclude, are not given, but "grounded" on what is given, and is thus their *fundamentum.* Hence Meinong, who has studied the psychology of intellection with especial care, has called the new presentations, due to this process of "grounding" (*Fundiren*), "objects of a higher order," or ideal objects.[1] They have validity in respect of the particulars on which they are grounded, but not reality as data existing for perception alongside of such particulars.

The reader will here be reminded of Hume's distinction between knowledge and probability. His four philosophical relations, "which, depending solely upon ideas, can be the objects of knowledge and certainty—resemblance, continuity, degrees in quality, and proportions in quantity or number"—are objects of higher order, and *ideal.* "The other three, which depend not upon the idea, and may be absent or present even while *that* remains the same"—namely, identity, the situations in time and place, and causation—are thus obviously not the result of grounding or *noesis* merely, are not ideal but *empirical,* and have, that is to say, existential import. In fact, the second of these, the situations, though they imply synthesis in the wider sense in which all complex perception does, do not involve intellectual synthesis at all: are neither ideal combinations nor ideal relations. And since such temporal and spatial situations enter into both the other two—numerical identity and causation—the mixed, *à posteriori* character of these is obvious. Whatever be the defects of Hume's psychology, his classification of relations is so far sound, and its epistemological importance can hardly be overrated. It is accordingly to be regretted that the one vague term "relation" does not allow us to make these distinctions more precise. The German language, with the two terms *Verhältniss* and *Beziehung,* can do more.

When we say that two "contents" are similar, and when too they admit of analysis, we can, if need be, enumerate certain elements as the ground of their partial likeness, and certain others as maintaining their partial diversity. We may further say that, abstracting from these last, we can regard the points of resemblance as constituting a general class to which the two contents belong as specific instances. But how is either comparison or abstraction possible when the two resembling contents appear as simple, and so far unanalysable? Instances, of course, are familiar to every one: thus we call red and orange colours, and say they resemble each other more than do red and blue. In presence of this question logicians and psychologists are apt to be at loggerheads. The logician maintains that abstraction and resemblance (as distinct from qualitative identity) imply complexity; and surely here he cannot be gainsaid. Yet there are the facts: reds and blues of sorts and a whole scale of degrees of likeness and unlikeness; but no constituent parts, no assignable marks of identity or diversity, are forthcoming, such as we find when we class sugar and salt together as solid or soluble, and pronounce them like in colour and unlike in taste. Here the logician's symbols $a+b+c$, $a+b+d$, have their counterparts: there—for the percipient's consciousness at all events—they have not. We cannot "consider and attend to either the sameness or the differences in" red and blue, as we can to the like or the unlike properties in salt and sugar. None the less it would be hasty to conclude that colours or any given sensations are simple. In the first place, musical notes, which were long taken to be so, can with due practice be perceived as a complex of ground-tone and over-tones; and there is indirect evidence of still greater complexity in the case of many so-called tastes. Further, we are often struck by the likeness of complex wholes—two faces, say—long before we can discern the exact points of resemblance. Still, so long as there is no perceptible complexity in the individual presentations there can be no analysis of them and, therefore, neither abstraction nor comparison based upon it. Can we find elsewhere the complexity that generalization and comparison invariably imply? This question has been already in the main anticipated (cf. pp. 77, 80), but perhaps with undue brevity. A word or two by way of further exposition seems therefore desirable.

Though colour may be regarded as a general term applicable alike to red, green, and blue, just as animal is a general term applicable alike to bird, beast, and fish, it is a mistake to infer that the processes are the same because of this similarity in their products. We seem bound to distinguish between consciously logical or "noetic" processes and processes that are unconsciously logical or "hyponoetic," as we may perhaps call them. In the former the subjective aspect is left aside; in the latter it cannot be. The only common mark we can psychologically assign to colours is that they are all seen, and to tones—as the element of notes and noises—that they are all heard. So often as we talk of tasting tastes, smelling smells, feeling touches, language leads us to bear witness to this fact. When the sunset red changes to the twilight grey, I still see; but when the thunder follows the lightning there is a double change, though not an absolute one: from seeing I pass to hearing, but I am sentient still. And if progressive differentiation be the order of experience (cf. p. 42), then the "universal" sentience precedes the differentiations seeing, hearing, &c., and, again, the "universal" colour the differentiations, red, green, blue, &c. Such "first universals," then, are not reached by abstraction, but are given in the fundamental continuity of experience, and their subsequent differentiation admits neither of definition nor the classification applicable to discrete complexes, which are the material of logical comparison only. When red is pronounced liker or nearer to yellow than it is to green, this is because a smaller change is experienced in the transition from red to yellow than in that from red to green, and because in the latter yellow is reached and passed before green appears.[2] Proximity and resemblance are, then, so far one and the same; also both are equally relative, admit of the same indefinite gradation, and have the same limit in *zero,* regarded either as coincidence or identity. The conception of "distance between" answers, then, to what we have called a hyponoetic relation, and this is plainly distinct from the analysis of discrete complexes, with which, as said, noetic comparison is alone concerned: the one implies and the other excludes the notion of continuity and change—a fact which helps still further to distinguish the two.

Emotion and Emotional Expression.

The nature of emotion and its relation to the various organic changes and bodily movements, commonly described as its expression or manifestation, have been continually under discussion since the appearance in 1884 of the notorious article, "What is an Emotion?" in which Professor W. James[3] turned the views of Common Sense upside

[1] A. Meinong, "Ueber Gegenstände höherer Ordnung u.s.w.," *Ztschr. f. Psychologie,* xxi., 1899, pp. 182 ff. Special mention must be made of an earlier paper by C. v. Ehrenfels ("Ueber Gestaltqualitäten," *Vierteljahrsschr. f. wissensch. Philosophie,* 1890, pp. 249 ff.), round which the whole subsequent discussion of this topic centres. Cf., too, Stout, *op. cit.,* bk. i. ch. iii.

[2] Assuming, of course, that the change is the simplest or directest possible, *i.e.,* a change of "colour proper" without change of saturation.

[3] *Mind,* ix. pp. 188 ff., and, again, *Principles of Psychology,* ch. xxv. Very similar views were advanced independently, and almost at the same time, by the Danish physiologist, C. Lange: hence the name,

down. "Common Sense says: we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike." But, Professor James continues, "the hypothesis here to be defended says that this order of sequence is incorrect: that the one mental state is not immediately induced by the other, that the bodily manifestations must first be interposed between, and that the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble because we are sorry, angry, or fearful, as the case may be." In a word, whereas it is commonly supposed that the emotion precedes and produces the expression, it seems here to be maintained that the expression precedes and produces the emotion. But the sequence denied in the first case is a psychological sequence, the sequence maintained in the second is a physiological sequence. The subject's experiences of the bodily expressions is here the emotion, and these are physically, not psychically, determined. "They are sensational processes," says Professor James; "processes due to inward currents set up by physical happenings."

The new theory is, then, in part psychological, in part psychophysical. As to the first part, which the author calls "the vital point of the whole theory," it consists mainly in exposing the ambiguity of the phrase "bodily expression of an emotion"—a phrase which is liable to mislead us into fancying that emotion, like thought, may be antecedent to, or independent of, any expression or utterance. My fear or anger may chance to be *expressive* to another, but they are of necessity *impressive* to me. "A disembodied human emotion is a sheer nonentity." In so far as I have a certain emotion, in so far I have "the feelings of its bodily symptoms." This is true, not to say trite; but how do these symptoms arise? With this question we pass to the psychophysical side of the theory, and here it becomes perplexing, and is itself perplexed; for to this question it is driven to return two distinct and divergent answers. First, we are told that it is not the emotion that gives rise to the bodily expression, but that, on the contrary, "the bodily changes follow directly the perception of the existing fact," it being beyond doubt "that objects do excite bodily changes by a preorganized mechanism." Again: "Each emotion is," for Professor James, "a resultant of a sum of elements, and each element is caused by a physiological process of a sort already well known. The elements are all organic changes, and each of them is *the reflex effect of the existing object*." The old attempts at classification and description being contemptuously dismissed as belonging only to "the lowest stage of science," we are informed that now we step from a superficial to a deep order of inquiry. "The questions now are *causal*: 'Just what changes does this object and what changes does that object excite?' and 'How come they to excite these particular changes, and not others?'" But we have not had to wait for the James-Lange theory to raise these questions, and surely there are none that bring out its defects more glaringly. "Objects" that determine bodily changes by means of preorganized mechanism and without psychical interposition might fairly be taken to be physical objects; and indeed the whole process is expressly described as reflex. But only very slovenly physiologists talk of "objects" exciting reflexes: it is inexact even to say that sensations do so. All that reflex action requires is a *stimulus*. "The essence of a reflex action," says Foster, "consists in the transmutation, by means of the irritable protoplasm of a nerve-cell, of afferent into efferent impulses." Let Professor James be confronted first by a chained bear and next by a bear at large: to the one object he presents a bun, and to the other a clean pair of heels; or let him first be thrilled by a Beethoven symphony and then by a Raphael Madonna. Will he now undertake to account, in terms of stimuli and their reflex effects, for the very different results of the similar "causes" in the one case, or for the similar results of the very different "causes" in the other? Such a challenge would certainly be declined, and Professor James would remind us that in his nomenclature "it is the total situation on which the reaction of the subject is made."[1] But there is just a world of difference between "object" = stimulus transformed by preorganized mechanism into an efferent discharge, and "object" = total situation to which the subject reacts. The attempt to explain emotion causally on the lines of the former meaning lands us in the conscious automaton theory, with which we must deal presently: this Professor James rejects. The latter meaning, on the other hand, involves the recognition of the subject's attitude as essential to the reaction, and of this as determined by pleasure, pain, or by some "interest" resting ultimately on these. Such, with scarcely an exception, has always been, and still remains, the analysis of emotion in vogue among psychologists. It brings to the fore a new category, that of worth or value, one wholly extraneous to the physiologist's domain, and repugnant to the mechanical analogies which are there in place. No doubt such a conception is attained only by reflection, but the experiences from which it is drawn, the affective states, the conative tendencies of the subject experiencing, must first precede. From this central standpoint alone the objective situation has a worth which explains the subject's attitude, and here alone can we find the clue which will enable us to answer the questions of cause that Professor James propounds.

The experimental investigations of Mosso, Féré, Lehmann, and others have shown that the vasomotor and such like bodily changes as are prominent in emotional excitement are present also to some extent in all forms of conscious activity. The more unwonted and interesting the situation, the more diffused movements predominate over movements that are purposive; the further assimilation, both on the cognitive and the reactive side, has advanced, the more diffusion is replaced by restriction and adaptation. But we are not warranted in separating these factors of voluntary activity into distinct processes, as the physiologist, for example, separates the functions of striped and unstriped muscle. Unless we are prepared to treat *all* activity as reflex—as the physiologist may quite well do, if he keep strictly to his own point of view—it does not seem possible to regard emotional expression as so much organic sensation with which purposive movement has nothing to do. No doubt this connexion of vegetal and animal functions remains one of the obscurest in all psycho-biology, though its teleological fitness is obvious enough.

Nevertheless, Professor James's main position is that an emotion is but a sum of organic sensations; and in order to establish this he is led to the second and very different statement which we have now to examine. Here, so far from suggesting inquiries as to the "objects" that excite emotion, his point is to maintain that in so far as the bodily cause is set up, *be the means what they may*, in so far the emotion is present.[2] And here, at length, the contention is explicit: Emotions *are* a certain complex of organic sensations, and such complexes *are* emotions: the two are not merely coexistent, they are identical. The exciting object is thus, after all, physiological; that is to say, it is whatever stimulus sets up the sensations. It cannot be psychological, "the total situation for the

James-Lange theory, by which their views are now commonly known. Of Lange's work, a German translation, *Ueber Gemüthsbewegungen: eine psychophysiologische Studie*, was published in 1887.

[1] "Physical Basis of Emotion," *Psychological Review*, 1894, p. 518. In this reply to criticisms Professor James is supposed to have modified his views: it would be nearer the truth to say that he has made admissions incompatible with them.

[2] *Text-Book of Psychology*, 1890, p. 383.

reacting subject," for in this sense the emotion, it is maintained, may be "objectless." In support of his position Professor James first of all cites pathological cases of such objectless emotion. He next follows up these with accounts of other cases in which emotional apathy seemed to keep pace with sensory anæsthesia, arguing that, according to his theory, a subject absolutely anæsthetic should also be incapable of emotion, although "emotion-inspiring objects might evoke the usual bodily expression from him." Whether *any* testimony from lunatics, hypnotics, and other minds diseased could suffice to establish this novel doctrine is questionable: that the evidence so far adduced is insufficient, Professor James seems himself to allow. There are some four or five of the apathetic cases altogether: three of them are regarded by the mental pathologists who describe them as adverse to Professor James's theory.[1] Of the fourth case, reported by a pathologist on Professor James's side, the latter himself candidly observes, "We must remember that the patient's inemotivity may have been a co-ordinate result with the anæsthesia of his neural lesions, and not the anæsthesia's mere effect." This missing link in the argument is supplied by the experiments of Professor Sherrington,[2] and these show conclusively that normal emotional states *are* possible along with complete visceral anæsthesia. As to emotional excitement induced by intoxication or disease, and so far *groundless*, the most that can safely be said is that the object may be vague, ill-defined, and shifting, but not that it is absent altogether. States of physical exaltation, depression, or irritability readily arouse by association appropriate *troupes* of imagery; only when they fail of this are we entitled to say that there is no object, and then we must add that there is also no emotion.

Relation of Body and Mind: Psychophysical Parallelism.

Of disembodied mind as a *res completa* we can form no conception. It might even be said that such a conception is a contradiction in terms, since living experience refuses to be sundered into the unmediated dualism of *res cogitans* and *res extensa*, as in Descartes' Philosophy; and since, again, the subject of experience is invariably related to the objective environment by means of its organism. It is this connexion of mind and organism that we have now to consider. In development and efficiency, in the intensity and complexity of their processes, mind and brain keep invariably and exactly in line together. Striking and impressive instances of this correspondence are to be found in comparative psychology, and especially in mental pathology; but it is needless here to enlarge on a point which in the main is beyond dispute. In this correspondence lay the plausibility of the old materialism. But a closer scrutiny discloses an impressive disparity—that of quality may suffice as an example. We reject materialism, accordingly, while still maintaining this *Psychoneural Parallelism* to be a well-established fact. From this we must distinguish a second sense of parallelism founded on the disparity just mentioned as also pertaining to the psychical and neural correlates. We may call this *Physiologico-psychological*, or, more briefly, *Methodological, Parallelism.* It rejects, as illogical, the attempt to penetrate to psychical facts from the standpoint of physiology, so persistently and confidently pursued by the old materialists. It also forbids the psychologist to piece out his own shortcomings with tags borrowed from the physiologist. The conceptions of the two sciences are to be kept distinct, as the facts themselves to which they relate are distinct (cf. above, p. 57). Confusion is inevitable if the psychologist, for example, talks of his volition as the cause of his arm moving, when by arm movement he means the process described by the physiologist in terms of efferent excitations, muscular flexions, and so forth; or if the physiologist speaks of a sensation of red as produced by retinal stimulation due to light-waves of a certain length, when by sensation he means what he immediately experiences on looking at a field-poppy. This methodological convention, as we may call it, implies a more stringent interpretation of causation than that expounded by J. S. Mill and his contemporaries. It does not, however, forbid psychological inferences on the basis of physiological facts, nor *vice versâ*. But in spite of this distinctness of the facts, and of the standpoints from which they are respectively studied, their causal relation cannot be simply ignored: it is, however, a problem that pertains strictly to the higher standpoint of philosophy. There have been in all four different theories of this relation within modern times: (1) that of mutual interaction—the Common-sense view—very inconsistently maintained by Descartes; (2) the "Occasionalism" substituted for this by Geulincx and the later Cartesians; (3) the Pre-established Harmony of Leibnitz; and (4) the Monism of Spinoza, which reduced matter and mind to parallel attributes of the One Substance.[3] The last of these—severed, however, from Spinoza's metaphysics—is now the prevailing theory, and to it the term *Psychophysical Parallelism* most properly applies. For whereas the parallelism first mentioned states a real correspondence between psychical processes and neural processes, but leaves open the question of a possible interaction between matter and mind, psychophysical parallelism is a pure hypothesis concerning the relation of psychical facts to physical theories, on the ground of which—as we shall presently see—any interaction between matter and mind is expressly denied.

But in the exposition of this hypothesis these two meanings of parallelism are frequently confused or interchanged. The same term "body" is applied both to an aggregate of matter and to the living organism. Now life must be regarded as either inherent in matter, or as the result simply of a particular material configuration, or as physically inexplicable. But, for the present at all events, it cannot be explained physically; nor are we even within measurable distance of such an explanation: so much is beyond cavil. Yet the hypothesis of psychophysical parallelism confines us to one or other of the former alternatives: at the same time its unwarrantable identification with psychoneural parallelism—where we find a real correspondence between mind and *organism*—tends to conceal the gravity of such assumptions. The standpoint of physiology, therefore, must be described not as identical with that of physics, but as intermediate between it and the standpoint of psychology. If the fact of life could be reduced to physical terms, physiology then, no doubt, would have to fall into line with physics, much as chemistry, for example, may have had to do. On the other hand, till a physical explanation of life is forthcoming, physiology belongs, with psychology, to the biological group of sciences, and cannot divest itself completely of the teleological conceptions essential to them, not a vestige of which belongs to bare physics. It is just because of this community in their conceptions that there actually is a certain "point to point" correspondence or parallelism between the psychical and the neural: as an *organ* a neuron is a unit; physically regarded, it ceases to be one. Yet this illicit identification of organism and material body is thought to be legitimate, inasmuch as physiological processes are found to rest invariably on a physical basis; and inasmuch as, though methodological parallelism forbids the physiologist to identify *psychosis* with *neurosis*, no limits can be imposed on his efforts to ascertain the mechanism of the neurosis itself. But if this be granted, is not psychophysical parallelism justified, in principle at all events? By no means: as little, for example, as an

[1] G. H. J. Berkley, "Two Cases of General Cutaneous and Sensory Anæsthesia without Marked Psychical Implications," *Brain*, 1891, vol. xiv. pp. 441 ff.

[2] "Experiments on the Value of Vascular and Visceral Factors for the Genesis of Emotion," *Proc. Roy. Soc.*, 1900, lxvi. pp. 390 ff.: and *Nature*, vol. lxii. pp. 328 ff.

[3] Particulars of these theories will be found in the articles dealing with the authors of them.

explanation of the mechanism of a locomotive would justify us in ascribing its origin, its maintenance, or its guidance to the machine itself. When life and mind are explained by their mechanism, the physicist may summon the biologist, as Mephistopheles did Faust, "*Her zu mir*": then, but not before.

A favourite mode of stating psychophysical parallelism is that known as the *Double Aspect Theory*. In this, besides the unjustified identification of the first and third meanings, we find also an equally unjustified interpretation of parallelism in the second sense. All that methodology prescribes is that psychologists and neurologists—and, we may add, that physicists too—shall severally, as "specialists," mind their own business. Again, all that the first two jointly ascertain is simply the fact of correspondence: the explanation of it is still to seek. Two propositions are now advanced which are held to meet this need. First—and negatively—the connexion, it is said, is not causal: mind does not act on body, nor body on mind: the changes on each side form two independent series, each "going along by itself." In other words, the series themselves are said to exemplify what methodology enjoins on the sciences that investigate them—they mind their own business and never intrude into each other's domains. Nevertheless their interaction is not *primâ facie* contradictory or absurd, and ordinary thought, as we have seen, assumes that it exists. What evidence, then, is there for denying it absolutely? Empirical evidence for such a universal negative there can hardly be; it must be established therefore—if established at all—on *à priori* grounds. Meanwhile two facts already noticed make seriously against it. On the psychical side sensations point to an intrusion of some sort, and are not psychically explicable (cf. above, p. 57); and the like—for the present at all events—must be said of the fact of life on the physical side. Apart from all this, it seems plain that methodological parallelism, so far from justifying the denial of interaction, simply precludes its discussion on the dualistic level to which that parallelism is confined. The gulf implied is indeed not absolute—of so much, parallelism in the first sense assures us—but those who are forced to keep to their own side of it obviously are not the people to settle how it is crossed. We are aware that the dualism is not absolute, it is replied: it is only phenomenal, and the two series of phenomena are conditioned by an underlying unity of substance. Such is the second, and positive, proposition of the Double Aspect Theory. Again asking for evidence, we learn that this underlying unity is unknown—in fact, unknowable. This unknowable substance is assumed, then, simply because—*the impossibility of causal connexion being taken as established*—no other alternative remains. The negative proposition is thus the foundation of the theory, and without it this agnostic monism becomes entirely arbitrary. We have therefore to continue our search for the grounds on which the possibility of interaction is denied. But it will be worth while first to examine certain ambiguities besetting the positive statement of the Double Aspect Theory.

Difference of aspect may result solely from difference of standpoint, or it may be due to difference in the reality itself. The circle, seen as concave from within and as convex from without, is an ancient instance of the first still in great favour; the pillar, that was cloud and darkness to the Egyptians but light to the children of Israel, may serve to exemplify the second. The former we may call the phenomenal, and the latter the ontal, meaning of "aspect." With these two very different meanings our theory plays fast and loose as suits its own convenience. To do this is easy—in so far as the reality is unknown and unknowable; and necessary—since in the end, the reality, however unknowable, must somehow include both the phenomenal aspects and all that pertains to them, and so far therefore be known. In dealing with "aspect" in the first sense, the one question to be raised concerns the nature and relation of the respective standpoints. To the one belongs what we know as individual experience, and this is essentially concrete, immediate, and qualitatively diverse; to the other belongs an abstract, conceptual scheme, wholly quantitative, familiarly known as the mechanical theory. Between these there is plainly no such co-ordination as the inept comparison with the inside and the outside of a circle implies.[1] Neither is there, on the other hand, the same complete opposition; for the entire mechanical theory is based upon individual experience as enlarged and developed by intersubjective intercourse (cf. above, p. 56). Both the sense-knowledge of the one and the thought-knowledge of the other relate to the one objective factor involved in both. So far, then, there is fundamentally only one standpoint—that of the subjective factor to the objective factor, which is immediately perceived in the one and mediately conceived in the other. The question here raised is then primarily epistemological, but it is a question, as we have seen, in which psychology is intimately concerned. "Aspect" in the second sense is independent of standpoints. We have here to deal with attributes of the one reality, more or less in Spinoza's sense; this reality itself is so far dual. But in this case the question of causal connexion between these attributes is not escaped. For to know that a thing has invariably two attributes does not enable us to determine straightway how the changes or "modes" of the one are connected with those of the other. (1) The same attribute might be always the initiating or independent variant, and then would come the question of finding out which of the two it was; or (2) it might be that now one, now the other, took the lead, the grounds of this alternation being then the matter for inquiry; or, finally, (3) it might be, as our theory assumes, that there was but a single series of double changes. The questions here raised are philosophical questions, but again they are questions in which psychology is intimately concerned. Our examination thus yields two results: first, there is fundamentally only a single standpoint—that of experience, now at the perceptual, now at the conceptual, level; and, secondly, the distinction of aspects is not merely phenomenal, but pertains "somehow" to reality. The question is how; and this leads us to resume our inquiry into the grounds on which interaction is denied.

They are neither psychological nor physiological, but—in spite of the outstanding difficulties connected with sensation and life which these sciences severally raise—such denial is upheld mainly on the strength of an interpretation of the principle known as the conservation of energy—an interpretation of it, however, which many of the ablest physicists disallow. The energy of the physical world, it is maintained, is a strictly invariable amount; matter, therefore, cannot act on mind, for such action would entail a decrease, nor can mind act on matter, since that would entail an increase, of this energy. In other words, the material world is held to be a "closed system"; and as all the changes within it are mass-motions, there can be none which are not the effect and equivalent of antecedent mass-motions. But now this statement must be established

[1] In fact, if there were, since it is only as we contemplate finite portions of the circle that the distinction of concave and convex is present, the nearer we approximated to its elements the more this difference of aspect would disappear. If on the physical side we called these elements atoms, there would be an answering element of "mind-stuff" on the psychical; and there would be no more unity and no other diversity in a given man's mind than in his brain regarded as a complex of atoms. Wild as all this seems, yet views of the kind have been seriously put forward more than once as the logical outcome of psychophysical parallelism.

on physical grounds: to assume it otherwise would be openly to beg the very question at issue. For if mind does act on matter, the physical mechanism *is* subject to changes from without, and so often its motions are *not* due to antecedent motions; and this—the Common-sense view—cannot, of course, be summarily dismissed as impossible or absurd. Now energy is essentially a metrical notion, and its conservation in finite and isolated material systems has been ascertained by careful quantitative experiments. To say that the energy of the material universe is constant is only a way of expressing the generalization of this result—is tantamount, in other words, to saying that it holds of all finite isolated systems. The *whole* universe may perhaps be called isolated, but we do not know that it is finite. We cannot, therefore, apply metrical conceptions to it, and consequently cannot interpret the conservation of energy as meaning that the physical part of it is a closed system. But if not a closed system, then the energy of a given group of bodies may be increased or decreased without interaction between that group and other bodies—may be increased or decreased by psychophysical interaction, that is to say. And, moreover, such psychophysical interaction would not invalidate the conservation of energy, rightly understood; for that merely means that the energy of a group of bodies can be altered only from without, and this might happen whenever such interaction occurred.[1] We seem, therefore, justified for the present in rejecting psychophysical parallelism as one of the three possible modes of relating mind and matter regarded as attributes of the real. Not only are there psychological as well as biological objections which it has not yet overcome, but there are so far no physical grounds in its favour.

At this point we may again for a moment turn aside to consider a modified form of the doctrine—the so-called *Conscious Automaton Theory*, an attempt to blend the old Cartesian views concerning the minds of man and brute. According to Professor Huxley, the best known modern exponent of this theory, "our mental conditions are simply the symbols in consciousness of the changes that take place automatically in the organism." This consciousness is supposed "to be related to the mechanism of the body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle . . . is without influence upon the locomotive's machinery": thus "the feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act." In other words, physical changes are held to be independent of psychical, whereas psychical changes are declared to be their "collateral products." They are called *collateral* products, or "epiphenomena" to obviate the charge of materialism, and to conform to the interpretation of the conservation of energy that we have just discussed. Such a theory is, strictly speaking, one of parallelism no longer: rather it adopts, instead, the first of the two possibilities we have noted above as opposed to parallelism. According to it, matter is the initiating or independent variant, on whose changes mind simply follows suit. It is open to two fatal objections. First, it is methodologically unsound: its psychology is physiological in the bad sense. It regards all states of consciousness as passive, *i.e.*, as ultimately either "feelings" or "reflexes." Volitional activity is declared illusory; and if this be true, intellectual activity must be illusory too. But to detect illusion requires experience of reality—we only know the sham by knowing the genuine first; and even passive states could not be experienced as such save by contrast with states that are active. To the physical side, then, we naturally turn for this knowledge which we are told is not to be found on the psychical; and we do so the more readily as, according to the present theory, the physical holds the primary place. But we turn in vain; for matter is inert, and its energy only "works" by taking the line of least resistance, like water running down hill. Moreover, such activity as we are in search of could only be found here in case the physical mechanism showed signs of being intelligently directed, and that would also be evidence that psychical activity is not illusory. Is, then, the physical side after all primary? No, we reply: the assumption is epistemologically unsound. This is our second objection. The *order* implied in the distinction of physical phenomena and psychical *epi*phenomena is contrary to all experience and indefensible. A physical phenomenon is either actually perceived or possibly perceptible; otherwise it is devoid of empirical reality altogether. But objects of perception are so far psychical; that is, they belong to immediate or individual experience. Therefore we cannot regard them as independent of this experience, nor this as their collateral product, *i.e.*, as epiphenomenal. Again, the *phenomenality* supposed to be common to both involves, as we have already seen, a fundamental identity in the standpoint of each: they belong to the same continuous experience at different levels. And lastly, their abstract, merely quantitative, character shows that it is the conceptions of physics, and not the fact of immediate experience, that are symbolic, and so to say epithetic. The attempt—either empirically or speculatively—to outflank mind by way of matter is an absurdity on a par with getting into a basket in the hope of being able to carry oneself.

These epistemological considerations may help us to deal with the prime and ultimate argument for strict parallelism. When all is said and done, it is urged, still the interaction of mind and matter remains inconceivable:

Tangere enim et tangi nisi corpus nulla potest res.

But this is hardly a sufficient reason for denying what is *primâ facie* a fact. Occasionalists, from Geulincx to Lotze, have acknowledged the same obscurity in *all* cases of transitive action. Yet they did not venture to deny that sensations were interruptions in the psychical series, the "occasions" for which were only to be found in the physical; nor that purposive movements were interruptions in the physical series, the "occasions" for which were only to be found in the psychical. And surely such a position is more in harmony with experience than that of the parallelists, who maintain that each series "goes along of itself"—a statement which, as we have repeatedly urged, contradicts psychology and assumes the physical "explanation" of life. Whereas occasionalism leaves the question of ultimate means to be dealt with by metaphysics,[2] parallelism forecloses it on the basis of a ready-made metaphysics—modern naturalism, that is to say—in which psychology as an independent science is entirely ignored. Starting with a dualism as absolute as that of Descartes — but replacing his two substances by one, enjoying the *otium cum dignitate* of the Unknowable—starting, too, from the physical side, no wonder such a philosophy finds that what is for us the most familiar and of the supremest interest, the concrete world of sense and striving, is for it the altogether inconceivable, the supreme "world riddle." And yet if the naturalist could deign to listen to the plainest teachings of psychology and of epistemology, the riddle would seem no longer insoluble, for

[1] The possibility is enough: we cannot tell what actually happens, and do not, therefore, know how far the direction of matter by mind calls for a modification or limitation of physical hypotheses. Cf. Ward, *Naturalism and Agnosticism*, 1899, vol. ii. pp. 73–86.

[2] Cf. Lotze, *Metaphysik*, sec. 61 *fin.*

his phenomenal dualism and his agnostic monism would alike disappear. The material mechanism which he calls Nature would rank not as the profoundest reality there is to know: it would rather become—what indeed "machine" primarily connotes—an instrumentality subservient to the "occasions" of the living world of ends; and so regarded, it would cease to be merely calculable, and would be found intelligible as well. Psychophysical parallelism, then, we conclude, is not a philosophically tenable position; and—pending the metaphysical discussion as to the ultimate nature of interaction generally—we have to rest content with the second of the three possible modes of connexion above defined, as occasionalism formulates it. According to this, the two series, the psychical and the physical, are not independent and "closed" against each other; but in certain circumstances—*e.g.*, in perception—physical changes are the occasion of psychical, and in certain circumstances—*e.g.*, in purposive movements—psychical changes are the occasion of physical: the one change not being explicable from its psychical antecedents, nor the other from its physical.

Into the metaphysical discussion we cannot, of course, enter here. It must suffice to say that it will not be conducted on the lines of our present inquiry: it will not start from a dualism of matter and mind, either regarded as substances or as phenomena. Its problem will rather be the interaction of subject and object—a duality in the unity of experience, which by no means coincides with the dualism of matter and mind, neurosis and psychosis, and the like.

Comparative Psychology.

Psychoneural parallelism is no doubt a well-established generalization; nevertheless, concerning its exact range and its precise meaning there are differences of opinion. It is applicable, every one will allow, so soon as there is evidence of experiences individually acquired (cf. p. 55 above); and from such point onwards, in ascending any biological phylum, we find that the psychical and neural aspects differentiate and develop together. But how when we descend? Interpreting the neural correlate physiologically, and not morphologically, as referring primarily to function and not to structure, we find it still present as irritability and conductivity (leading to contraction, secretion, &c.), even in unicellular organisms. But as at higher levels psychosis is correlative to neurosis, the principle of continuity would justify us in assuming a like correspondence here. Moreover, "learning by experience," the comparative psychologist's criterion, obviously presupposes some antecedent and underlying process, of which it is the differentiation and development. And our general analysis of mind, if correct, enables us to describe this process—"the irreducible psychical minimum," of which we are here in search. We have such complete psychosis—and it is the simplest we know—in the emotional or diffused movements that follow immediately upon sensation; and these are so far purposive—though not intentional—that they tend to heighten or retain what is pleasurable, and to alleviate or remove what is painful (cf. pp. 43 and 73). Given that plasticity,[1] which is the psychological presupposition of all acquisition, then learning by experience is a possible development from such a primitive stage.

But though every psychosis have its concomitant neurosis, it is uncertain how far the converse holds good. The action of the heart, for example, depends upon neuroses of which we have now no *direct* consciousness. Facts of this kind have led to three hypotheses concerning the lowest forms of life, differing more or less from that just proposed. (i.) Perfectibility and instinct are found, it is said, to be in inverse ratio. Hence in the lowest forms of life there is no "learning by experience," because a stationary state of complete adjustment to environment has been already attained, and all reactions have therefore become "secondarily automatic": consciousness having served its purpose, has disappeared. To such a very Buddhistic psychology it may be objected: (1) that even organic reflexes tell upon the so-called vital sense or *cœnæsthesis*, and so far—the irreducible minimum being still intact—do not preclude all possibility of learning, should occasion arise; and (2) that the psychical life even of a Protozoan does not, according to the best evidence, show any such mechanical finality as is here supposed. (ii.) According to the second view, which is advocated by Mr Herbert Spencer, the behaviour of the lower organisms is wholly made up of such reflexes, supposed to be devoid of all psychical concomitants; but consciousness—so far from having disappeared—first comes upon the scene at the opportune moment when the increasing complexity of the mechanism calls for its guidance. Psychologically this hypothesis is less defensible than the last, and it has already been dealt with at some length (cf. pp. 42 *fin.*, 43). It not only assumes, as that does, far more uniformity in the interaction of organism and environment than the facts warrant, but in regarding life as prior to mind, and as the means of its evolution, it burdens science with two insoluble problems instead of one. For even if it were possible chemically to build up protoplasm, we should still be as far from organisms as a heap of bricks are from putting themselves together as a house. (iii.) The last view we have to notice is essentially an extension of the preceding, and is chiefly interesting as a *reductio ad absurdum* of that. The physics of colloidal substances—at present wanting, but confidently expected "in the near future" by certain biologists—is the key which is to unlock the mysteries of protoplasm. Certain organisms, regarded as varieties of this substance, react positively to a given physical property of the environment, and others negatively: thus a moth flies towards the light, and a centipede runs from it—the one is positively, the other negatively, "heliotropic"; the radicle of a seed, growing downwards, is positively, the plumule, growing upwards, is negatively, "geotropic." Instincts are but complexes of such tropisms, and owe their character entirely to the symmetrical form and definite structure of the colloidal substance. Now if it facilitate the work of the biologist to say that when what we ordinarily regard as a hungry caterpillar climbs to the tip of a branch, it is forced so to do by positive heliotropism; that then positive chemiotropism sets up mastication of the young buds; and that, lastly, "we can imagine this process leading to the destruction of the substances in the skin of the animal that are sensitive to light, and upon which the heliotropism depended," so leaving it free to crawl downwards and come in contact with the new buds which have in the meantime unfolded[2]—if such language serve any useful purpose, all well and good; only it must be applied to the hungry man too: in short, all behaviour must be described in the same terms. For the champion of colloids to betake himself to consciousness as he approaches the higher forms of life, is as much a breach of methodological parallelism as it is for the psychologist to fall back upon protoplasm as he approaches the lower. But to suppose that psychical processes first appear in the complicated form of association of ideas—which learning by experience is taken to imply—and at the same time to assume that

[1] Plasticity—the psychological "*à priori*" or ground of the possibility of experience—is a convenient term to express what is implied in retentiveness and differentiation.

[2] Cf. Loeb, *Comparative Psychology*, 1901, pp. 188 ff.—an interesting book, full of psychological crudities.

such experience, even when it appears, is "ultimately due to the motions of colloidal substances," these are incongruous absurdities which only the grossest ignorance would be bold enough to maintain.

Concluding, as we have done, that mind and matter—as we may provisionally call them—do really interact, we naturally infer that organic structures are not the result solely of material processes, but involve the co-operation of mental direction and selection: in other words, we are led to regard structure as partly shaped and perfected by function, rather than function as solely determined by structure, itself mechanically evolved. And such a view is justified by the fact that mechanical evolution is primarily a process of "degradation" rather than development, a case of *facilis descensus* contrasting with the upward struggle of life *per aspera ad astra*. Still, the notion of life or mind as formative and directive has its difficulties. In the first place, we have no experience of mind organizing matter—no experience of the actual process, that is to say—however sure we may feel of the fact. Hence the occasionalism to which here, at any rate, science is confined. But even so, the difficulty is not wholly removed. In the handicrafts whence we derive the conception of organs the artificer handles, but does not literally order, his tools—as if they too were intelligent. The conscious direction of such movements is doubtless facilitated by the fact that many of the complex co-ordinations actually involved in them are carried out automatically, thanks to structural modifications, either inherited or acquired. And, regarding life phylogenetically, we can imagine this process carried back indefinitely. Indeed, if it be illogical to talk of mechanisms evolving themselves and giving rise to the beings whose ends they serve, we have no choice but to accept this dualism of mind-shaping and matter inert. No choice, that is, unless we can establish the primacy of the psychological standpoint. Here we have duality but not dualism, and the object is not inert. But still there remain two difficulties,—possibly resolvable into one,—the plasticity already referred to as involved in all biological development and hereditary transmission; as to these, psychology is almost wholly in the dark.[1]

AUTHORITIES.—**Historical.**—The history of psychology is still strangely neglected. Max Dessoir has commenced a *Geschichte der neueren deutschen Psychologie*, comprising three volumes: one section of the first, dealing with the 17th century writers prior to Kant, has appeared (2nd ed., 1897); it contains a useful collection of material. From *Les origines de la Psychologie contemporaine* (1897), by the neo-Thomist scholar, Msgr. D. Mercier, much may be learnt, though its purpose is not primarily historical.

Positive.—The output of systematic works on psychology within the last twenty-five years is quite unprecedented. One of the most important of these—for the English reader the most important—is the *Principles of Psychology*, 2 vols., 1890, by W. James. Other works in English calling for special mention are G. F. Stout, *Analytic Psychology*, 2 vols., 1896; *A Manual of Psychology*, 2nd ed., 1901; Höffding, *Outlines of Psychology*, 1891 (translated from Danish); G. T. Ladd, *Psychology, Descriptive and Explanatory*, 1894; W. Wundt, *Gründriss der Psychologie*, 4th ed., 1901 (translated). Dealing mainly with experimental psychology are Külpe, *Gründriss der Psychologie auf experimenteller Grundlage dargestellt*, 1893 (translated); Ebbinghaus, *Grundzüge der Psychologie*, 1902, still in course of publication; and E. B. Titchener, *Experimental Psychology: a Manual of Laboratory Practice*, 2 vols., 1901.

Specially interesting as treating psychological problems on new lines are *La Psychologie des Idées-forces*, by A. Fouillée, 2 vols., 1893—perhaps the best French contribution to recent psychology; its cardinal point is the fundamentally dynamical character of the psychical. R. Avenarius, *Kritik der reinen Erfahrung*, 2 vols., 1888–90, an attempt, on the model of Kirchhoff and Mach's treatment of physics, to *describe* experience, taking the relation of the central nervous system to the environment as starting-point. Its strange and forbidding terminology prevented the timely recognition of its merits; but since the author's death in 1896—from overwork and disappointment—quite a literature has grown up, partly expository, partly controversial, devoted to this latest *critique*. H. Cornelius, *Psychologie als Erfahrungswissenschaft*, 1897, rather epistemological than psychological, and claiming affinity with the *critiques* of Kant and Avenarius. In J. Rehmke's *Lehrbuch der allgemeinen Psychologie*, 1894—a psychology *with* a soul, and claiming to be philosophy as well—the problems of perception and of psycho-neural interaction are discussed at length. F. Brentano, *Psychologie vom empirischen Standpunkte*, Bd. i., 1874, and still unfortunately incomplete: Brentano treats presentations and judgments as fundamentally distinct, feeling and willing, on the other hand, as fundamentally one. His influence on Austrian psychologists has been considerable, and is more or less apparent in the following:—K. Twardowski, *Zur Lehre vom Inhalt und Gegenstand der Vorstellungen*, 1894; A. Meinong, *Psychologisch-ethische Untersuchungen zur Werththeorie*, 1894; v. Ehrenfels, *System der Werththeorie*, 2 vols., 1897–98; A. Höfler, *Psychologie*, 1897.

Important as treating of particular topics are C. Stumpf, *Tonpsychologie*, 2 vols, 1883–90; A. Lehmann, *Die Hauptgesetze des menschlichen Gefühlsleben* (translated from the Danish), 1892; various monographs by T. Ribot on diseases of memory, will, personality, on the psychology of attention, of the emotions, of general ideas, &c.—all translated into English; J. M. Baldwin, *Social and Ethical Interpretations in Mental Development*, 1897; W. Wundt, *Volkerpsychologie*, 1900, 3 vols., in course of publication.

Later editions have appeared of many of the works mentioned in the earlier article, Sully's *Outlines* being replaced by a much fuller work, *The Human Mind*, 2 vols., 1892.

There are now several periodicals devoted exclusively to psychology, the chief being the *American Journal of Psychology*; the *Psychological Review*; *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*; and *L'Année Psychologique*.

(J. W*.)

[1] On the subject of comparative psychology generally, see *Animal Behaviour*, 1900, by Prof. C. Lloyd Morgan; L. T. Hobhouse, *Mind in Evolution*, 1901.

Pteridophyta.—The *Pteridophyta*, or, as they are frequently called, the Vascular Cryptogams, were treated of in the ninth edition of this work under the title FERNS, since the majority of the existing plants of this great subdivision of the vegetable kingdom belong to that group. The importance and interest of the other Pteridophytes, of which the Club-mosses and Horsetails are the most familiar examples, depend largely on the fact that they are the surviving representatives of large groups of plants which flourished in earlier geological periods. In order to understand the relationship of those now living, the extinct forms must be taken into consideration, and so far as is possible must be included in the general scheme of classification. For a fuller description of the extinct Vascular Cryptogams than can be given here the articles on the Palaeozoic and Mesozoic floras should be consulted, and with regard to the living forms, the article on FERNS already mentioned. The investigations since 1879 have resulted in an increase of our knowledge of the details of morphology and natural history of these plants, which has placed many of the problems presented by them in a new light. Thus, though points treated fully in the ninth edition of the *Encyclopaedia Britannica* will only be referred to here, it is necessary to review the whole subject. For fuller information regarding the anatomy of the sporophyte and explanation of anatomical terms, the article on ANATOMY OF PLANTS should be consulted.

Life-history.

The relation which exists between the two alternating stages or generations, which together constitute the complete life-cycle of all plants higher than the *Thallophyta*, is perhaps the most natural characteristic of the *Pteridophyta*. From the germinated spore of a fern-plant a small, flat, green organism is developed; this is the prothallus (gametophyte, sexual generation). As the result of fertilization of the ovum produced by this, the fern-plant (sporophyte, asexual generation) originates; from it spores are

ultimately set free, with the germination of which the life-history again commences. The point common to all *Pteridophyta* is that from the first the gametophyte is an independent organism, while the sporophyte, though in the first stages of its development it obtains nutriment from the prothallus, becomes physiologically independent when its root develops. This independence of the two generations for the greater part of their lives distinguishes

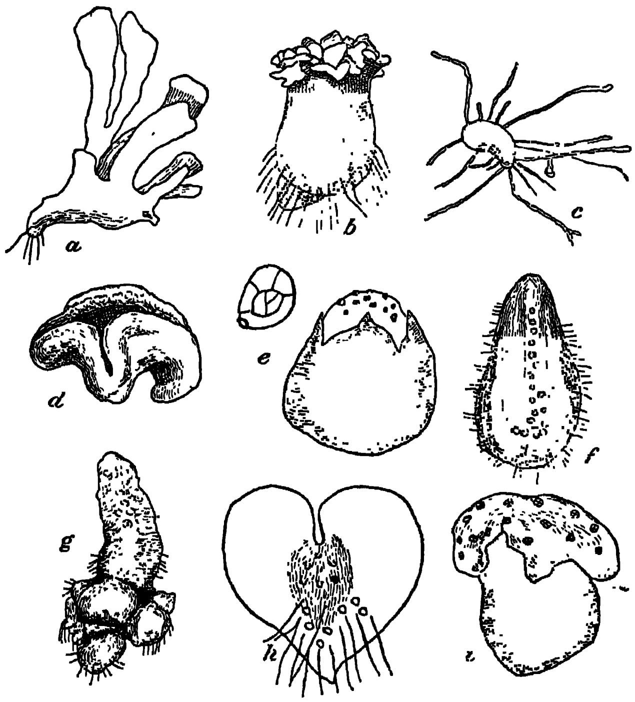

Fig. 1.—Diagrammatic sketches of prothalli of—*a*, Equisetum; *b*, Lycopodium cernuum; *c*, L. Phlegmaria; *d*, L. clavatum; *e*, Selaginella; *f*, Botrychium Virginianum; *g*, Helminthostachys; *h*, a Fern; *i*, Salvinia.

this group on the one hand from the *Bryophyta* (in which the sporophyte is throughout its life attached to the gametophyte), and on the other hand from the Gymnosperms and Angiosperms (in which the more or less reduced gametophyte remains enclosed within the tissues of the sporophyte). The gametophyte, which is usually dorsiventral, though in some cases radially symmetrical, is a small thallus attached to the soil by rhizoids. In structure it is equally simple, being composed of parenchymatous tissue without any clearly marked conducting system. Usually it grows exposed to the light and contains chlorophyll, but subterranean saprophytic prothalli also occur. In the heterosporous forms the gametophyte is more or less reduced. The reproductive organs ultimately produced on the same or on different individuals are of two kinds, the antheridia and archegonia; the origin of both is from single superficial cells of the prothallus. The antheridium at maturity consists of a layer of cells forming the wall which encloses a group of small cells; from each of the latter a single motile spermatozoid originates. The archegonium consists of a more or less projecting neck, and the venter, which is usually enclosed by the tissue of the prothallus. A central series of cells can be distinguished in it, the lowest of which is the ovum; above this come the ventral canal cell and one or more canal cells. When the archegonium has opened by the separation of the terminal cells of the neck, the disintegration of the canal cells leaves a tubular passage, at the base of which is the ovum. Down this canal the spermatozoid, which in the Ferns has been shown to be attracted by reason of its positive irritability to malic acid, passes and fuses with the ovum. After fertilization the latter surrounds itself with a cell-wall and develops into the sporophyte. The early segmentation of the embryo

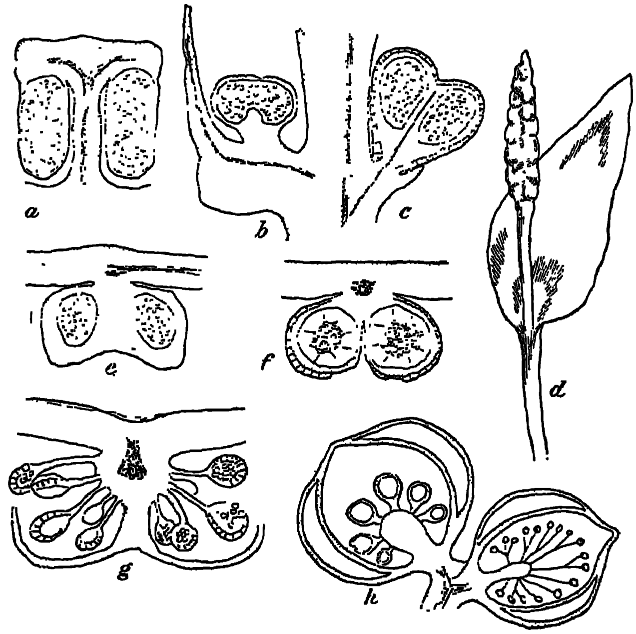

Fig. 2.—Diagrammatic sketches of spore-producing members of—*a*, Equisetum; *b*, Lycopodium; *c*, Psilotum; *d*, Ophioglossum; *e*, Kaulfussia; *f*, Angiopteris; *g*, Nephrodium; *h*, Salvinia. (All except *d* represent vertical sections of sporangiophore or sorus.)

differs in the several groups, but usually the first leaf or leaves, the apex of the stem, and the first root are differentiated early, while a special absorbent organ (the foot) maintains for some time the physiological connexion between the sporophyte and the prothallus. The sporophyte is always highly organized both as regards form and structure. Root, stem, and leaf can be distinguished even in the simplest forms, and the plant is traversed by a well-developed vascular system. The reproductive organs of the sporophyte are the sporangia, within which the spores are produced; these are often borne on or in relation to leaves, which may be more or less distinct from the foliage leaves in form and structure. The cells of the wall of the sporangium are usually so constructed as to determine the dehiscence of the sporangium and the liberation of its spores. The spores produced in each sporangium vary from very many to a single one in the case of some heterosporous forms. These latter bear spores of two kinds, microspores and megaspores, in separate sporangia. From the microspore an extremely reduced male prothallus, and from the megaspore the female prothallus, develops. The spores of the homosporous Vascular Cryptogams are usually of small size; the prothalli produced from them usually bear both antheridia and archegonia, though under special conditions an imperfect sexual differentiation may result. The complete life-history, with its regular alternation of gametophyte and sporophyte, is now known in all except a few rare genera of recent *Pteridophyta*, and will be described in connexion with the several groups.

The *Pteridophyta* as known at present comprise four main subdivisions, the *Equisetales*, *Sphenophyllales*, *Lycopodiales*, and *Filicales*. The *Sphenophyllales* are only known in a fossil state, while the other three include both fossil and recent representatives.

Classification.

The systematic arrangement of the Vascular Cryptogams for the purposes of identification and description necessarily remains unchanged, while the comparative morphology is being more fully worked out. But modifications in the order of placing the natural groups are of importance in

expressing the results of such investigations. Such a scheme may be placed here in a tabular form before entering on the consideration of the life-history, natural history, morphology, and classification of the several groups:—

Pteridophyta.

I. EQUISETALES .	*Equisetaceæ.*	
	Calamariaceæ.	
II. SPHENOPHYLLALES	*Sphenophyllaceæ.*	
	Cheirostrobaceæ.	
III. LYCOPODIALES .	*Lycopodiaceæ.*	
	Psilotaceæ.	
	Selaginellaceæ.	
	Lepidodendraceæ.	
	Isoetaceæ.	
IV. FILICALES .	*Ophioglossaceæ.*	
	Filicaceæ.	*Marattiaceæ.*
		Osmundaceæ.
		Schizæaceæ.
		Gleicheniaceæ.
		Matoniaceæ.
		Loxsomaceæ.
		Hymenophyllaceæ.
		Cyatheaceæ.
		Polypodiaceæ.
	Hydropterideæ.	*Salviniaceæ.*
		Marsileaceæ.

I. EQUISETALES.—The plants of the single living genus *Equisetum*, which vary in height from a few inches to forty feet, have subterranean rhizomes, from which the erect shoots arise. The general appearance and construction of the shoot, with its elongated hollow internodes and whorls of united leaves inserted at the nodes, have been described in the article on FERNS. The leaves of successive whorls alternate with one another, and this applies also to the branches which arise in the axil of the leaf sheath. In most species many of these buds, which alternate with the leaves, remain dormant, but in others the aërial shoots are copiously and repeatedly branched. In some species branches of the rhizome with tuberous internodes are formed, which serve as a means of vegetative reproduction. The roots which arise from the base of the lateral buds remain undeveloped on the aërial stem. The general course of the vascular bundles in the stem of *Equisetum* is figured and described in the article on FERNS. The young stems, and the older stems of certain species, are clearly monostelic, but in other species an inner and outer endodermis may be present, or an endodermal layer surrounds each bundle. The vascular bundles themselves are collateral, the xylem consisting of the protoxylem, towards the centre of the stem, and two groups of xylem, between which the phloëm is situated; the protoxylem elements soon break down, giving rise to the carinal canal. There is no secondary thickening except at the node in *E. maximum*, where some short tracheides, arranged in radial rows, arise from a cambium. The stems, the surface of which exhibits a number of ridges with intervening furrows, perform the greater part of the work of assimilation. The chlorophyll-containing tissue reaches the surface at the sides and base of the furrows, where stomata of peculiar form occur in the epidermis, while subepidermal strands of sclerenchyma occupy the ridges. In the cortical tissue beneath each furrow a wide intercellular space is present running the length of the internode, and called the vallecular canal. The central cylinder of the root, in which there are several xylem and phloëm strands, has around it a two-layered endodermis, the inner layer of which appears to take the place of a pericycle. The sporangia are borne upon lateral outgrowths of the axis (the sporangiophores), which arise in whorls and are associated in definite strobili or cones; at the base of the cone an outgrowth of the axis like a rudimentary leaf sheath (the annulus) is present. Each sporangiophore consists of a stalk expanding into a peltate disc of hexagonal outline; from the inner surface of the latter six to nine sporangia hang parallel with the stalk. The single vascular bundle supplies a branch to the base of each sporangium. The latter arises from a number of superficial cells, the cells destined to form the spores being derived from a single one of these. A tapetal layer is derived from the cells surrounding the sporogenous group, and the arrest of a number of the spore mother-cells further contributes to the nourishment of the remainder, each of which gives rise to four spores. The outermost layer of the cell-wall of the ripe spore splits along spiral lines, giving rise to the elaters; these two long strips of wall, attached by their middle points to the spore, tend to straighten out in dry and close round the spore in damp air. They thus assist in the opening of the sporangium, which takes place by a slit on its inner face. Further, several spores will be likely to germinate together owing to their elaters becoming entangled; a fact of some importance, since the antheridia and archegonia, though occurring sometimes on the same prothallus, are more often borne on separate individuals. The prothali contain abundant chlorophyll, and are dorsiventral. Those that bear the antheridia are the smaller, and are either filamentous, or flattened, with the margin irregularly lobed. The antheridia are deeply sunk in the tissue; the spermatozoids consist of a spiral of two or three coils, the numerous cilia being attached to the pointed anterior end. The female prothalli, which are sometimes branched, consist of a thick cushion bearing thin, erect, lateral lobes, at the base of which the archegonia are situated. The necks of the latter are short, the central series of cells consisting of ovum, ventral canal cell, and one or two canal cells. The half of the embryo directed towards the archegonial neck gives rise to the apex of the stem and a sheath of three leaves, the other half to the small foot and the primary root. The first shoots are of limited growth, being replaced by lateral branches, which gradually acquire the number of leaf teeth characteristic of the species.

Fossil species, some of which attained a great size, are known, to which the name *Equisetites* is given, since they appear to be closely allied to the existing forms. Two other extinct genera, *Phyllotheca* and *Schizoneura*, may be mentioned here. Abnormal specimens of *Equisetum* in which the strobilus is interrupted by whorls of leaves are of interest for comparison with the fructification of *Phyllotheca*. The most important and best known of the extinct *Equisetales* are, however, the Calamites, for a detailed account of which the article PALÆOBOTANY: *Palæozoic*, must be consulted. In the primary structure of the stem the Calamites present many points of resemblance to *Equisetum*, but secondary thickening went on in both stem and root. These plants, which appear to have grown in swampy soil, thus attained the dimensions of considerable trees. The leaves, which were of simple form (except in *Archæocalamites*, where they forked), were inserted in whorls at the nodes; they were either free from one another or cohered by their bases into a sheath. The branches alternated in position with the leaves, and sprang from just above the insertion of the latter. Some of the branches terminated in cones, which present a general similarity to those of *Equisetum*. This similarity is closest in *Archæocalamites*, an ancient type found in Upper Devonian rocks; in this the strobilus consists of peltate sporangiophores inserted in whorls on the axis. In the other Calamarian strobili known the whorls of sporangiophores are separated by whorls of bracts. In some the sporangiophores stood midway between the sterile whorls, while in others they approached the whorl above or below. There is a close resemblance between these sporangiophores and those of *Equisetum*, but as a

rule only four sporangia were borne on each. Some Calamites were heterosporous, sporangia with microspores and megaspores being found in the same cone.

Our knowledge of the extinct *Equisetales*, full as it is with respect to certain types, does not suffice for a strictly phylogenetic classification of the group. The usual subdivision is into *Equisetaceæ*, including *Equisetum* and *Equisetites* (with which *Phyllotheca* and *Schizoneura* may be provisionally associated), and *Calamariaceæ*, including *Calamites* and *Archæocalamites*.

II. Sphenophyllales.—The two very distinct genera *Sphenophyllum* and *Cheirostrobus*, included in this group, are known only from the Palæozoic rocks. Though the high specialization of this ancient group of plants renders the determination of their natural affinities difficult, indications are afforded by anatomy and the morphology of the strobilus. In general appearance the species of *Sphenophyllum* (the remains of *Cheirostrobus* known do not allow of any idea of its habit being formed) present some resemblances to the *Equisetales*. The long, sparingly branched stem bore at the somewhat swollen nodes whorls of six to eighteen wedge-shaped or linear leaves, which did not alternate in successive whorls. Both the broader and narrower leaves may be more or less deeply divided, and both forms may occur on the same shoot. From the relation of the thickness of the stem to its length it may be inferred that the shoots of *Sphenophyllum* derived support from adjoining plants. Without entering into detail regarding the anatomy, it may be stated that secondary thickening took place in both genera. The single stele in the stem consisted of the phloëm surrounding a solid central strand of xylem, the groups of protoxylem being situated at the projecting angles. In *Sphenophyllum*, in which the transverse section of the xylem is triangular, there were three or six protoxylem groups; in *Cheirostrobus* they were more numerous. The anatomy of the stem is thus very unlike that characteristic of the *Equisetales*, and presents essential points of resemblance to the *Lycopodiales*, especially the *Psilotaceæ*. The general morphology of the cones, on the other hand, points to an affinity with the *Equisetales*. The cone of *Sphenophyllum* consisted of an axis bearing at the nodes whorls of bracts, united below into a sheath. The overlapping bracts afforded protection to the sporangia, which were borne on sporangiophores springing from the upper surface of the coherent bracts near their origin from the axis; two sporangiophores usually arose from each bract, and sometimes adhered to its upper surface for some distance. Each bent round at the upper end, and bore one or two sporangia on the side turned towards the axis. The mature sporangium had a wall of a single layer of cells, which were larger towards the base, where they continued into the epidermis of the sporangiophore. In other species of *Sphenophyllum*, which are known only as impressions, single sporangia, or groups of four, appear to have been inserted directly on the upper surface of the bracts. In *Cheirostrobus* a similar relation of sporangiophores to bracts existed, but here each bract was divided into three segments. From each segment, near its base, a stalked peltate sporangiophore arose; this bore four sporangia, which hung parallel to the stalk. That these three sterile segments, with their sporangiophores, are together comparable to one of the bracts of *Sphenophyllum*, with its sporangiophores, is shown by the vascular supply in each case being derived from a single leaf-trace. So far as is at present known, the *Sphenophyllales* were homosporous. The differences between the two genera described above are sufficiently marked to justify the division of the *Sphenophyllales* into the two orders *Sphenophyllaceæ* and *Cheirostrobaceæ*. A consideration of the characters of both shows that resemblances suggesting actual relationship exist between this group and the *Equisetales* and *Lycopodiales*, between which they are here placed. It has been suggested that the *Sphenophyllales* may have sprung from a very old stock which existed prior to the divergence of the latter groups. So long, however, as our knowledge of these three phyla is confined, as at present, to specialized forms, the nature of the relationship between them must remain hypothetical.

III. Lycopodiales.—The living representatives of this group, for a general description of which the article Ferns should be referred to, are of small size compared with the related plants which lived in Palæozoic times. A large proportion of the living species are tropical, though others have a wide distribution. As general characteristics of the *Lycopodiales*, the simple form of the leaves, which are generally of small size, and the situation of the sporangia on the upper surface of the sporophylls, which are often associated in cones, close to their insertion on the axis, may be mentioned; there are both homosporous and heterosporous forms, the prothalli exhibiting corresponding differences. Before considering the characteristics of the several orders of this phylum, it is of interest to recognize in many of the surviving forms peculiarities in mode of life, to which we may reasonably ascribe their success in the struggle for existence or their escape from severe competition. Thus *Tmesipteris* and many species of *Lycopodium* are epiphytic, *Psilotum* is a partial saprophyte, and many species of *Isoetes* are aquatic. Vegetative reproduction is effected in various ways: by the separation of the branches of a creeping stem in some *Lycopodia*, the persistence through the winter of the apex of the shoot in *L. inundatum*, the formation of leafy bulbils on the aërial stem of *L. Selago* and others, and of small gemmæ on the rhizome of *Psilotum*. A highly specialized means of vegetative reproduction is seen in the tubers of *Phylloglossum* and the embryos of some Lycopods. The modifications shown by the gametophyte of *Lycopodium* will be described below. All such special relations of the plant to its environment, which might be expected in the few forms of a large group which had persisted beyond the others, are less marked in the genus *Selaginella*. It would appear as if the latter was more suited to the conditions of the existing flora, and many of the specific forms within it may rather be regarded as recently evolved than as simply persistent.

Lycopodiaceæ.—This order contains the two genera *Phylloglossum* and *Lycopodium*; the former has a single species, while nearly one hundred species of *Lycopodium* are known. Erect and creeping terrestrial plants and pendulous epiphytes occur in the latter genus. The simple leaves, which are of small size and do not possess a ligule, are arranged spirally around the branched stem in the majority of the species. The roots of the erect forms often grow downwards in the cortex of the stem to reach the soil. The anatomy of *Lycopodium* presents considerable variety in detail, but the stem is always monostelic and the development of the xylem centripetal, the protoxylems being situated at the periphery of the stele; pericycle and endodermis surround the stele, and the wide cortex may be more or less sclerenchymatous. The central cylinder of the root often shows a striking resemblance to that of the stem. The *Lycopodiaceæ* are homosporous. The spores are formed in sporangia of considerable size, situated on the upper surface and near the base of the sporophylls. The latter may differ from the foliage leaves and be arranged in definite cones, or the two may be similar and occupy alternate zones of a shoot with continued growth; sometimes rudiments of sporangia are found at the bases of the leaves. In the development of the sporangium the sporogenous tissue is derived from a number of superficial cells by divisions parallel to the surface. The tapetum is derived from the layer of cells surrounding the sporogenous group. Short trabeculæ of sterile tissue have been found to project into the cavity of the sporangium of some species. The spores, when liberated by the dehiscence of the sporangium, give rise to the prothallus, which is now, owing mainly to the investigations of Treub and Bruchmann, known in a number of tropical and temperate species. In habit

and mode of life of the prothallus these present striking differences, which may be correlated with the situations inhabited by the sporophyte, and are perhaps to be regarded as adaptations which have enabled the species to survive. Thus in *L. cernuum* and others the prothallus is green and grows on the surface of the soil; in the species living on the moors it is subterranean and saprophytic, though capable of developing chlorophyll when exposed to light; while in *L. Phlegmaria* and other epiphytic forms the prothallus consists of fine branches growing saprophytically in rotting wood. A comparison of these various types would appear to indicate that the primitive form of prothallus in the genus was radially symmetrical and contained chorophyll. The prothalli of *L. cernuum* come nearest to this; in them the meristem forms a zone slightly below the summit, which may bear a number of green lobes. The different forms of the prothallus found in *L. Selago* give an idea of how the more extremely modified types could be derived from such a prothallus as that of *L. cernuum*. All the saprophytic prothalli contain an endophytic fungus in definite layers of their tissue. The antheridia and archegonia are produced above the meristematic zone, and are more or less sunk in the tissues of the prothallus. The most important difference in the sexual organs concerns the length of the archegonial neck; this is shortest and has only a single canal cell in *L. cernuum*, while in *L. complanatum* it is longer than in any other Vascular Cryptogam, and contains a number of canal cells. The spermatozoids are biciliate. The embryo in *L. cernuum* and other forms with superficial green prothalli is attached to the prothallus by a small foot, and develops at first as a tuberous body (the protocorm) bearing rhizoids; this forms a number of simple leaves, and upon it the apex of the shoot arises later. In the saprophytic forms the protocorm is absent, and in some of them the foot is of large size. When new individuals of species which possess a protocorm arise vegetatively from the leaves or roots of young plants, the protocorm appears in the young sporophyte. This fact leads to the consideration of *Phylloglossum*, which resembles the embryo of *Lycopodium cernuum* in so many respects that it has been spoken of as a permanently embryonic form of Lycopod: it is in some respects the simplest existing Pteridophyte. Its prothallus resembles that of *L. cernuum*, but wants the crown of assimilating lobes. The plant is reproduced by tubers, which resemble the protocorm in bearing first a number of protophylls and later the upright shoot with its single terminal strobilus. The sporangia agree with those of *Lycopodium* in structure and position.

Psilotaceæ.—The two genera included in this order are somewhat isolated among the *Lycopodiales*. In both *Psilotum* and *Tmesipteris* the functions of the root-system, which is completely absent, are performed by leafless rhizomes bearing absorbent hairs and inhabited by an endophytic fungus. *Psilotum* lives epiphytically or in soil rich in humus, while *Tmesipteris* is epiphytic (and, it has been suggested, partially parasitic) upon stems of tree ferns: the former has small scale-like leaves; those of the latter are of considerable size. The stem is monostelic, the protoxylem groups being towards the periphery of the xylem, the development of which is thus centripetal; the centre of the stele is occupied by sclerenchymatous tissue. The leaves, which bear the sporangia, are bilobed and do not form definite cones, but alternate in irregular zones with the foliage leaves. The sporangia of the *Psilotaceæ* are associated in synangia, which occupy the same position relatively to the sporophyll as the single sporangium of *Lycopodium*. The careful study of the development of the synangium of *Tmesipteris*, which consists of two loculi, and of *Psilotum*, which consists of three, has shown that their structure can be adequately explained as originating by the septation of a single sporangium resembling that of *Lycopodium*. Other views of the nature of the *Psilotaceous* synangium are, however, possible—one, which regards the sporophyll and synangium as corresponding to the bract and sporangiophores in *Sphenophyllum*, being of special interest, on account of the resemblance in anatomy between the *Psilotaceæ* and the *Sphenophyllales*. There is some reason to believe that the prothallus of *Psilotum* resembles some *Lycopodium* prothalli, but conclusive evidence is wanting; that of *Tmesipteris* is unknown.

Selaginellaceæ.—The single genus of this order (*Selaginella*) contains between three and four hundred species. There is considerable diversity among them as regards external form, the majority having dorsiventral aërial shoots with dimorphic leaves, while in others the shoots are radially symmetrical and the leaves alike. The stem contains one, two, or several steles; in one species the stele is tubular. The phloëm completely surrounds the xylem, which usually develops from two protoxylem groups. In the aërial stem of the British species (*S. spinosa*) the radial stele has a number of protoxylem groups arranged round the periphery, much as in *Lepidodendron*. The cells of the endodermis are developed as trabeculæ, which traverse the continuous air-space surrounding each stele. The simple, uni-nerved leaves have a ligule near the base; the base of the ligule is somewhat sharply marked off from the other tissues of the leaf. In some species a depression of the leaf-surface encloses the ligule, regarding the function of which little is known. The roots, the stele of which is monarch, may arise directly from the stem, or are borne on rhizophores, which spring from the shoot at the point of branching, and root on reaching the soil. In structure they resemble the roots, but their morphological nature is uncertain. The sporophylls are arranged radially in the cones, which are terminal on the branches. A single sporangium is borne on the axis just above the insertion of each sporophyll. *Selaginella* is heterosporous, the megasporangia being often found towards the base of the cone. The development of the micro- and mega-sporangia is the same up to the stage of isolation of the spore mother-cells. The sporogenous tissue, which is referable to several archesporial cells, is surrounded by a tapetum, mostly derived from the sporogenous group. In the microsporangium all the mother-cells undergo the tetrad division, giving rise to the numerous microspores. In the megasporangium, on the other hand, the four megaspores, which arise from a single mother-cell, are nourished at the expense of the other sporogenous cells and of the tapetum. On germination the microspores give rise to a reduced prothallus, consisting of the small cell first cut off and a wall of cells enclosing two to four central ones; from these latter the biciliate spermatozoids originate. The megaspore becomes filled with the female prothallus, the formation of cell-walls commencing at the pointed end of the spore, where from the first the nuclei are more numerous, and later extending to the base. The surface of the prothallus which is exposed when the thick wall of the spore is ruptured may produce a few rhizoids; upon it the archegonia, consisting of a short neck and the central series of ovum, ventral canal cell, and canal cell, arise. After fertilization the embryo forms a short suspensor; the apex of the stem, with a leaf on each side of it, is first distinguishable; at the base of this is the foot; while the root arises on the farther side of the latter. Thus the position of the foot in *Selaginella* is different from what obtains in the other Vascular Cryptogams. A point of interest in this heterosporous genus is that the formation of the prothallus may commence before the megaspore is liberated from the sporangium.

Lepidodendraceæ.—This order includes only extinct forms, the best known of which are the plants placed in the genera *Lepidodendron* and *Sigillaria*. These plants, a fuller description of which must be sought in the article PALÆOBOTANY: *Palæozoic*, underwent secondary increase in thickness and attained the size of large trees; the aërial stem was more or less branched dichotomously. The leaves, which were of simple form and provided with a ligule, were, as the leaf-scars on the stem show, variously arranged. In *Sigillaria* the latter form vertical rows, while in *Lepidodendron* the arrangement is a complicated spiral. The stem had a single stele, the primary xylem of which was polyarch and centripetally developed. The upright stems were attached to the soil by a number of dichotomously branched members (*Stigmaria*), which, whatever their morphological nature may be, appear to have performed the function of roots: they have numerous cylindrical appendages, which penetrated the soil on all sides. The cones, which in some instances at least were heterosporous, presented a general resemblance to those of *Lycopodium* and *Selaginella*, a single sporangium being situated on the upper surface of each sporophyll. The cavities of the large sporangia were sometimes traversed by trabeculæ of sterile tissue resembling those found in *Isoetes*. In some of the heterosporous forms (*Lepidocarpon*) the sporangia were sometimes surrounded by an integument; and since only a single megaspore attained maturity, the structure of the megasporangium suggests a comparison with an ovule.

Isoetaceæ.—The single genus (*Isoetes*) contains about fifty, mostly aquatic, species, though a few are amphibious or terrestrial. The plants present considerable uniformity in general habit, consisting of a short, unbranched stem, bearing the closely crowded awl-shaped leaves, which in the larger species attain the length of a foot. Each leaf bears a ligule resembling that of *Selaginella* in structure and position. The stem is monostelic, the centre of the stele being occupied by a mass of short tracheides; but little can be said as to the primary structure of the central cylinder, which appears to be reduced. A meristematic zone forms, a short distance outside the xylem, from which secondary tissue is developed both internally and externally; that to the inside contains both xylem and phloëm elements. By the unequal development of the secondary cortex the stem becomes two- or three-lobed; the roots, which branch dichotomously, spring from the furrows between the lobes. The leaves have a single main bundle, and in the mesophyll are four longitudinal series of large intercellular spaces separated by transverse diaphragms. The sporangia, which are situated singly on the adaxial surface of the leaves, between their insertion on the stem and the ligule, arise from a considerable number of epidermal cells. The cells composing the young sporangium are at first similar, but ultimately become differentiated into sterile trabeculæ, which may stretch from the inner to the outer wall, and the mother-cells of the spores. The latter are more numerous in the microsporangium than in the megasporangium. The tapetal layer is partly formed from the sporangium wall and partly as a layer covering the trabeculæ. The

spores, which are set free by the rotting of the sporangial wall, germinate much as in the case of *Selaginella*, though the similarity may be a case of independent resemblance. Important points of difference are found in the multiciliate spermatozoids, and in the embryo, which has no suspensor.

The several orders of *Lycopodiales* described above, while presenting a number of features in common, are distinctly isolated from one another. A natural classification of such specialized plants can only be obtained when the extinct forms are more fully known. What is known at present, while it does not indicate the phylogeny of the *Lycopodiales*, at least shows that such living orders as *Lycopodiaceæ* and *Selaginellaceæ* cannot be regarded as forming a linear series. The difficulty is increased when it is borne in mind that the small surviving forms probably have a long geological history, and may have coexisted with the *Lepidodendraceæ*. For these reasons no attempt has been made to arrange the orders in larger divisions, since such a division as that of the ligulate and eligulate forms, while convenient for practical purposes, may not express the phylogeny of the group. The resemblances between the outstanding order *Psilotaceæ* and the *Sphenophyllales* have been noted above, and it remains to be mentioned that the *Isoetaceæ* have been regarded as more nearly allied to the *Filicales* than to the forms near which they are here placed.

IV. Filicales.—The article on Ferns dealt so much more fully with the Ferns than with the other Vascular Cryptogams that it is sufficient to refer to it for a general account of their life-history, structure, and habit, and the principles on which they are classified. The classification in that article was that of the *Synopsis Filicum*, the standard systematic work on these plants; the modifications in general arrangement adopted below are the expression of the progress which has been made in tracing the phylogeny of the group. One main departure must be specially noted here. The *Ophioglossaceæ* and *Marattiaceæ*, united in the article on Ferns as *Stipulatæ*, though possessing some characters in common, do not appear to constitute a natural group, and have been separated; the former are placed by themselves, but, pending further evidence as to their true relationship, are still included in the *Filicales*, while the latter are grouped with the rest of the homosporous ferns as *Filicaceæ*. The heterosporous forms are treated by themselves as *Hydropterideæ*, though further research will probably indicate more precisely their relationship to the *Filicaceæ*.

Ophioglossaceæ.—The peculiarities of this small order of *Pteridophyta* render their systematic position a matter of some doubt, especially in the absence of evidence as to their geological history. In the three genera, *Ophioglossum*, *Botrychium*, and *Helminthostachys*, there is an underground rhizome, from which one leaf or a few leaves with sheathing bases are produced annually; the roots arise in more or less definite relation to the insertion of the leaves. The latter are simple, or irregularly lobed in *Ophioglossum*, more or less compoundly pinnate in *Botrychium*, and palmately pinnate in *Helminthostachys*. The fertile branch or branches are situated on the adaxial surface of the leaves, and may be simple, as in *Ophioglossum*, or more or less compound, the degree of branching in the sterile and fertile segments exhibiting a general parallelism. The stem is monostelic, the arrangement of the xylem and phloëm being collateral. The endodermis and pericycle surround the whole stele in *Botrychium* and *Helminthostachys*; in *Ophioglossum* each bundle has a separate sheath. Well-marked secondary thickening occurs in *Botrychium*. In the roots of *Ophioglossum* and *Botrychium* and in the first formed roots of *Helminthostachys* an endophytic fungus is present, forming a mycorhiza—the stele in the larger roots has the usual radial arrangement of xylem and phloëm. The morphology of the fertile spike is a disputed question, upon the answer to which the systematic position of the *Ophioglossaceæ* largely rests. The spike is most simple in *Ophioglossum*, where it bears on each side a row of large sporangia, which hardly project from the surface, the vascular bundles occupying a central position. In the young spike, which arises when the leaf is still very small, a band of tissue derived from superficial cells is distinguishable along either side; this sporangiogenic band gives rise to the sporogenous groups, the sterile septa between them, and the outer walls of the sporangia. The spike of *Helminthostachys* corresponds to that of *Ophioglossum*, but in it the sporangia are borne on two lateral rows of branched sporangiophores. The sporangia resemble those of *Botrychium*, which project from the ultimate subdivisions of the branched spike; each is developed from a number of cells, the sporogenous tissue arising from a single cell. Two diverse views of the morphology of the fertile spike in these plants have been entertained which must be mentioned. The older view was that it was a fertile segment of the leaf; and though its ventral position presents a difficulty, this must be regarded as a possible explanation when the analogous case of the *Marsileaceæ* is taken into consideration; the occasional occurrence of sporangia on the lamina in *Botrychium* has also been regarded as supporting it. On the other hand, the spike has been explained as due to the elaboration of a single sporangium occupying a similar position with regard to the leaf as in the *Lycopodiales*, and evidence of considerable weight has been brought forward in support of this interpretation. The important bearing of this question on the relationship of the *Ophioglossaceæ* to the phyla of the *Filicales* and *Lycopodiales* will be obvious. The *Ophioglossaceæ* are homosporous, and the prothalli, which are known in two species of *Ophioglossum* and *Botrychium*, and in *Helminthostachys*, are subterranean and saprophytic. The prothallus of *O. pedunculosum*, as observed by Mettenius, subsequently reached the surface and produced green lobes; those of the other species known are wholly saprophytic, and contain an endophytic fungus. They thus present a general, but probably homoplastic, resemblance to the prothalli of certain *Lycopodia*. Important points of difference exist, however, in the apical position of the meristem of the Ophioglossaceous prothalli, in the presence of a basal cell to the archegonium, and in the multiciliate spermatozoids. In these respects, and in the absence of a suspensor from the embryo, the *Ophioglossaceæ* approach the *Filicaceæ*. The position of the *Ophioglossaceæ* can at present only be regarded as an open question, in considering which the possible antiquity of the group must be borne in mind.

Filicaceæ.—This order of *Pteridophyta* differs from the others in being well represented in our present flora by forms, many of which can be regarded, not as archaic types which have persisted to the present day, but as having been evolved in comparatively recent periods. The external form of the Ferns having been fully dealt with in the article already mentioned, it will suffice to refer to the more striking adaptive modifications in the gametophyte and sporophyte, and to certain effects of altered external conditions which have been ascertained experimentally. The dorsiventrality of the prothallus has been shown to depend mainly on the illumination, the filamentous form being retained in feeble light; a similar result is obtained when the prothalli are cultivated in water. These facts may have a bearing on the filamentous prothalli of some *Hymenophyllaceæ*. The reproduction of the prothallus by gemmæ in species of *Trichomanes*, *Vittaria*, and *Monogramme*

is another interesting adaptation; the perennial prothallus of *Gymnogramme leptophylla* is described in the article on FERNS. The phenomena of apogamy and apospory, which have now been observed in a number of Ferns, may be mentioned here. In the former the prothallus produces one or more fern-plants vegetatively, the projection which develops into the sporophyte in many cases occupying the position of an archegonium. In some apogamous Ferns sporangia may occur on the prothallus, and the vegetative organs of the sporophyte may also occur singly. In apospory the converse phenomenon is seen, the gametophyte springing vegetatively from the sporangium, receptacle of the sorus, or leaf margin of the fern-plant. In a number of cases, though not in all, apospory appears to be correlated with a failure of the sporangia to develop, and a similar correlation between apogamy and the prevention of sexual reproduction appears probable. The adaptations in the vegetative organs of the sporophyte are similar to those in the Flowering Plants. Thus there are a few Ferns which climb, others are water plants, while many, especially those which live as epiphytes, are more or less xerophytic. Some of the epiphytic forms (*Polypodium quercifolium, Platycerium*) have strongly dimorphic leaves, the sterile leaves serving in some cases to catch falling débris, and thus to provide the plant with soil. Lastly, the symbiotic relation between the plant and ants is found in Ferns, the rhizome of *Polypodium carnosum* containing cavities inhabited by these insects. The existence of these myrmecophilous Ferns suggests a possible explanation of the nectaries on the leaves of some other species, such as the common Bracken.

The main existing groups of the *Filicaceae* may now be briefly described, with special reference to the characters of gametophyte and sporophyte, which have been found of value in determining affinities.

Marattiaceae.—These are ferns of considerable size, the large leaves of which are borne on a short, erect, swollen stem (*Angiopteris, Marattia*), or arise from a more or less horizontal rhizome (*Danaea, Kaulfussia*). The leaves, at the base of which are two large stipule-like outgrowths, have a thick leaf-stalk, and are simple or simply pinnate in *Danaea*, pinnate in *Archangiopteris*, bi- to tri-pinnate in *Marattia* and *Angiopteris*, and digitately lobed in *Kaulfussia*. The stem, from the ground tissue of which sclerenchyma is absent, has a complicated system of steles arranged in concentric circles; the thick roots, the central cylinders of which have several alternating groups of xylem and phloëm, arise in relation to these. The pinnae, except in a few filmy forms, are thick; in *Kaulfussia* large pores derived from stomata occur in the epidermis. The sori are borne on the under surface of the pinnae, usually in a single row on either side of the midrib, but in *Kaulfussia* dotted over the expanded lamina. The large sporangia, each of which originates from a number of superficial cells, are here incompletely separated from one another and arranged in a single circle forming a synangium. The association is closest in *Danaea*, where the individual sporangia of the elongated sorus, which is sunk in a depression of the leaf, open by pores; in *Marattia* and *Kaulfussia* they dehisce by slits on the inner face; while in *Angiopteris* they are almost free from one another. The spores produce a green prothallus of large size, the sexual organs of which hardly project from the surface. The cotyledon and stem grow up vertically through the prothallus, the root turning downwards into the soil.

Osmundaceae.—The two genera of this group, *Osmunda* and *Todea*, have thick erect stems, covered with the closely crowded leaf bases. The stem is monostelic, the vascular tissues being separated into curved groups comparable with collateral vascular bundles, which surround the pith. The somewhat thick roots are diarch. The leaves are large and pinnate; their lamina is usually thick, though filmy species of *Todea* occur. The leaf-base shows indications of stipular outgrowths. In *Todea* the sori, each of which consists of a single circle of bulky sporangia, are borne on the under surface of the pinnae. In *Osmunda* the region of the leaf which bears the sporangia has its lamina little developed; the leaf thus bears sterile and fertile pinnae, or, as in *O. cinnamomea*, sterile and fertile leaves may be present. The sporangia originate from single cells, though surrounding cells may contribute to the formation of the stalk. The latter is thick and short, and the wall of the sporangium, which opens by a median slit, has a group of thick-walled cells at the summit, forming the annulus. The prothalli are similar to those of the other *Filicaceae*, but more massive; the same may be said of the archegonia and antheridia, which, however, project more than in the preceding group.

Schizaeaceae.—The anatomy of the stem differs in the four recent genera of this order, and presents a series possibly illustrating the origin of a number of concentric steles from a solid stele, the intermediate step being represented by those forms in which the central cylinder is tubular. The sporangia are borne singly or in sori of two or three on the margin or under surface of leaves, the fertile pinnae of which differ more or less from the sterile segments. The sporangium is of considerable size, and dehisces by a median slit, the annulus being a more or less definitely limited horizontal ring of cells near the apex. The prothallus and sexual organs may resemble those of the *Polypodiaceae*; in *Aneimia* and *Mohria* the prothallus, though flattened, is not bilaterally symmetrical, the growing point being on one side; a filamentous type of prothallus is known in *Schizaea*.

Gleicheniaceae.—These forms have a horizontal rhizome, from which simply pinnate leaves arise in *Platyzoma*, while *Gleichenia* bears compound pinnate leaves with continued apical growth. The rhizome usually has a solid central cylinder in *Gleichenia*, while that of *Platyzoma* is tubular. The sporangia arise simultaneously in the sorus, which is borne on the under surface of the ordinary pinna; in those species with large sporangia the latter form a single circle, in others sporangia may also arise from the central part of the receptacle. The annulus is horizontal and the dehiscence median. The prothalli, while resembling those of the *Polypodiaceae*, have points of similarity with those of the preceding groups.

Matoniaceae.—This contains the single genus *Matonia*, two species of which are known from the Eastern Tropics. They are of special interest, since they have been shown to be the surviving forms of a group species of which have been identified from Jurassic and Cretaceous rocks. The living species have a long rhizome, from the upper surface of which the large leaves arise; these are branched in a pedate manner, each branch being pinnate. The structure of the rhizome is complicated, a transverse section showing that the centre may be occupied by a solid stele, outside of which are two tubular steles. The sori are borne on the under surface of the pinnae, each consisting of a single series of large sporangia covered by a coriaceous indusium, which is attached to the central part of the receptacle. The sporangium, which corresponds on the whole to that of the *Gleicheniaceae*, has a somewhat oblique annulus; the dehiscence also is not truly median. The gametophyte is unknown.

Loxsomaceae.—The single genus *Loxsoma* has a tubular stele in its rhizome, which bears leaves resembling those of some *Davallias*. The elongated receptacle of the marginal sori is surrounded by a basal cup-shaped indusium. The sporangia, which arise in basipetal succession on the receptacle, dehisce by a median slit, though the annulus is somewhat oblique; they have resemblances to the *Gleicheniaceae*. When mature, the sporangia are raised above the margin of the indusium by the elongation of the receptacle, thus facilitating the dispersion of the spores. The gametophyte is unknown.

Hymenophyllaceae.—This group, which contains the two genera *Hymenophyllum* and *Trichomanes*, is characterized by the prevalent "filmy" texture of the leaves. Many of the species inhabit situations in which the air is constantly moist, especially in the tropics; some are terrestrial; others epiphytic on tree stems, or, in the case of the smaller species, some of which are very minute, on the leaves of other plants. A single solid central cylinder is found in the rhizome. The sori, which are marginal, have a long receptacle, bearing the sporangia in basipetal succession, and are surrounded by a cup-shaped indusium. The sporangia present a considerable range in size, the largest being found in species of *Hymenophyllum*, the smallest in *Trichomanes*. Each has an almost horizontal annulus resembling that of *Gleichenia*, but the dehiscence is lateral. The gametophyte in *Hymenophyllum* is flat and variously lobed; that of *Trichomanes* may be similar, but in other species is filamentous. The archegonia and antheridia present points of similarity to those of the *Gleicheniaceae*.

Cyatheaceae.—This order includes the majority of existing tree-ferns, as well as some of smaller size. The anatomy of the stem, with its ring of flattened steles, is figured in the article on FERNS. The sorus has a somewhat elongated receptacle, on which the sporangia arise basipetally; the indusium may be cup-shaped, bivalve, or wanting. The dehiscence of the sporangium is almost transverse, as in the *Polypodiaceae*, but the annulus is slightly oblique. The prothalli correspond to those of the next group.

Polypodiaceae.—This group, which contains the remaining Ferns, will doubtless require subdivision as our knowledge of the morphology of the genera classed in it becomes extended. The stem rarely has a tubular stele; for the most part two to many steles, arranged in a ring or in two concentric circles. In a number of genera, which there is reason to regard as relatively primitive, the sporangia show the same regular basipetal succession as in some of the preceding groups; in the great majority, however, the succession is not regular, but those of various ages are intermixed in the sorus. The sporangia dehisce by a transverse slit, the annulus being truly

vertical or, in some of the genera in which they are regularly arranged, very slightly oblique. The prothallus and sexual organs are of the type described in the article on FERNS; some of the more interesting modifications have been referred to above.

A consideration of the *Filicaceæ* as arranged above will show that the several suborders may in general terms be said to form a series between those in which the sorus consists of a single circle of bulky sporangia and those *Polypodiaceæ* in which the numerous small sporangia appear to be grouped without order in the sorus. When the survey is extended to the extinct Ferns of which the fructification is known, those from the more ancient rocks are found to group themselves with the existing suborders with large sporangia, such as the *Marattiaceæ*, *Gleicheniaceæ*, and *Schizæaceæ*; the *Polypodiaceæ*, on the other hand, do not appear until much later. The extinct forms cannot be dealt with in detail here; but it may be pointed out that their order of appearance affords a certain amount of direct evidence that the existing Ferns with a single circle of large sporangia in the sorus are relatively primitive. The series which can be constructed from a study of the sorus is in general supported by the anatomy of the sporophyte, and by the structure and sexual organs of the gametophyte. A more detailed investigation of all the characters of the Ferns will be needed before the course of evolution thus broadly indicated can be traced, but the results obtained by Bower afford a deeper insight into the general method of progression and the selective factors in the process. On the ground mainly of an examination of the sorus and sporangium, Bower has shown that the *Filicaceæ* may be divided into three groups—the *Simplices*, *Gradatæ*, and *Mixtæ*—in which the sporangia arise simultaneously, in basipetal succession, or irregularly in the sorus respectively. The first includes the *Marattiaceæ*, *Osmundaceæ*, *Schizæaceæ*, *Gleicheniaceæ*, and *Matoniaceæ*; the second the *Loxsomaceæ*, *Hymenophyllaceæ*, *Cyatheaceæ*, and the *Dennstædtineæ* (a group including species placed in the *Synopsis Filicum* in *Dicksonia* and *Davallia*); while the remaining *Polypodiaceæ* constitute the *Mixtæ*. The change from the one type of sorus to the other may have taken place in several different lines of descent, some of which have been traced. A consideration of the biology of the sorus gives an insight into the advantages obtained by the one type over the preceding, as regards protection, spore production, and the dispersal of the spores, and thus indicates the way in which natural selection may have acted. The differences in the form and mode of dehiscence of the sporangia (those of the *Simplices* having median dehiscence and a horizontal annulus, those of the *Gradatæ* a more or less oblique position of the annulus and of the plane of dehiscence, while in the *Mixtæ* the annulus is vertical and the dehiscence transverse) stand in relation to the position of the sporangia in the sorus relatively to one another. The application of the important criteria, which Bower has thus pointed out, to the construction of a strictly phylogenetic classification of the *Filicaceæ* cannot be made until the anatomy, the sexual generation, and the palæobotanical evidence have been further examined from this point of view. Though on this account and because, as Dr Bower himself points out, the subdivisions *Simplices*, *Gradatæ*, and *Mixtæ* do not correspond to definite phylogenetic groups, they have not been used in classifying the Ferns above, their importance as an advance towards a natural classification should be fully recognized. It may be added that in the large number of existing forms and the numerous fossil remains of those that have become extinct the *Filicaceæ* offer an opportunity such as is perhaps afforded by no other group for the study of the history of descent.

Hydropterideæ.—The uncertainty which exists as to the exact affinity of the two orders of *Pteridophyta* placed in this group must be associated with the more or less complete aquatic habit of the plants belonging to them. This general characteristic is expressed in the name *Hydropterideæ*, while that of *Rhizocarpæ*, under which they were described in the article FERNS, rests on an early misconception of their morphology. For a general account of the group the article named should be consulted. Since it was written, repeated detailed investigations have resulted in a very complete knowledge of the structure and development of the four genera of this group: space will not allow of a full account being given here, and for this some of the works cited below must be referred to. Mention must, however, be made of the anatomy and the reproductive structures of the sporophyte to indicate the difficulty of deciding the affinity of these orders. The latter are associated by the well-marked heterospory they exhibit; but such a character does not necessarily indicate a natural group, and there is some reason to believe that the nearest relations of the *Salviniaceæ* and *Marsileaceæ* are to be found at different points in the series of Homosporous Ferns. In the *Salviniaceæ*, which contain two genera of small floating plants, *Salvinia* and *Azolla*, the sporangia are associated in sori surrounded by an indusium springing from the base of the receptacle. The sori consist either of microsporangia or megasporangia, which are arranged, except when only one is present, in basipetal succession on the receptacle; this suggests that an affinity may be found with some of the groups placed in the *Gradatæ* by Bower. The complete absence of an annulus from the sporangia prevents the comparison from being carried farther; and the vascular system is so reduced, probably in relation to the aquatic habit, that the anatomy affords no safe guide. The same holds good to some extent for the *Marsileaceæ*; but here the presence of a tubular stele in the forms, with thicker rhizomes, affords an indication, at least, that their affinity is also with the *Gradatæ*. In structure and development the sporocarp is, however, essentially different from the indusiate sorus of the *Salviniaceæ*, and, though its position on the ventral surface of the leaf-stalk presents a difficulty, must probably be regarded as corresponding to a modified leaf-lobe. In the absence of direct evidence from Palæobotany, and bearing in mind the modifications associated with adaptation to an aquatic life in other plants, the recognition of any more definite affinity for these heterosporous Ferns appears to be inadvisable. Further evidence is necessary before they can be removed from such a position of convenience as is assigned to them here, and placed in relation to the series of *Filicaceæ*.

Phylogeny.

The several phyla of *Pteridophyta* having now been briefly described, their relationship to one another remains for consideration. The available evidence does not suffice to solve this question, although certain indications exist. In the earliest land vegetations of which we have any sufficient record specialized forms of *Equisetales*, *Lycopodiales*, *Sphenophyllales*, and *Filicales* existed, so that we are reduced to hypotheses founded on the careful comparison of the recent and extinct members of these groups. In this connexion it may be pointed out that the fuller study of the extinct forms has as yet been of most use in emphasizing the difficulty of the questions at issue. It has thus led to a condition of uncertainty as regards the relationship of the great groups of Vascular Cryptogams, in which, however, lies the hope of an ultimate approach to a satisfactory solution. The study of the *Sphenophyllales*, however, as has been pointed out above, appears to indicate that the *Equisetales* and *Lycopodiales* may be traced back to a common ancestry. As to the relationship of the *Filicales* to the other phyla, evidence from extinct plants appears to be wanting. If, as has been

suggested by Bower, the strobiloid types are relatively primitive, the large-leaved *Pteridophyta* must be supposed to have arisen early from such forms. The question cannot be discussed fully here, but enough has been said above to show that in the light of our present knowledge the main phyla of the Vascular Cryptogams cannot be placed in any serial relationship to one another.

It may even be regarded as an open question whether some of them may not have arisen independently and represent parallel lines of evolution from Bryophytic or Algal forms. This leads us to consider the question whether any indications exist as to the manner in which the *Pteridophyta* arose. It will be evident that no direct record of this evolution can be expected, and recourse must be had to hypotheses founded on the indirect evidence available. There appears to be no reason to doubt that the sexual generation is homologous with the thallus of a Liverwort, or of such an *Alga* as *Coleochæte*. It is with regard to the origin of the spore-bearing generation of the *Pteridophyta* that differences of opinion exist. This, though at first dependent on the prothallus, soon becomes independent. It may be regarded as derived from a wholly dependent sporogonium not unlike that of some of the simpler *Bryophyta;* the latter are assumed to have arisen from primitive Algal forms, in which, as the first step in the interpolation of the second generation in the life cycle, the fertilized ovum gave rise to a group of swarm-spores, each of which developed into a new sexual plant. On this view the origin of the sporophyte is looked for in the gradual development of sterile tissue in the generation arising from the fertilized ovum, and a consequent delay in spore-formation. Certain green *Algæ* (*e.g.*, *Œdogonium*, *Coleochæte*), the *Bryophyta*, and the simpler *Pteridophyta*, such as *Phylloglossum*, are regarded as illustrating the method of progression, though the existing forms may not constitute an actual series. For a discussion of this view, which regards the alternation of generations in Pteridophytes as antithetic and the two generations as not homologous with one another, reference may be made to the works of Celakovsky and Bower. Although the antithetic theory is supported by many facts regarding the life-history and structure of the group of plants under consideration, it must be remembered that it is at least possible that a stage in which the sporophyte was wholly dependent on the gametophyte may not have been passed through in their evolution. The spore-bearing generation may throughout its phylogenetic history have been independent at one part of its life, and have been derived by modification of individuals homologous with those of the sexual generation, not by the progressive sterilization of a structure the whole of which was originally devoted to asexual reproduction. A number of facts regarding the *Algæ*, and also those relating to such deviations from the normal life cycle as apogamy or apospory, may be regarded as lending support to this view, which, in contrast to the theory of antithetic alternation, has been called that of homologous alternation. Without entering farther into the discussion of these alternative theories, for which the literature of the subject must be consulted, it may be pointed out that on the latter view the strobiloid forms of *Pteridophyta* would not necessarily be regarded as primitive relatively to the large-leaved forms, and also that the early stages of the origin of the sporophyte in the two cases may have proceeded on different lines.

Another question of great interest, which can only be touched upon here and may fitly close the consideration of this division of the Vegetable Kingdom, concerns the evidence as to the derivation of higher groups from the *Pteridophyta*. The most important positive evidence on this point appears to indicate that the most ancient Gymnosperms were derived from the *Filicales* rather than from any other phylum of the Vascular Cryptogams. A number of extinct forms are known intermediate between the Ferns and the Cycads, and classed as *Cycadofilices*, some of which, when their reproduction is more fully known, may have to be classed with the *Filicales* rather than with the Gymnosperms. These forms will, however, be found discussed in the articles treating of extinct plants and the Gymnosperms, but their recognition will serve to emphasize, in conclusion, the important position the *Pteridophyta* hold with regard to the existing flora.

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Public Health.—Few branches of law have expanded more rapidly than the law of public health. Premising that the Local Government Act, 1894, transferred to urban and rural district councils, elected by ballot by the parochial electors, the powers of the existing urban and rural sanitary authorities, and also conferred on such councils certain powers related to public health (*e.g.*, the execution of the Acts as to petroleum and infant life protection), we may commence with the Public Health Acts Amendment Act, 1890, and the Public Health Act, 1896. The first of these statutes confers enlarged powers on such local authorities as choose to adopt it—the right of adoption being general in the case of urban authorities, and in that of rural authorities limited to certain specified provisions unless it is extended by the Local Government Board. The adoption is effected by a resolution passed at a meeting of the local authority convened by special notice for the purpose, and a copy of the resolution is required to be sent to the Local Government Board, and—where certain parts of the Acts are adopted—to the Board of Trade and the Home Office. After some general provisions, the Act deals successively with (i.) danger or obstruction caused by telegraph, telephone, lighting, railway signalling, and other wires; (ii.) sewers, sanitary conveniences, and similar matters; and (iii.) music and dancing licences. A word may be said in regard to each of these sections in turn. (i.) Urban authorities are empowered to make by-laws for the prevention of danger or obstruction to the public from wires of the class indicated, and any apparatus connected with their erection. Provision may be made for the inspection of such wires, and offenders against by-laws are liable to penalties on conviction by a court of summary jurisdiction, subject to an appeal to quarter sessions; and the court may also order the removal of any wire or apparatus so placed as to constitute a contravention. The by-laws before taking effect must have been submitted to, and confirmed by, the Board of Trade. The Board of Trade may exempt from the operation of such by-laws for a maximum period of five years from their confirmation any wires, &c., already erected. But any danger arising from an exempted wire may be dealt with on application to a court of summary jurisdiction. None of the above provisions applies to wires belonging to the Postmaster-General, or undertakings under the Electric Lighting Acts, or is to interfere with the working of mines lying under or adjacent to any street along or across which wires have been stretched. (ii.) Injurious matters, chemical refuse, waste steam, &c.,

are not to be turned, or allowed to pass into drains; the local authority is enabled to make communications with, or repair drains at the owner's or occupier's expense, and also to make by-laws regulating the provision and maintenance of sanitary conveniences in manufactories and elsewhere; common courts and passages are to be kept clean; medical officers and inspectors of nuisances are empowered to seize, and justices to condemn all unsound "articles intended for the food of man" which are sold, or exposed or being prepared for sale within the district of any local authority, and the licence of the occupier of any slaughter-house who is convicted of the sale of any meat unfit for food may be revoked; hoardings are to be set up during the progress of buildings; cellars under streets are to be kept in good repair, and safe means of ingress to and egress from places of public resort, such as churches, chapels, or theatres, are to be provided. Similar provision is made for the safety of platforms on public occasions, and of whirligigs, swings, and shootings galleries. Urban authorities are enabled to provide refuges in streets, cabmen's shelters, and public clocks. (iii.) Places to be used for public dancing, music, &c., are to be licensed by the licensing authority of the district in which they are carried on. The licences are granted annually in October, except in Middlesex, where, under the Music and Dancing Licences (Middlesex) Act, 1894, they may be granted at any time.

The Public Health Act, 1896, abolishes the old system of quarantine, and empowers the Local Government Board to make regulations as to the landing of infected persons from ships. Elaborate provision has been made for the notification of infectious diseases by the Infectious Diseases (Notification) Acts, 1889 and 1899. The former statute was originally adoptive only, but it has now been extended by the latter to every district in England or Wales —in London notification has been compulsory since 1891. For the purposes of these Acts "infectious disease" means smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlatina or scarlet fever, typhus, typhoid, enteric, relapsing, continued or puerperal fevers, as well as any other infectious disease which, by a resolution duly passed by the local authority, and sanctioned by the Local Government Board, is declared to be included within the definition. When any such disease occurs in any building used for human habitation, or in any ship, boat, tent, van, shed or similar structure (other than Crown buildings, or ships, vessels, or boats belonging to any foreign Government), the fact must be notified to the medical officer of health of the district. The duty of giving this notification is imposed, first on the head of the house to which the patient belongs, failing whom, on the nearest relative present, and on his default on the person in charge of, or in attendance on, the patient, and on his default on the occupier of the building. Any medical practitioner visiting the patient is also bound to give notice. Reference should also be made to the following statutes: the Infectious Disease (Prevention) Act, 1890, provides for the inspection of dairies, and the cleansing and disinfecting of premises, and under the Public Health (Ports) Act, 1896, the Local Government Board may by order assign to any port sanitary authority powers or duties arising under this statute. The Isolation Hospitals Act, 1893, enables county councils to promote the establishment of hospitals for the reception of patients suffering from infectious diseases; the Cleansing of Persons Act, 1897, enables local authorities to permit persons who apply to them, on the ground that they are infested with vermin, to have the gratuitous use of cleansing apparatus; and the Vaccination Act, 1898, profoundly modified the law as to vaccination.

Notification of infectious diseases.

In addition to these statutes, account has to be taken of a large body of legislation which relates indirectly to the law of public health, or at least comes well within its range of operation. It deals with a very great variety of subjects, and only a comparatively slight sketch of its results need be given here. The Factories and Workshops Act, 1895, extended the Factory Acts to laundries and docks, and enlarged the powers of courts of summary jurisdiction to provide for the safety of these establishments, especially as regards protection from fire. The Coal Mines Regulation Act, 1896, aims at the prevention of accidents due to inflammable gas and coal-dust in coal mines. The Merchant Shipping Act, 1894, enabled local authorities to make by-laws providing *inter alia* for the licensing, inspection, and sanitary condition of seamen's lodgings. The Rivers Pollution Prevention (Borders Councils) Act, 1898, enables joint committees of English and Scottish county councils of counties on both sides of the Border (viz., Northumberland and Cumberland in England, and Dumfries, Roxburgh, and Berwick in Scotland) to exercise the powers of the Rivers Pollution Prevention Act, 1876, in relation to any river or tributary which is partly in England and partly in Scotland—an expression including the Tweed. The Dangerous Performances Act, 1897, extends the earlier Act, 1879, which prohibited the employment in dangerous performances of children under 14 years of age, to boys under 16 and girls under 18, and also provides that, except where an accident causing actual bodily harm occurs, no prosecution may be instituted under either of the statutes without the consent in writing of the chief officer of police of the police area in which the offence is committed. The Infant Life Protection Act, 1897, which requires persons retaining for reward more than one infant under five, for nursing or maintenance for more than forty-eight hours, to notify the fact to the local authority, imposes upon local authorities the duty of instituting inquiries whether there are any persons residing within their districts who come within the Act, and empowers them to appoint male or female inspectors for the purpose of enforcing its provisions. Lastly, reference may be made to the Contagious Diseases (Animals) Act, 1894, which consolidated the law on this subject.

London.—Down to the year 1891 London was governed, in matters of public health, by a series of special statutes and by provisions in the general statutes, the scope of which is explained in the article on PUBLIC HEALTH in vol. xx. of this Encyclopædia. The law as to the metropolis was, however, consolidated, and is now regulated by the Public Health (London) Act, 1891. The authorities for the execution of the Act were, for the City of London, the Corporation, the vestries of the larger and the district boards of some of the smaller parishes, and certain boards of guardians. Under the Local Government Act, 1899, the powers of each existing vestry and district board are transferred to the council of the borough comprising the area within the jurisdiction of such vestry and district board; and the borough councils take over certain of the powers of the county council (*e.g.*, as to street obstruction and the registration of dairymen) and exercise concurrent jurisdiction with it in other matters. Provision is made for the appointment of medical officers of health and sanitary inspectors. The medical officer is for some purposes placed on the footing of a district poor-law medical officer, and he cannot be removed without the consent of the Local Government Board. In its structure and substance the Public Health (London) Act, 1891, which consists of 144 sections, closely resembles the general Acts. The principal matters with which it deals are: (i.) nuisances, general and

particular; (ii.) workshops, bakehouses, and dairies; (iii.) removal of refuse; (iv.) water-closets, &c.; (v.) food and water; (vi.) infectious diseases and epidemics; (vii.) hospitals and ambulances; (viii.) mortuaries; (ix.) lodging-tents and underground rooms; (x.) legal proceedings, appeals, and inquiries. On some of these subjects a few notes may be added. (i.) *Nuisances.*—It is the duty of every sanitary authority to inspect its district for nuisances. Certain nuisances, chiefly relating to the insanitary condition of premises, cisterns, closets, &c., may be abated summarily. The authority, on complaint by one of its officers or by any member of the public, if satisfied of the existence of the nuisance, serves a notice to abate it on the person in fault; and if this is not complied with, it may be enforced, under liability to a fine, by a nuisance order made by petty sessions. If the nuisance order includes a prohibition or closing order or requires structural alterations, an appeal lies to quarter sessions. The sanitary authority may also apply to the High Court for abatement of nuisances. Large powers of dealing with particular nuisances are given. (ii.) *Workshops, bakehouses, and dairies.*—The sanitary authority may order lime-washing and cleansing of workshops, other than bakehouses, to which some of the provisions of the Factory Acts are applied. The Local Government Board (in lieu of the Privy Council, 49 and 50 Vict. c. 32, s. 9) may make orders as to dairies. (iii.) *Removal of refuse.*—The sanitary authority is to clean streets and footways (which occupiers and owners are relieved of their duty of sweeping) and also remove house refuse, and any dustman demanding a fee or gratuity for removing dust is liable to a fine of 20s. The sanitary authority is also bound, if required, to remove trade refuse on payment of a reasonable sum. (v.) *Food and water.*—Provision is made for the inspection, seizure, and destruction of unsound food of any description intended for man. An occupied house without proper water supply is deemed a nuisance liable to be dealt with summarily, and if a dwelling-house is deemed unfit for human habitation, new houses are not to be occupied until after the water supply is certified; and a water company on cutting off a consumer's supply is to give notice to the sanitary authority. Petty sessions, on complaint by the sanitary authority, may close polluted wells whether public or private. (vi.) *Infectious diseases and epidemics.*—The provisions as to notification are practically identical with those under the general Acts. Elaborate provision is made for dealing with dangerous infectious diseases. Premises for disinfection, disinfectants, and carriages for removal are to be supplied. The medical officer of health or any medical man may order the disinfection of houses. The sanitary authority must house free of charge persons temporarily removed for disinfection, and pay for unnecessary damage and for articles destroyed. Penalties are imposed for throwing infectious rubbish into ash-pits and for letting an infectious house without proper disinfection. (vii.) *Hospitals and ambulances.*—Sanitary authorities may provide hospitals, recover their costs of maintaining non-infectious patients in them, and, with sanction, provide temporary supplies of medicine and medical assistance to the poorer inhabitants. The Metropolitan Asylums Board may provide landing-places, vessels, ambulances, &c. (viii.) *Mortuaries.*—Every sanitary authority is to provide a mortuary, and may, and if required by the county council must, provide a *post-mortem* room, not at a workhouse. Places for holding inquests and for preserving unidentified dead bodies are also to be provided. (ix.) *Lodging-tents and underground rooms.*—The sanitary authority is to make by-laws as to lodgings, and may make by-laws as to tents and vans, which, if in such a state as to be a nuisance, may be dealt with summarily. Underground rooms are not to be let or occupied as dwellings unless they satisfy certain stringent requirements prescribed by the Act as to height, drainage, ventilation, &c. Provision is made for the enforcement of this prohibition, and, in case of two convictions within three months, the court may order the room to be closed. (x.) *Legal proceedings, appeals, inquiries.*—A general power of entry on premises for the purposes of the Act is given to the sanitary authority. The county council has power to prosecute offenders on default by the sanitary authority; and the Local Government Board, on complaint by the county council, may also interfere. There is a general appeal under the Act from magistrates to quarter sessions, and from notices by or acts of the sanitary authority to the county council. Inquiries by the Local Government Board are to be held under the provisions of the Public Health Act, 1875.

Besides the Public Health (London) Act, 1891, it is necessary to note that the law of public health in London is also affected by a number of later statutes relating to the metropolis alone. Thus the Baths and Wash-houses Act, 1896, allows closed swimming-baths to be used gratuitously for music and dancing in London with the licence of the London County Council. The Canals Protection (London) Act, 1898, empowers the county council to require a canal company to protect dangerous places on its canal.

Scotland.—The various statutes relating to public health in Scotland are now consolidated and amended by the Public Health (Scotland) Act, 1897, which, together with the Infectious Diseases Notification Act, 1889 (*v. sup.*), and the Burgh Police (Scotland) Act, 1892, constitutes the statutory law of Scottish sanitary administration. The central authority is the Local Government Board for Scotland. The local authorities are—(i.) in burghs under the Burgh Police (Scotland) Act, 1892, the town council or burgh commissioners; (ii.) in other burghs, the town council or board of police; (iii.) in districts where the county is divided into districts, the district committee; (iv.) in counties not so divided, the county council. The substantive provisions are similar to those of the English Acts.

Ireland.—Most of the English Acts apply to Ireland with modifications and adaptations. See the following statutes: Infectious Diseases (Notification) Acts, 1889 and 1890; Cleansing of Persons Act, 1897. The collective title, "Public Health (Ireland) Acts, 1878 to 1896," was by the Short Titles Act, 1896 (59 and 60 Vict. c. 14) given to the consolidating Act of 1878, the Act of 1890, and the Act of 1896. See also the Local Government Act, 1898, §§ 32, 105, schedule 5. The most important of these statutes is the Public Health (Ireland) Act, 1896, 59 and 60 Vict. c. 54, which invested rural sanitary authorities with the powers and duties of urban authorities. The Public Health (Ireland) Act, 1900, gives power to the Local Government Board for Ireland to determine the area of charge in respect of certain special expenses.

United States.—It is within the police power of each state to legislate on such subjects as adulteration, contagious diseases, quarantine, vaccination.

AUTHORITIES.—**English**: GLEN. *Public Health Acts.* London, 12th edition, 1899.—LUMLEY. *Public Health Acts.* London, 5th edition, 1896.—FITZGERALD. *Public Health Acts.* London, 7th edition, 1895.—HUNTER. *Open Spaces.* London, 1896.—HUNT. *London Local Government.* London, 1897.—HUNT. *London Government Act, 1899.* London, 1899.—MACMORRAN, LUSHINGTON, and NALDRETT. *London Government Act, 1899.* London, 1899.—SHAW'S *Vaccination Manual.* London, 1899. **Scottish**: MACDOUGALL and MURRAY. *Handbook of Public Health.* Edinburgh. **Irish**: VANSTON. *Public Health in Ireland.* Dublin, 1892.—VANSTON'S *Public Health Supplement.* Dublin, 1897. **American**: BOUVIER. *Law Dict.*, ed. Rawle. London and Boston, 1897.

(A. W. R.)

Publishing.—Under the description of Bookselling, the earlier volumes of the *Encyclopædia Britannica* (ninth ed., vol. iv. pp. 39, 40) dealt summarily with the early history of what is now known as publishing. It is, however, not quite correct in modern times to speak of publishing and bookselling as identical. The publisher now confines his energies entirely to the production and publication of books, while the bookseller retails them to the public. By this division a larger constituency is reached, as the bookseller's counter is considered the best medium through which a book can be seen and advertised.

A change of system.

Before dealing with the present system of publishing, it will be best, if only for comparison, to sketch briefly some of the methods of publishing which were in vogue during the later part of the 18th and the early part of the 19th century, before the severance of the seller from the producer of books. Formerly, by a system of association, the principal booksellers produced for themselves most of the books they sold, and in many cases they employed the authors to write them. Dr Johnson and Oliver Goldsmith, as well as many other well-known authors, were so engaged. By this system of co-operative publishing, prices were fixed, discounts regulated, and all trade questions easily adjusted. The cost of producing a book was borne by this circle of publisher-booksellers, who were called partners, and the books thus produced were usually of a popular character, such as dictionaries, natural histories, encyclopædias, and general educational literature. The interests in these works were frequently divided and subdivided into lots or shares, which, in the case of an expensive book, or of one for which a large circulation was anticipated, were sometimes very numerous and often formed a complex arithmetical problem. These divisions or shares in a book sometimes consisted of as many as 300 different lots. On the title-page of the first edition of Johnson's *Lives of the Poets* there were the names of thirty-six of these associated booksellers, and on the second edition of the same work, forty-two. The following extract from a trade catalogue sale which was held at the London Coffee House, Ludgate Hill, in 1805, will illustrate this curious custom:—

One 160th Johnson's *Dictionary* sold for £23	5	0
16 7/8 books in 3000 Pope's Works ,,	6	6	0
15 books in 1000 Sterne's Works ,,	11	0	0

And in a division by the partners of Cruden's *Concordance* the fractions of shares into which this once very popular book was divided were as follows:—

$$\frac{3}{52} \quad \frac{21\frac{1}{2}}{1500} \quad \frac{1}{18} \quad \frac{7}{60} \quad \frac{338\ \frac{527}{936}}{1000}$$

This partnership in the copyright of a book led to frequent meetings on the part of the proprietors to discuss new issues and divide profits. These transactions were usually accompanied by a dinner, which in later years developed into a trade usage, every publisher of importance during the last half of the 19th century giving at least one dinner in each year to his customers. This custom was continued until 1897, Messrs R. Bentley & Son being the last publishers to give a trade dinner, a year previous to their incorporation with Messrs Macmillan & Co. in 1898. Mr John Murray's trade sale dinner was discontinued in 1887, and Messrs Longman & Co.'s in 1872. On those occasions books were offered at a considerable reduction from the ordinary cost prices. The invitation to these dinners was always by a sale catalogue, which was sent out to "a select number of booksellers of London and Westminster," and which in its shape and character, for nearly 200 years, showed little change, the earliest known being dated 1704. They were always on thick woven folio paper, with broad margins for figures, with some such formulary as the following printed on the first page:—"Beginning at nine in the morning, when the whole company shall be entertained with a breakfast, and at noon with a good dinner and a glass of wine, and then proceed with the sale, to finish that evening."

From this early period down to the middle of the 19th century the stock sold at these sales consisted largely of miscellaneous books, besides those which the publisher-bookseller himself partly controlled. After that date the shares of most of these partnership books were either bought up by one partner or through the lapse of time became worthless, the old methods gradually died out, and the publisher, as we know him, became the sole producer of the works which the booksellers sold.

There were, however, during the first half of the 19th century several great publishing houses, some of whom still exist, who, with foresight and discretion, issued many of their publications on their own responsibility, notably the house of Longmans, who speculated large sums in the works of Wordsworth, Moore, Macaulay, and also in the issue of the *Edinburgh Review*. This was true also of John Murray, who paid immense sums to Lord Byron, Scott, Crabbe, Irving, Hallam, Southey, and to the writers in the *Quarterly Review*. The same business methods existed in the houses of Blackwood, Colburn, Constable, Rivingtons, A. & C. Black, and others, who displayed great knowledge of the requirements of that age, many of them making large fortunes.

This complete centralization of the publisher's responsibility developed many changes, some of them considerably influencing the relation of the author to the publisher as well as the position of the publisher to the bookseller. There also grew up conditions in these trades which eventually led to the formation of protection societies for the author, the publisher, and the bookseller.

The old-established publishers, being in many instances men of culture and education, gathered round them authors of position and renown, with whom they became on intimate terms. A personal relationship was thus fostered which frequently resulted in business suggestions beneficial to both author and publisher. This is further illustrated in the published lives of the Murrays, the Blackwoods, of Daniel Macmillan, and Adam Black, as well as in the biographies of authors themselves. The great commercial prosperity which was associated with this and a later period induced many men of enterprise and capital to enter the publishing trade, with the result that through the multiplicity of publishers a competition arose for the successful writer, which, although enriching the author, has occasionally severed many pleasant social relationships. There are, however, still many exceptions to this condition of affairs.

Publishers' readers.

The changes which have affected the publishing trade from time to time are well illustrated by the difference in the position of the publishers' readers—those men of letters who assist and advise the publisher in the literary side of his business. In the time of Dr Johnson, when the publisher was practically no more than a bookseller, and publishing mainly consisted in combinations of booksellers to share expenses, there was very little room for independence in the position of their literary advisers. Indeed, at that time the publisher's reader, so far as he existed, was practically the publisher's "hack," engaged in odds and ends of literary work at a very insufficient stipend, and subject at times to actual indignities at the hand of his employer. In some such position Johnson himself served Cave at St John's Gate, Clerkenwell; and most of the booksellers could claim the assistance of a ready man of this description, though rarely, of course, of equal distinction.

Gradually, however, as the business of publishing assumed a different complexion, there was a tendency for each bookseller to act for himself, and little literary cliques were gathered around the different houses, ready to advise and assist. In this way the *Quarterlies* sprang into existence, and rivalry became more direct and more lively between the different houses. Then each house sought to become the exclusive publisher to the best writers of the day, and the duties of the publisher's adviser became more extensive. He was often something of a go-between from publisher to author, and himself a writer of distinction and high reputation. Scott's relation to the Ballantynes and Gifford's to Murray are almost inseparable from many of the associations of the publisher's reader: they read manuscripts and advised upon proposals, consulted with writers, and represented the literary conscience and judgment of the firms, to whom they stood as friendly sponsors. But the development did not stop there. "The mob of gentlemen who write with ease" increased so rapidly in number and pertinacity that it soon became necessary for every house to keep in constant employ at least one, and often several advisers, who should read the manuscripts and report upon their quality. By the beginning of the 'thirties this custom was universal; and the reader was also expected to suggest schemes and help to carry them through. Charles Whitehead, for example, a Bohemian of the old school, was responsible to the firm he served for the suggestion that Charles Dickens should be asked to write *The Pickwick Papers* to accompany a series of projected illustrations by Seymour. In this way the position of "reader" often became a very responsible one, and gave many meritorious but undistinguished men of letters a chance of affording their first opportunity to writers who were soon to outstrip them alike in commercial value and in literary reputation. Thus it was Mr Smith Williams, the reader, who induced Mr George Smith (Smith, Elder & Co.) to publish *Jane Eyre*. Then, as the competition among publishers became more acute, and the business gave wider opportunities for taste and culture, the status of the "reader" naturally advanced *pari passu*. A man of judgment and executive skill was able to indicate to a promising writer faults which might easily be remedied and qualities which should be cultivated; courtesies of this kind made for business, and so there grew up a new rivalry between house and house, who vied with one another in securing the best advice available.

These were the golden days in the history of the publisher's reader, and they were perhaps at their zenith in the middle 'seventies. Then Mr John Morley, for example, advised Messrs Macmillan, and Mr George Meredith Messrs Chapman & Hall; and several of the most distinguished writers of our day bear testimony to the invaluable advice which they received from these gentlemen at the outset of their own careers, advice extending to a detailed examination of their manuscripts, and elaborate suggestions for their improvement and alteration. The recent increase, however, in the number of publishers, and the purely mercantile nature of certain developments in the business, seem not unlikely in the future to undermine the position of the "reader," and to render him once more a mere appanage of the office. This change of front is, no doubt, chiefly attributable to the growing tendency to neglect the old and intimate personal relations between publisher and author, and to entrust the whole of the business arrangements to a literary agent or middleman, who undertakes the entire conduct of a manuscript from the time it leaves the author's hand until the day of its publication, arranges the author's contract, and collects his dues. The result of this innovation, however effectually it may relieve the writer of business anxieties, has undoubtedly been to separate author from publisher, and very often to deprive the author of the advantage of the publisher's experience in the way of advice and direction. In this way the "reader" has lost the better part of his occupation. Instead of being a cultured expert, prompting the writer with suggestions, he tends to become a sharp man of business, acquainted with the "sales" of every successful author, and the sums which it is safe to adventure in advance of publication, and the young and inexperienced writer seems likely to find less and less literary assistance within the walls of a publishing house.

There are naturally several branches of publishing into which this rather illiberal competition cannot enter, and here the more humane functions of the literary adviser are still unimpaired. The fields of *belles lettres*, criticism, bibliography, scientific and (perhaps) educational literature are exempt from the present stress of the market, and it is here that we must look for the preservation of the calmer and more dignified spirit of business. Here the "reader" has still his place and his opportunity. But in the wider field of general publishing his position has almost certainly passed its meridian, and only a complete change in the nature of business methods can restore it to the privileges and satisfactions which it once enjoyed.

The literary agent.

Competition among publishers for the successful author assisted in the establishment about 1880 of the literary agent. The business of these literary agencies, of which there are about ten, is to dispose of an author's MS. to the highest purchaser, to arrange for the serial issue of the work, to negotiate and settle the American and foreign editions, to keep the author's accounts, and to act as the intermediary between him and the publisher, for which he charges a commission. Some publishers resent this interference, and will not consider a MS. coming through these sources; but the demand for the work of a popular writer is always great, and through the prices obtained by means of the literary agent an author is stimulated to give quantity rather than excellence of work, thereby frequently enriching himself at the expense of his reputation.

The Authors' Society.

Growing up about the same time and covering somewhat the same ground as the literary agent is the Society of Authors. This society, which owed its inception mainly to the initiative of Sir Walter Besant, was established in 1883, and from its commencement met with a considerable amount of support from the workers in literature. Lord Tennyson became its first president, and Lord Lytton, Matthew Arnold, Huxley, Tyndall, and Dr Martineau were among its 36 vice-presidents. The registered office of the society is 39 Old Queen Street, Storey's Gate, S.W. Its accredited organ, *The Author*, was established in May 1890, and has a circulation of over 2000 copies; the subscription to the society is £1, 1s. per annum, or 10 guineas for a life membership. In the first year of its existence it had only 68 paying members; it now has over 1300. The main principles of the society are: (1) the maintenance, definition, and defence of literary and musical property; (2) the consolidation and amendment of the law of domestic copyright; (3) the promotion of international copyright. The society has grown with its requirements, and now not only aims at defining and establishing the principles and methods of publishing, but examines agreements and advises authors as to the best publishers for their purpose. It looks through and carefully examines publishers' accounts and estimates for printing and production; it takes action on behalf of its members for the recovery of MSS.; and will for a small fee give a critical report upon the work of young

authors submitted to it. Although not antagonistic to the literary agent, it warns the author who is starting on his career not to enter into contracts or dispose of his MS. before consulting the society, as in his preliminary efforts the advice of the Authors' Society would be found useful. The great work of the society has been its continual insistence on the value of literary property and the right of the author to his share of profit. It has therefore laid down what it considers the heads under which the various methods of publishing should fall; these are as follows: (1) sale outright; (2) limited sale; (3) the half-profits system; (4) the royalty system; (5) publication by commission.

In discussing these proposals of the Authors' Society separately, it must be understood that variations may take place by agreement between author and publisher in any of the several departments, and the various arrangements are here explained rather than suggested as a system to be adopted for publishing. With regard to *sale outright* much might be urged, both for and against. It is not an infrequent occurrence for an author, who has probably put his most original work into his first book, to be unable to find a publisher. Cases might be mentioned where, after many unsuccessful attempts, an author has disposed of the copyright of his book for a nominal sum, and the work has afterwards turned out a surprising success. To the credit of the publishers, this success has generally been recognized by further payments, but legally the author has no further claim. It is therefore suggested that if an author considers his work to be one of merit, he should not dispose of his rights in the book. If, however, the author cannot afford to wait the verdict of the public, he is sometimes compelled to accept the best price offered for his MS. On the other hand, by sale outright the author dispenses with all future trouble, and the loss, if any, falls upon the publisher, who, in order to make his investment a satisfactory one, must do his best to make the book a success by reviews, advertisement, and through trade mediums. These advantages should be a considerable help to a young author.

The method of *limited sales* is not often adopted. It is an arrangement by which an author sells to a publisher the right of producing his book for a limited period for a stated sum, or sells a limited number of copies at an agreed price. Neither of these methods is considered desirable, and should never be undertaken without an agreement.

The *half-profits system* is less objectionable. According to this plan, the publisher produces the book at his own risk, and the net profits are divided in half or on an agreed ratio between author and publisher. Under this system the cost of production and advertising is met before any profit can accrue. This method should not, however, be undertaken unless the author knows well the integrity of the publisher with whom he is dealing, as under this arrangement it is possible for the publisher to take discounts in which the author does not share.

By far the most satisfactory system and the one most generally adopted is the *royalty system*, by which the publisher produces the book at his own cost and pays the author a royalty upon each copy sold. These royalties vary from 10 per cent. to 25 per cent., and in very exceptional cases to 30 per cent., according to the reputation of the author and the anticipated sale of the book. Sometimes by arrangement a royalty is paid upon all copies sold over and above a certain number, or after the cost of production has been covered, but none of these methods should be undertaken without an agreement legally drawn up and duly signed. Most of the leading novelists now publish on the royalty system, as by this they receive a larger return for their literary property. Frequently it is arranged that an author shall receive a large sum on depositing the MS. with the publisher, or on publication, on account of royalties, which in the case of a popular novelist will amount to thousands of pounds.

The method of *publishing on commission* is generally adopted when an author has opportunities for producing his book himself. By this method the work is issued at the expense and risk of the author, and the publisher or agent is paid by a commission on all copies sold, and also on the cost of production, should this be undertaken by the publisher or agent. Provided the book is a successful one, this method is, from a financial point of view, the most satisfactory to an author; for should he have time and opportunity to see the book through the press, he takes all the intermediate profits, and also the commission on production; but it has the objection that a publisher may not throw his energies into the sale of a commission book to the same extent that he would if it were issued upon the royalty system, or if he had himself bought the copyright.

In all these methods of publishing, care should be taken in drawing up agreements, and also, where possible, the copyright should remain in the possession of the author. The success of a book can frequently be traced not only to the effective way a publisher produces it, but also to the way he advertises it, and to the channels through which he causes his advertisements to pass; so that the selection of a publisher is an important matter. It is a fact that the name of a particular publisher on the title-page of a book is a guarantee that the book has been well considered before being issued; this has a great effect with the bookseller who stocks it, and also with the public who buy.

Undoubtedly one of the great factors in publishing, besides an exact knowledge of what to publish, is to bring before the book-buyer the particular character of book that he can use, without undue waste of either money or energy; and this can be done best by judicious advertising, and through the intelligent bookseller.

Remainders. To the author as well as the publisher one of the principal difficulties is the disposal of the books that do *not* sell, that is, to use the usual trade term, of "Remainders." With the consent of the author these are generally either sold by public auction or privately to a trader known as a remainder-buyer. Books so sold fetch a purely nominal sum, sometimes not amounting to the cost of the paper upon which they are printed. Some publishers prefer sending their unsaleable stock back to the paper mills to be repulped, rather than that they should be sold in this unsatisfactory manner. It has sometimes happened that a book sold out in this way has found its real place in a cheaper market, and a fresh and quite unexpected demand for the book has been created. In no case, however, should a book be remaindered until two years after its publication.

Although established after both the Authors' and Booksellers' Association, still, as the predominant partner in the trades coming between the author and the public, it would be right to treat here of the origin and work of the Publishers' Association of Great Britain and Ireland. This association was established in 1896, and had as its first president Mr C. J. Longman. It has a membership of about 70, consisting of all the principal London and provincial publishers. The objects of the association are to promote and protect by all lawful means the interests of the publishers of Great Britain and Ireland. The work undertaken and accomplished has been varied and useful, and in its results has affected the publishers themselves as well as the book trade generally. Amongst the most important questions discussed have been the stopping of colonial piracies, copyright, bibliography, trade terms, and publication agreements.

Publishers' agreement. The following are the principal clauses from a draft agreement between author and publisher drawn up by the association, which has received legal sanction and upon which agreements may be founded for publishing upon the royalty system:—

The publisher shall at his own risk and expense, and with due diligence, produce and publish the work, and use his best endeavours to sell the same.

The author guarantees to the publisher that the said work is in no way whatever a violation of any existing copyright, and that it contains nothing of a libellous or scandalous character, and that he will indemnify the publisher from all suits, claims, and proceedings, damages, and costs which may be made, taken, or incurred by or against him on the ground that the work is an infringement of copyright, or contains anything libellous or scandalous.

The publisher shall, during the legal term of copyright, have the exclusive right of producing and publishing the work in the English language throughout the world. The publisher shall have the entire control of the publication and sale and terms of sale of the book, and the author shall not, during the continuance of this agreement (without the consent of the publisher), publish any abridgment, translation, or dramatized version of the work.

The publisher agrees to pay the author the following royalties on the published price [these by arrangement].

No royalties shall be paid on any copies given away for review or other purposes.

The author agrees to revise the first and, if necessary, to edit and revise every subsequent edition of the work, and from time to time to supply any new matter that may be needful to keep the work up to date.

The author agrees that all costs of corrections and alterations in the proof sheets exceeding 25 per cent. of the cost of composition shall be deducted from the royalties payable to him.

In the event of the author neglecting to revise an edition after due notice shall have been given to him, or in the event of the author being unable to do so by reason of death or otherwise, the expense of revising and preparing each such future edition for press shall be borne by the author, and shall be deducted from the royalties payable to him.

During the continuance of this agreement the copyright of the work shall be vested in the author [or publisher], who may be registered as the proprietor thereof accordingly.

The publisher shall make up the account annually.

If the publisher shall at the end of three years from the date of publication, or at any time thereafter, give notice to the author that in his opinion the demand for the work has ceased, or if the publisher shall for six months after the work is out of print decline or, after due notice, neglect to publish a new edition, then and in either of such cases this agreement shall terminate; and on the determination of this agreement in the above or any other manner, the right to print and publish the work shall revert to the author, and the author, if not then registered, shall be entitled to be registered as the proprietor thereof, and to purchase from the publisher forthwith the plates or moulds and engravings (if any) produced specially for the work, at half cost of production, and whatever copies the publisher may have on hand at cost of production; and if the author does not within three months purchase and pay for the said plates or moulds, engravings, and copies, the publisher may at any time thereafter dispose of such plates or moulds, engravings, and copies, or melt the plates, paying to the author in lieu of royalties a percentage of the net proceeds of such sale.

If any difference shall arise between the author and the publisher touching the meaning of this agreement, or the rights or liabilities of the parties thereunder, the same shall be referred to the arbitration of two persons (one to be named by each party) or their umpire, in accordance with the provisions of the Arbitration Act, 1889.

Much business of an international character has also been undertaken by the association, especially in the important work of organizing the International Congresses of Publishers. The aim of these has been to promote and establish a true international friendship, so that if trade or other differences should arise in any country, they may be settled by the intervention of the publishers in the particular country; and also to extend the advantages of the Bern Convention by securing the adherence of those countries which have not yet joined (see COPYRIGHT). The first of these Congresses was held at Paris in 1896, the second at Brussels in 1897, the third at London in 1899, and the fourth at Leipzig in 1901. At all these Congresses questions were discussed, and in many cases settled, in a spirit which beneficially affected the trade of Great Britain and other countries, and which may go far to remove possible causes of future friction.

The net system.

One of the most important actions of the publishers, and one which has had a material bearing upon the bookselling trade of the United Kingdom, was the adoption and enforcement of what is known as the *Net System*, which means that no bookseller may give a discount to the public off the price at which a book is published when issued under this system. This arrangement was the subject of much discussion between authors, publishers, and booksellers, but eventually a *modus operandi* was arrived at, which was deemed satisfactory to the various interests in question, and on 1st January 1900 the system came into operation: publishers undertaking to discontinue supplying any bookseller who gave a discount off the selling price of net books, and the booksellers, through their association, signing an agreement to fall in with the publishers' proposals and to charge the published price, giving no discount. At the outset some of the discount booksellers took exception to the coercive policy thus introduced, but their opposition gradually died out, owing to the firm stand taken by the publishers; and although some objections are still raised against the system, it is in the main accepted as the best solution of the discount difficulty yet proposed. The publishers have at present refused to take action as to discounts in regard to books published in any other way than on the net system.

Discount.

Many previous attempts had been made to grapple with the discount difficulty. In July 1850 twelve hundred booksellers within 12 miles of the London General Post Office signed a stringent agreement not to sell below a certain price. This agreement was broken almost immediately. Another attempt was made in 1852; but at a meeting of distinguished men of letters resolutions were adopted declaring that the principles of the Booksellers' Association of that period were opposed to free trade, and were tyrannical and vexatious in their operation. The question was eventually referred to a commission, consisting of Lord Campbell, Dean Milman, and George Grote, which decided that the regulations were unreasonable and inexpedient, and contrary to the freedom which ought to prevail in commercial transactions. An attempt was also made in 1869 to impose restrictions upon the retail bookseller; but these also failed, mainly through the want of decided action on the part of the publishers. Later success was undoubtedly due to the unity of purpose which animated all parties, and was made possible through the existence of both a publishers' and booksellers' association, the members of which worked in harmony and towards a definite and settled end.

The 6s. novel.

Besides the discount question, there have been many disturbing elements in the publishing and bookselling trade. Perhaps no greater change ever took place than that which was brought about by the Education Act of 1870, which caused a revolution in educational literature, rendering most of the then existing school-books practically useless, new educational methods taking the place of the old-fashioned system of questions and answers. Another change was brought about by the abolition of the three-volume novel. It had always been the custom to issue works of fiction in several volumes. Richardson's *Clarissa Harlowe* was in 8 volumes, Fielding's *Tom Jones* in 6 volumes, and Sterne's *Tristram Shandy* in 9 volumes; but during nearly the whole of the 19th century, until 1897, three volumes were considered the regulation number for all novels. In 1894 Mudie's and Smith's circulating libraries sent to the publishers a circular suggesting drastic changes in the prices of this mode of issue, which had the effect of gradually reducing the number of novels in this form; and in the last year of their existence, 1897, only four novels were thus published. Up to this time the 6s. volume was reserved for the cheap edition of a work first published in three volumes, but the abolition of the latter opened the flood-gates for the publication of original fiction in one-volume form. The result has been a yearly growth in this department of literature, which now forms the principal stock of the general bookseller. To the popular novelist this change has been beneficial, as he at once appeals to the large majority of readers before the critics have had time to express their opinion, in one sense or another, which was hardly the case in the days of the three-volume novel. As illustrating the large demand created by this form of issue, it may be mentioned that of Miss Corelli's *The Master Christian*, published in 1900, nearly 260,000 copies have been sold; and of Mr Hall Caine's *The Eternal City*, published in September 1901, over 120,000 copies were disposed of in six months in Great Britain alone. Other examples

of large sales might easily be cited. By this one-volume form of issuing novels the colonial bookselling trade has been greatly benefited, as it is now usual to publish simultaneously with the English editions another edition entirely for sale in India and the Colonies. This trade is a very increasing one, and is considered an important factor in the sale of a book.

Cheap books. The increase in the publication of very cheap editions has been a feature of recent years. Enormous numbers of low-priced (even sixpenny) editions of standard works have been issued, and this is notably the case with cheap reprints of books of which the copyright has just expired. New novels of good standing have also been first published in a sixpenny edition. Akin to this is the practice of publishing novels serially in the cheap monthly magazines, such as those which Messrs Harmsworth, Newnes, and Pearson have popularized.

The number of books published in the United Kingdom somewhat declined between 1897 and 1902, the South African War and the death of Queen Victoria naturally affecting the book-market. In 1897 there were issued 6244 new books; in 1898, 6008; in 1899, 5971; in 1900, 5760; and in 1901, 4955. About 1500 in each year were fiction.

Distributing. Coming between the publisher and the retail bookseller is the important distributing agency of the *wholesale bookseller*. It is to him that the retailer looks for his miscellaneous supplies, as it is simply impossible for him to stock one-half of the books published. In Paternoster Row, which has for over a hundred years been the centre of this industry, may be seen the collectors from the shops of the retail booksellers, busily engaged in obtaining the books ordered by the book-buying public. It is also through these agencies that the country bookseller obtains his miscellaneous supplies. At the leading house in this department of bookselling almost any book can be found, or information obtained concerning it. At one of these establishments over 1,000,000 books are constantly kept in stock. It is here that the publisher calls first on showing or "subscribing" a new book, a critical process, for by the number thus subscribed the fate of a book is sometimes determined.

What may be termed the third partner in publishing and its ramification is the *retail bookseller;* and to protect his interests there was established in 1890 a London Booksellers' Society, which had for its object the restriction of discounts to 25 per cent., and also to arrange prices generally and control all details connected with the trade. The society a few years afterwards widened its field of operation so as to include the whole of the United Kingdom, and its designation then became "The Associated Booksellers of Great Britain and Ireland." This association, with the aid of the publishers, established the net system before mentioned, and by unity of action aims at stopping further underselling and the giving of ruinous discounts. Mr H. W. Keay is the president of the association, and the registered offices are 1 Bathurst Street, London, W.

The United States. From the beginning of the 20th century there has been a large influx into England of American literature, especially fiction. Not only has there been a growing appreciation of many American writers, but the attractive "get-up" of American books has made its influence felt upon the British market. Some of the American methods of distribution have also been attempted in Great Britain, but with only partial success. The most successful effort has been the sale of important expensive works through the medium of newspapers. Canvassing, which is a common method of distributing books in the United States, meets with little support in the United Kingdom, although about the middle of the 19th century a large trade was done throughout England and Scotland by canvassers, who sold in numbers and parts such works as Family Bibles, Daily Devotions, Lives of Christ, and Foxe's *Book of Martyrs*. It is, however, an acknowledged fact among publishers that there is still a large British public not reached through the ordinary channels of trade, and how this book-buying public can be touched is a question which is continually exercising the minds of the enterprising producer. The methods of publishing in America are similar to those adopted in Great Britain, but the discount to the booksellers is generally given *pro ratâ* according to the number purchased. It is, however, in respect of the means of distribution that the systems of the two countries differ most. In America the general stores to a considerable extent take the place of the English bookseller, and by their energy and extensive advertising a wider public is served. In the distribution of fiction the American plan of "booming" a book by copious advertising, although expensive, is often the means of inducing a large sale, and of bringing an author's name before the public, but it does not always establish a permanent reputation for him. In 1901 the net system, as adopted in Great Britain, was partially introduced into America.

The Continent. The Continental methods of publishing and distribution, especially in Germany, differ, in many respects very materially, from those of Great Britain. In even the smallest German towns there is a bookseller who receives on sale, immediately upon publication, a supply of such new books as he or the publisher may think suitable to his class of book-buyers. The bookseller submits these books to his customers, and by this method most books issued are at once placed at the disposal of any buyer interested in the particular subject. The large sums spent in other countries upon advertisement are thus saved. At the book fairs held in Leipzig at Easter and Michaelmas the accounts for books sent on sale are made up and paid. In France all books have to be licensed before publication, but the methods of publication differ little from those of other Continental countries.

See also S. S. Sprigge, *The Various Methods of Publication.*

(J. Sh*.; A. Wa.)

British Publishing Houses.

The following firms, whose names are well known from the books they published, have ceased to exist:—

Bentley, R., & Son, founded by Richard Bentley in 1832. He started business with H. Colburn in 1829. In 1837 he commenced the issue of *Bentley's Miscellany*, in which Dickens's *Oliver Twist* and Ainsworth's *Guy Fawkes*, illustrated by G. Cruikshank, appeared. At his establishment in New Burlington Street, Richard Bentley and his son George gathered round them a famous band of men of letters; among them was the Rev. R. H. Barham, the celebrated author of *The Ingoldsby Legends*, which was first published in 1840. This firm also published the "Library of Standard Novels" and the "Favourite Novel Library." In the latter Mrs Henry Wood's *East Lynne* appeared. In 1866 the firm took over the publication of *Temple Bar*, founded by G. A. Sala and Edmund Yates; *Bentley's Miscellany* was afterwards incorporated with this magazine. Mr Richard Bentley was the last member of this firm, and he, with his father, Mr George Bentley (1828–95), worthily maintained its historical reputation until its incorporation by Messrs Macmillan & Co. in 1898.

Bohn.—Henry George Bohn, born of German parents in London in 1796, was a man of great literary and business activity. His father was a bookseller, and young Bohn in 1831 started as a dealer in rare books, besides buying up the surplus stock of publishers and selling them at a cheap rate to the retail booksellers. In 1841 he issued his celebrated *Guinea Catalogue*, a monumental work containing 23,208 different items. Bohn was also noted for his book auction sales; one held in 1848 lasted four days, the catalogue comprising twenty folio pages. Printed on this catalogue was the following information: "Dinner at 2 o'clock, dessert at 4, tea at 5, and supper at 10." The name of Bohn is principally remembered by the important "libraries" which he inaugurated; these were commenced in 1846, and comprised such subjects as history, science, classics, theology, archæology, &c., consisting in all of 766 volumes. The libraries were bought in 1864 by Messrs G. Bell & Sons. Bohn died in 1884.

Colburn.—Henry Colburn obtained his earliest experience of bookselling at the establishment of W. Earle, Albemarle Street, and afterwards as an assistant at Mr Morgan's Library, Conduit Street, of which in 1816 he became proprietor. He afterwards removed to New Burlington Street, where he established himself as a publisher, resigning the Conduit Street Library to Messrs Saunders & Otley. In 1814 he originated the *New Monthly Magazine*, of which at various times Thomas Campbell, Bulwer

Lytton, Theodore Hook, and Harrison Ainsworth were editors. Colburn published in 1818 *Evelyn's Diary*, and in 1825 the *Diary of Pepys*, edited by Lord Braybrooke, paying £2200 for the copyright. He also issued Disraeli's first novel, *Vivian Grey*, and a large number of other works by Theodore Hook, G. P. R. James, Marryat, and Bulwer Lytton. In 1830 Mr R. Bentley was taken into partnership; and in 1832 Colburn retired, but set up again soon afterwards independently in Great Marlborough Street; his business was taken over in 1841 by Messrs Hurst & Blackett. Henry Colburn died on 16th August 1855, leaving property to the value of £35,000.

Constable, Archibald, was born on the 24th of February 1776 at Carnbee, in Fifeshire. In 1788 he was apprenticed to Peter Hill, bookseller, of Edinburgh, but started in business for himself in November 1795 as a dealer in rare and curious books. the *Scots Magazine* was acquired by him in 1801, and Leyden, the poet, antiquarian, and Orientalist (d. 1811), became its editor. He introduced Constable to literary circles. In 1802 Constable commenced the *Farmers' Magazine*, and in the same year the *Edinburgh Review* burst upon an astonished world. The first number was issued in November 1802, under the nominal editorship of Sydney Smith; Lord Jeffrey was, however, the guiding spirit of the review, having as his associates Lord Brougham, Sir Walter Scott, Hallam, Playfair, and afterwards that brilliant essayist Lord Macaulay. Constable was also publisher of the *Encyclopædia Britannica*, then in its sixth edition, which passed in 1827 into the hands of Adam Black on Constable's failure. In 1804 A. G. Hunter joined Constable as partner, bringing considerable capital into the firm. In 1805, jointly with Longman & Co., Constable published Scott's *Lay of the Last Minstrel*, the demand for which exceeded anything previously known in the annals of British poetry; he also published, subsequently, *Marmion*. In 1808 a split took place between Constable and Sir Walter Scott, the latter transferring his business to the firm of Ballantyne & Co. In 1811, however, a reconciliation took place between Constable and Scott. Constable again became Scott's publisher; but the Ballantynes maintained their printing establishment, in which Scott was largely interested. In 1814 Constable purchased for £700 the copyright of *Waverley*. This was issued anonymously; but in a short time 12,000 copies were disposed of, Scott's other works following in quick succession. Through over-speculation, complications in Constable's business arose, and in 1826 a crash came. Constable's London agents stopped payment, and he failed for half a million of money, while Ballantyne also went bankrupt for £90,000. Constable began business afresh, but died on the 21st July 1827. After Constable's bankruptcy, Robert Cadell (who had been his partner), in conjunction with Sir Walter Scott, bought from the various publishers in whose hands they were all the novels which had been issued up to that time, and began the issue of the famous forty-eight volume edition, which was published in monthly volumes between 1829 and 1833. It was annotated by the author, who called it his Magnum Opus. The result of its publication was that the debt on Abbotsford was redeemed, and that Cadell bought the estate of Ratho, near Edinburgh, which he owned till his death in 1847. From Cadell's executors the entire copyrights of Scott's works were acquired by Adam and Charles Black in 1851.

Moxon.—Edward Moxon, poet and publisher, published in 1826 his first volume, entitled *The Prospect, and other Poems*, which was received with much favour as containing the germ of better things. In 1830 Moxon was started by Samuel Rogers as a publisher at 34 New Bond Street. The first volume he issued was Charles Lamb's *Album Verses*. In the following year he took over the publication of the *Englishman's Magazine*, which was contributed to by Charles Lamb (whose adopted daughter Moxon afterwards married), Arthur H. Hallam, and Alfred Tennyson. Removing to Dover Street, Piccadilly, Moxon published an illustrated edition of Rogers's *Italy*, £10,000 being spent upon the illustrations. In 1839 he issued the first complete edition of Shelley's poems. Some passages in *Queen Mab* were the cause of a charge of blasphemy being made against Moxon in 1841. The case was tried before Lord Denman. Serjeant Talfourd defended Moxon, but the jury returned a verdict of "Guilty," and the offensive passages were for a time eliminated. In 1840 Browning's *Sordello* was published; and in succeeding years works by Lord Houghton, Tom Hood, Barry Cornwall, Lord Lytton, Browning, and Tennyson appeared. Edward Moxon died on the 3rd of June 1858, his business being continued by Mr J. B. Payne and Mr Arthur Moxon, who in 1865 published Swinburne's *Atalanta in Calydon*; but in 1871 it was taken over by Messrs Ward, Lock & Tyler.

Knight, Charles, born at Windsor on 15th March 1791, was apprenticed to his father, a bookseller in the royal borough. Upon the completion of his indentures he practised journalism and interested himself in several newspaper speculations. He, W. & R. Chambers, and John Cassell were the forerunners of "literature for the people." In 1832, in conjunction with some Eton friends, he started *Knight's Quarterly Magazine*, to which Praed, Derwent Coleridge, and Macaulay contributed, many of the last-named's early poems appearing in its pages. In 1828 he started the *British Almanac* and the *Companion to the Almanac*, and also the "Library of Entertaining Knowledge." In 1832 there appeared the celebrated *Penny Magazine*, which reached a sale of 200,000 in weekly and monthly parts. This was followed by the *Penny Encyclopædia*, which was also a great success. Knight was the publisher of the works issued under the direction of the Society for the Diffusion of Useful Knowledge, with which Lord Brougham, Lord John Russell, and William Tooke were associated. The *Illustrated Bible*, edited by the Rev. Dr Kitto, the *National Encyclopædia*, *The Land We Live In*, *Popular History of England*, *English Encyclopædia*, and *Half-Hours with the Best Authors* were among the many works instituted and carried through by this earnest worker in popularizing good literature. He died at Addlestone, Surrey, 9th March 1873.

Of existing publishing houses, some date back into the early part of the 18th century. Their long and honourable record as leaders in the publishing world is inseparable from that of the literature of their time.

Murray, John.—The founder of this firm was John M'Murray, born at Edinburgh in 1745. In 1762 he was a lieutenant in the navy, but retired in 1768, and was soon engaged in the active business life of London. In 1766 he took over the old-established business of W. Sandby, Fleet Street; and after this period M'Murray found it convenient to drop the Scottish prefix, and called himself plain John Murray (1). In 1780 he issued the *London Mercury*, a volume of annual intelligence; and in 1783 he started the *English Review*. Among his earlier publications were Mitford's *Greece*, Langhorne's *Plutarch's Lives*, and, in 1791, D'Israeli's *Curiosities of Literature*. He died on the 6th November 1793, bequeathing to his only son his copyrights and business. John Murray (2), born in 1778, was only fifteen years of age when his father died. After a year or two, during which the widow nominally managed the business, Mr Highley was admitted a partner, and the firm became "Murray & Highley," the latter to conduct the business until young Murray came of age. In 1803 the partnership was dissolved, Highley taking all the medical publications. Afterwards, in 1812, Murray migrated to Albemarle Street, where, with uncommon gifts and a speculative spirit, he earned for himself the name, given to him by Lord Byron, of "The Anak of Publishers." In 1806 Murray married Miss Elliot, of Edinburgh, shortly afterwards publishing Mrs Rundell's *Domestic Cookery Book*, and in 1807 he took a share with Constable in publishing *Marmion*. Thus began a connexion with Sir Walter Scott, who, through differences arising on political questions with the writers in the *Edinburgh Review*, assisted Murray in launching a Tory periodical, the *Quarterly Review*, with Gifford as its editor, the first number being issued on 1st of February 1809; among the contributors being Scott, Canning, Southey, Barrow, and Hookham Frere. The *Quarterly* at once brought Murray into prominence with the Conservative leaders as well as with literary men. Murray was, jointly with Constable, the publisher of some of Scott's early poems and novels, but, greatly to his distress, he was compelled to break this association on account of the methods which, as he foresaw, ultimately led to disaster. In the spring of 1812 *Childe Harold* was published. This was brought to Murray by Dallas, to whom Byron had presented it, Murray paying £600 for the copyright. In the same year he bought the business and stock-in-trade of Mr Miller, 50 Albemarle Street, and transferred himself there. Literary London flocked to his house, and John Murray became the centre of the publishing world. In his drawing-room, at four o'clock daily, was collected together most of the talent, literature, and art of that time. It was in this room in 1824, after the death of Lord Byron, that the MS. of his autobiography, which he had given to Moore, was destroyed, it being considered by Gifford to be unfit for publication. A lifelong friendship existed between Lord Byron and his publisher, he having paid him nearly £20,000 for his various poems. Murray paid Thomas Moore £4200 for writing the life of Byron, to Crabbe £3000 for his *Tales of the Hall*, all his transactions being of the most generous character. In 1824, however, he lost £27,000 on the failure of his shortlived Conservative daily paper, the *Representative*. Murray was as celebrated for his books of travel as for *belles lettres*. He died on the 29th June 1843, leaving also an only son. John Murray (3), born in 1808, inherited much of his father's business tact and judgment. In early life he took especial pleasure in foreign travel; the famous handbooks for travellers were issued under his personal editorship, some of them being written by himself. In the first year of his accession he issued the "Home and Colonial Library," and in his selection of authors he successfully maintained the reputation of the old firm. One of his most successful books was Campbell's *Lives of the Chancellors*. He also issued books by Hallam, W. E. Gladstone, Lyell, Layard, Dean Stanley, Murchison, Darwin, Livingstone, and Samuel Smiles. He died 2nd April 1892, and was succeeded by

his son. John Murray (4) was born in London in 1851, was the second president of the Publishers' Association, and is an active worker in everything connected with the publishing and bookselling trade. He is associated in his business with his brother A. H. Hallam Murray.

LONGMANS, GREEN & Co.—This firm dates back farther than any other English publishing house. Its founder, Thomas Longman (1), born in 1699, was the son of Ezekiel Longman, described as a gentleman of Bristol, who died in the year 1708. Thomas was apprenticed in June 1716 to John Osborne, bookseller, of Lombard Street, London. At the expiration of his apprenticeship he married Osborne's daughter, and in August 1724 purchased the stock and household goods of William Taylor (the first publisher of *Robinson Crusoe*) for the sum of £2282, 9s. 6d. Taylor's two shops were known as the Black Swan and the Ship, and occupied the same ground in Paternoster Row upon which this famous publishing house now stands. Osborne, who afterwards entered into a partnership with his son-in-law, issued upon the share system, in conjunction with other booksellers, various educational books, and also Ephraim Chambers's *Cyclopœdia*. In 1754, having no son, Thomas Longman took his nephew, who was born in 1731, into partnership, the title of this firm becoming T. & T. Longman. Upon the death of his uncle in 1755, Thomas Longman (2) became the proprietor of all the partnership stock. He maintained the old traditions of the firm, and greatly extended his colonial trade. He married Miss Harris, and by her had three sons. Of these, Thomas Norton Longman (3), born in 1771, followed in 1797 his father in his publishing business. In 1794 Owen Rees became a partner in the firm, and Thomas Brown, who was for many years after 1811 a partner, entered the house as an apprentice. Mr Brown died in 1869 at the age of 92. In 1799 Longman purchased the copyright of Lindley Murray's *English Grammar*, which had an annual sale of about 50,000 copies; he also purchased about 1800 the copyright, from Joseph Cottle, of Bristol, of Southey's *Joan of Arc* and Wordsworth's *Lyrical Ballads*. He also published the works of Wordsworth, Coleridge, Southey, and Scott, and acted as London agent for the *Edinburgh Review*, which was started in 1802. From this period the firm greatly enlarged its business, issuing many works of an important character. In 1804 Mr Hurst and Mr Orme became partners; and in 1824 the title of the firm was changed to Longman, Hurst, Rees, Orme, Brown & Green. In 1814 arrangements were made with Thomas Moore for the publication of *Lalla Rookh*, for which he received £3000; and when the house of Constable, Edinburgh, fell in 1826, Longmans became the proprietors of the *Edinburgh Review*, while the advent of Thomas Babington Macaulay powerfully contributed to the fortune and reputation of the firm. They also issued in 1829 Lardner's *Cabinet Encyclopœdia*, which was contributed to by many of the most conspicuous workers in literature of the day; and in 1832 M'Culloch's *Commercial Dictionary*. Thomas Norton Longman (3) died on 29th August 1842, leaving his two sons, Thomas (4) and William Longman, in control of the gigantic business in Paternoster Row. Their first success was the publication of Macaulay's *Lays of Ancient Rome*, which was followed in 1849 by the issue of the first two volumes of his *History of England*, which in a few years realized a sale of 40,000 copies; the subsequent volumes reaped a still greater success; and a cheque for £20,000, on account of profits, given to Lord Macaulay is a record in payment for authorship. The two brothers were well known for their literary talent; Mr Thomas Longman edited a beautifully illustrated edition of the New Testament, and Mr William Longman was the author of several important books, among them being a *History of the Three Cathedrals dedicated to St Paul*, in which he took a great interest, and a work on the *History of the Life and Times of Edward III.* In 1863 the firm took over the business of Mr J. W. Parker, and with it *Fraser's Magazine*, and the publication of the works of John Stuart Mill and the historian J. A. Froude; while in 1890 they incorporated with their own all the publications of the old firm of Rivingtons, established in 1711, and with it the important works formerly issued by Hatchards, Piccadilly, whose publishing business had previously been bought by Rivingtons. The head of the present firm is Mr Thomas (5) Norton Longman, his brother Mr G. H. Longman, sons of Mr Thomas Longman; Mr C. J. Longman and Mr H. H. Longman, sons of Mr William; and Mr W. E. Green, being also members of the firm.

BLACK, ADAM & CHARLES.—The founder of this firm, Adam Black, was born in Edinburgh on 20th February 1784; he was the son of a builder of that town. After serving his apprenticeship to the bookselling trade, and a few years in London with Lackington, Allen & Co., he began business at 57 South Bridge, Edinburgh, in 1807. In 1826, at the time of Constable's (*q.v.*) failure, he was recognized as one of the principal booksellers in Edinburgh; he was joined in business a few years later by his nephew Charles. The two most important events connected with the firm were the publication of the 7th edition of the *Encyclopædia Britannica* and the purchase of the stock and copyright of the Waverley Novels. The original proprietors of the *Encyclopædia* were Andrew Bell and Colin Macfarquhar; in 1827 the copyright passed into the hands of Adam Black and a few friends, the 7th edition being published by him under the editorship of Professor Macvey Napier; its issue was commenced in monthly parts in March 1830, and finished in 1842. It was in twenty-one quarto volumes, and cost in production £108,766, the number sold being 4500 copies. An 8th and 9th edition were published by Messrs Black. In 1851 A. & C. Black bought the copyright of the Waverley Novels, at a cost of £27,000; and in 1861 they became the proprietors of De Quincey's works.

Adam Black was for some years M.P. for Edinburgh; he retired from business in 1865, and died on 24th January 1874. He was succeeded by his sons, who, finding that London would be more central for publishing, relinquished in 1895 their establishment at Edinburgh, and removed to 4, 5, and 6 Soho Square, London.

MACMILLAN & Co. LIMITED.—The founders of this firm were Daniel and Alexander Macmillan. The former was born in the Isle of Arran in 1813, while his younger brother was born at Irvine on 3rd October 1818. Coming to London, they entered the house of Seeleys in 1839; but Alexander in 1843 commenced business in Aldersgate Street, and in the same year the two brothers purchased the business of Newby, in Cambridge. In 1845 they became the proprietors of the more important business of Stevenson, in Cambridge, when Mr Barclay became a partner, the firm being styled Macmillan, Barclay & Macmillan. In 1850 Barclay's name disappeared from the title-pages of their publications, and the firm became settled in Cambridge. Mr Daniel Macmillan died in 1857, and in the same year an impetus was given to their business by the publication of Kingsley's *Two Years Ago*. A branch office was opened in 1858 at Henrietta Street, London, which led to a large extension of their trade. These premises were surrendered for larger ones in Bedford Street, and in 1897 their magnificent premises in St Martin's Street were opened. Mr Alexander Macmillan died in January 1896. By his great energy and literary associations, and with the aid of his partners, there had been built up in little over half a century one of the most important publishing houses in the world. Besides the issue of many important series of educational and scientific works, they published the works of Kingsley, Huxley, Maurice, Tennyson, Lightfoot, Westcott, J. R. Green, Lord Roberts, Lewis Carroll, with many other authors whose names are well known in literature. In 1898 they took over the old-established publishing house of R. Bentley & Son, and with it the popular works of Mrs Henry Wood, Miss Rhoda Broughton, *The Ingoldsby Legends*, and also *Temple Bar* and *The Argosy*. In 1893 the firm was converted into a limited liability company, with Mr Frederick Macmillan as chairman and Mr G. Macmillan, Mr G. L. Craik, and Mr Maurice Macmillan as directors. There is probably no English house which has such a large connexion in America as Macmillans. Although distinct in its trading, the Macmillan Company of New York has in Mr F. Macmillan one of its most important and experienced members.

RIVINGTON & Co.—Charles Rivington, the originator of this firm in 1711, was a Derbyshire man, who took over the business of Richard Chiswell, and at the sign of the Bible and the Crown carried on a business almost entirely connected with theological and educational literature. Charles Rivington was born at Chesterfield, and at an early age evinced a taste for religious books. He came to London, and was apprenticed to a Mr Matthews; and in 1718, in conjunction with other firms, he published Mason's *Vindication of the Church of England*. He also published one of Whitfield's earliest works, and brought out an edition of the *Imitation of Christ*. In 1736 he became one of the company of booksellers who called themselves the "New Conger." In 1741 he published the first volume of Richardson's *Pamela*, which went through five editions in its first year of publication. Charles Rivington died on 22nd February 1742, and was succeeded by his two sons, John and James. The latter turned to other pursuits, but John pursued his father's policy, and was known as the great Church of England publisher of the day. In 1760 he was appointed publisher to the Society for Promoting Christian Knowledge, retaining the agency for over seventy years. Having admitted his sons Francis and Charles into partnership, they commenced the issue of a standard edition of the works of Shakespeare, Milton, Locke, and other British classics; also Cruden's *Concordance*. John Rivington died on the 16th January 1792. Francis and Charles started in January 1793 the *British Critic*, in two-shilling numbers, which attained a circulation of over 3000 copies. In 1810 John, the eldest son of Francis, was admitted a partner; and in 1819 they took a lease of 3 Waterloo Place, where they remained until the business was sold, in 1890, to Messrs Longmans & Co. In 1827 George and Francis, brothers of John, joined the firm; and by the publication (1833) of *Tracts for the Times*, to which Newman, Pusey, and Keble contributed, the house of Rivingtons was strengthened in its position as High Church publishers. John Rivington died 21st November 1841, his son being admitted a partner in 1836. George Rivington also died in 1842; and in 1859 Francis Rivington retired, leaving the business in the hands of John Rivington and Francis Hansard Rivington.

As before stated, in 1890 the business and the right to trade were bought by Longmans & Co. A business of the same character was, however, carried on from 1889 to 1893 by Mr Septimus Rivington and Mr J. G. Percival, as Percival & Co., 34 King Street, Covent Garden. This was changed in 1893 to Rivington, Percival & Co.; and in 1897 the firm was enabled to revive its previous title of Rivington & Co., maintaining large educational and theological connexions with the Moderate and High Church party.

Smith, Elder & Co.—George Smith (1), the founder of this firm, was born in Scotland in 1789, and died 1846. From Scotland he migrated to London, where he found employment first with Rivingtons, St Paul's Churchyard, and afterwards with J. Murray. In 1816, together with a fellow Scotsman, Alexander Elder, he commenced business at 158 Fenchurch Street as booksellers and stationers; and in 1819 they added publishing to their business. It was here that George Smith (2) was born, on 19th March 1824; and in the same year the business was removed to 65 Cornhill, a house which was afterwards justly celebrated in literary and business circles. At the age of fourteen George Smith (2) came into the business, and shortly afterwards took over the control of the publishing department. His father dying in 1846, the responsibility of the business devolved principally upon his son, and under his management increased by leaps and bounds, multiplying thirteen times in twenty years. A large portion of the business was connected with foreign agencies and banking, especially with India. This was relinquished in 1868 in favour of Messrs H. S. King & Co. Mr Smith removed the publishing business to Waterloo Place. Here the literary side of his career was extended and developed; he exerted considerable influence upon men and letters, encouraging young writers and laying the foundation of lasting friendships. For over thirty years Mr G. Smith (2) was the friend and publisher of John Ruskin, and it was with him that *Jane Eyre* found a publisher in 1847. In 1855 was started the *Overland Mail* and the *Homeward Mail*, journals which still have a large circulation. By this firm were issued works by W. M. Thackeray, Mr and Mrs Browning, Wilkie Collins, Matthew Arnold, Miss Martineau, James Payn, and Mrs Humphry Ward. In 1866 was published Anthony Trollope's *Last Chronicles of Barset*, for which £3000 was paid. In January 1860 the first of the three great ventures connected with Mr Smith was commenced, the *Cornhill Magazine* being issued in that month, under the editorship of W. M. Thackeray, with whom was associated many of the brilliant writers of the period. The second venture was the founding of the *Pall Mall Gazette*, the first number appearing on 7th February 1865, price 2d. The third and most important venture in Mr Smith's career was the publication of *The Dictionary of National Biography*, the first volume being issued in 1882; it was completed in 1901, consisting in all of 66 volumes; and this monumental work was the crowning effort of a successful career. Mr George Smith died on 6th April 1901. In 1894 Mr George Smith's son-in-law, Mr Reginald J. Smith, entered the firm, and afterwards became sole acting partner.

Blackwood, W., & Sons.—The house of Blackwood owes its origin to William Blackwood, who was born of humble parents at Edinburgh on the 20th November 1776. At the age of fourteen he was apprenticed to Bell & Bradfute. In 1797 he entered the employment of Mundell & Co., Glasgow. In 1800 he joined Mr Ross, a bookseller and book auctioneer; but finding the old-book trade more to his liking, he left Edinburgh for London, where he remained three years. Returning to Edinburgh in 1804, he opened an old-book shop in Princes Street, selling old, rare, and curious books. He undertook the Scotch agency for John Murray and other London publishers, and gradually drifted into publishing on his own account. On 1st April 1817 was issued the first number of the *Edinburgh Monthly Magazine*, which on its seventh number bore the name of *Blackwood's* as the leading part of its title, by which it has ever since been known. "Maga," as this magazine soon came to be called, was the organ of the Scottish Tory party, and round it gathered John Wilson ("Christopher North"), Maginn, Lockhart, Lord Neaves, Carlyle, Moir, Lord Lytton, Galt, Aytoun, and Mrs Oliphant. William Blackwood died on the 10th September 1834, and was succeeded by his two sons, Alexander and Robert. In 1829 they removed to the premises they now occupy in George Street; and in 1845 Alexander Blackwood died, and was shortly afterwards followed by his brother Robert. A younger brother, John, who was born in 1818, succeeded to the business; four years later he was joined by Major William Blackwood, who continued in the firm until his death in 1861. In 1862 John Blackwood took into partnership the Major's elder son, William, who, with his uncle, largely developed the business until John's death in 1879. John Blackwood was a man of strong personality and great business discernment; it was he who introduced George Eliot to the world of letters. He also inaugurated the "Ancient Classics for English Readers" and other important series, while the many great writers who had their works issued from this house are too numerous to catalogue. The present head of the firm is Mr William Blackwood, assisted by his two nephews, Mr George W. Blackwood and Mr J. H. Blackwood.

Cassell & Co. Limited.—John Cassell, the founder of this firm, was born at Manchester on 23rd January 1817, and died on 1st April 1865. Starting in humble life, he educated himself, and early gained a considerable knowledge of English literature, and also attained a proficiency in French. In 1836 his energies became centred in the temperance movement, in which he laboured with eloquence and zeal. He started a temperance publishing office in the Strand, and at the same time did a large trade in tea and coffee. A few years after he developed a more influential business in La Belle Sauvage Yard, Ludgate Hill. Messrs Petter and Galpin became partners, and added greatly to the business by the issue of good literature for the working classes, one of the most useful being the *Popular Educator*, which was followed by the *Technical Educator*. The firm also published the *History of Julius Cæsar*, by Napoleon III., and the English edition of the illustrated works of Gustave Doré. The business is now under the control of a limited company, who produce all their own serial and other publications.

Chambers, W. & R.—The elder of the two pioneers of popular literature, William Chambers, was born at Peebles on 16th April 1800, his brother Robert two years later. From the village school they obtained the foundation of an education by which, with industry and perseverance, they were enabled to gain for themselves a knowledge which was almost encyclopædic. Each brother started separately a small shop, with a capital of a few shillings, selling some of their old school-books, doing printing, and producing some of the books they sold. Robert early developed a literary taste, writing in all seventy volumes, besides innumerable articles, among the former being the *Vestiges of the Natural History of Creation*, the authorship of which was not, however, acknowledged until after his death. On the 4th February 1832 appeared the first number of *Chambers's Edinburgh Journal*, which met with immediate success, reaching a circulation of 50,000 copies of its weekly issue. This brought the two brothers together as partners, Robert supervising the literary part of the concern, William being business manager. In 1844 appeared the *Cyclopædia of English Literature*, from 1860 to 1868 the famous *Chambers's Encyclopædia*, and in 1864 that remarkable work, the *Book of Days*. Robert Chambers died at St Andrews on 17th March 1871. His brother William had accepted the offer of a baronetcy, but died on 20th May 1883, before it could be bestowed. The business is now a limited company, and beside educational and general literature, it publishes a large number of books for juveniles.

Chapman & Hall Limited.—This firm commenced business in 1834 at 186 Strand, removing in 1850 to 193 Piccadilly, and in 1881 settled in Henrietta Street, Covent Garden, where it has continued to carry on the business of publishing. Charles Dickens wrote *The Pickwick Papers* for them. They afterwards published many of Dickens's works; but in 1844 they quarrelled, and Dickens transferred his publishing to Bradbury & Evans. This breach was healed in 1859; and at the death of Dickens, Frederick Chapman bought the entire copyright of Dickens's works. This firm also published works by Mr and Mrs Browning, Anthony Trollope, Carlyle, and George Meredith; and in 1865 they started the *Fortnightly Review*, of which G. H. Lewes was the first editor. This magazine was originally issued twice a month, but in 1867 it was changed to a monthly periodical. In 1880 the firm became a limited company under the managership of Mr Frederick Chapman (1823–95), and the business is now continued as general publishers.

Gardner (Wells), Darton & Co.—The head of this firm, Mr Joseph W. Darton, is the successor in a long line of ancestry, all of whom have maintained a high position in the issue of books for children. The first, William Darton (Darton & Harvey, Gracechurch Street), was born in 1755 and died in 1816. He, his son William Darton (2) (1781–1854), and grandson, John Maw Darton (1810–81), were members of the Society of Friends. For over half a century this firm almost monopolized the trade in children's books. Amongst their early publications was the *Original Poems* by Jane and Ann Taylor. They also issued works by Priscilla Wakefield, Maria Hack, Peter Parley, Mrs Sherwood, and William and Mary Howitt. In 1857 Mr J. W. Darton joined the firm of Wells Gardner & Co., who publish *Chatterbox*, *Sunday*, and works in juvenile and devotional literature.

Heinemann, William.—Mr William Heinemann was born at Surbiton on 18th May 1863, and after some years of experience with the late Nicholas Trübner, he established himself as a publisher on 1st January 1890. In 1893 Mr Sydney S. Pawling, a nephew of the late C. E. Mudie, the librarian, joined him in partnership. Mr Heinemann married, in 1899, Magda Stuart-Sindici ("Kassandra Vivaria"). He is himself the author of several plays, and, besides issuing the later works by Mr Hall Caine and other popular novelists, he has introduced into England translations of many important and artistic works from the Continent.

Low (Sampson), Marston & Co. Limited.—Sampson Low, the founder of this firm, was born in London in November 1797. He was the son of Sampson Low, printer and bookseller, Soho Square, was apprenticed at a circulating library in Bond Street, and afterwards entered the employ of Longmans & Co. In 1819 he

commenced business at 42 Lamb's Conduit Street as a bookseller and stationer. In connexion with Mr William Longman and other publishers, he started in 1837 *The Publishers' Circular*, which became Low's property in 1867. In this journal a list of new books is printed, and from these lists the *Annual Catalogue* of books is issued, the first volume appearing in 1839. From these volumes the *British Catalogue* was compiled, followed by the *English Catalogue of Books*, the only bibliographical work of reference for new books. In 1848 Low opened a publishing office in Red Lion Court, which in 1852 was removed to Ludgate Hill, where he greatly developed his publishing business, and also added to it a depôt for the sale of American books. He died on 5th March 1871. In 1856 Mr Edward Marston became a partner; in 1867 the firm removed to Fleet Street, and finally to St Dunstan's House, Fetter Lane, in 1887. This firm has a large American and continental agency; they are the publishers of the *Nineteenth Century and After*, and books in various branches of literature.

ROUTLEDGE, GEORGE, & SONS LIMITED.—George Routledge, a native of Cumberland, was apprenticed at Carlisle, came to London, and found employment at the house of Baldwin, Cradock & Joy. He afterwards obtained a subordinate position under the Government, and opened a small shop in Ryder's Court, Leicester Square. In 1845 Routledge moved to Soho Square; and in 1848 he was joined in partnership by his brother-in-law, Mr William Warne, and afterwards by Mr F. Warne. The firm then removed to Farringdon Street, where they successfully developed a business in issuing cheap literature, giving Lord Lytton £20,000 for the right to issue a cheap edition of his works for a term of ten years. They also issued the works of G. P. R. James, Harrison Ainsworth, Mayne Reid, and James Grant. Among the various "libraries" they started were the "Railway" and the "Popular." In 1865 Mr F. Warne terminated his partnership and established a fresh business in Bedford Street. Mr Routledge's business was removed to the Broadway, where his two sons, Robert and Edmund, were associated with him. Mr George Routledge died 13th December 1888, Mr Robert Routledge 23rd July 1899, and Mr Edmund Routledge on 25th August 1899.

BELL, GEORGE, & SONS.—This business was founded by George Bell in 1840, as a publisher of works in educational, classical, and general literature. Upon the retirement of Mr H. G. Bohn they purchased from him his various "libraries" of standard, classical, and other branches of literature, numbering in all 766 volumes. During recent years great attention has been given by this firm to fine art publications and to the production of artistically illustrated works.

ALLEN, GEORGE.—When John Ruskin decided to sever his connexion with Messrs Smith, Elder & Co., he selected his lifelong friend, Mr George Allen, of Orpington, Kent, to sell his books to those who wanted them. It was a strange campaign against the publisher and bookseller, but by this action Ruskin added one more to the long list of publishers. It was in 1873 that this country publishing business was inaugurated; and from that time a gradual development took place, until it was found desirable to remove Mr Allen's establishment to London. Here the business has greatly increased; and besides the works of Ruskin, books in all departments of literature have been issued.

BLACKIE & SON LIMITED.—This firm, which was founded in 1809 by John Blackie, has been largely engaged in the canvassing trade, but during recent years has developed an important publishing business in books for boys and girls, issuing annually a large number of books by G. A. Henty and others.

VIRTUE, H., & CO. LIMITED.—George Virtue, one of the leaders in the book-canvassing business, was born at Coldstream, Berwickshire, in 1793, but early in life came to London, and in 1820 was established as a religious book-remainder buyer near the Houses of Parliament. He frequently reissued these books in parts for canvassers, who made calls upon people at their houses who subscribed for the books thus issued. On the 15th July 1821 he was given an interest in Pierce Egan's *Life in London, or the Adventures of Tom and Jerry*, illustrated by I. R. and G. Cruikshank. This work caused great excitement, and was freely bought and imitated. In 1831 he moved to Paternoster Row, where he issued for canvassers Fletcher's *Guide to Family Devotion*, of which 30,000 copies were sold. Virtue also arranged with W. H. Bartlett to produce a series of fine art works descriptive of various countries of the world. The first issued was *Switzerland*, of which 20,000 copies were sold. He also produced *Scotland*, at a cost of £40,000. In 1849 the *Art Union* passed into his hands; the title of this magazine he changed to *The Art Journal*, which to this day maintains a high reputation for artistic merit. George Virtue died on the 8th December 1868: but some years before his death the business had been transferred to his son, Mr J. S. Virtue. The firm is now a limited company, under the chairmanship of Mr Herbert Virtue, and has important and extensive printing and binding premises in the City Road, London.

CAMBRIDGE UNIVERSITY PRESS.—The London business of this press was established at 17 Paternoster Row in 1873. Previous to that period it had confined its energies to producing books which were sold through the various bookselling agencies. One of their most important undertakings was the issue, in connexion with the Oxford University Press, of the Revised Version of the New Testament in 1881, and the Old Testament in 1885. They also issue an important collection of classical works in the "Pitt Press Series." This term was given to the series from the building at Cambridge erected by money subscribed to perpetuate the memory of William Pitt. The business was formerly under the management of Mr C. J. Clay, and is now conducted by his two sons, Messrs J. & C. F. Clay.

CHATTO & WINDUS.—John Camden Hotten, the originator of this firm, was born in 1832. He was a man of considerable literary ability, compiling a *Slang Dictionary* and various works on topography and family history. In 1854 he commenced business in Piccadilly as a publisher and seller of rare and curious books. Hotten died in 1873, and was succeeded by Mr Andrew Chatto. He, with his partners, have developed an important publishing business, especially in fiction and *belles lettres*.

OXFORD UNIVERSITY PRESS.—This press trades under three different imprints, namely: 1. *Oxford, printed at the University*, for Bibles, prayer-books, &c; 2. *Henry Frowde, Oxford University Press Warehouse*, for miscellaneous works not issued under the authority of the delegates; 3. *The Clarendon Press*, for classical and especially erudite works. The Clarendon Press publications were formerly issued through the agency of Macmillan & Co., but in 1874 a London business was opened under the management of Mr Henry Frowde. Besides a large and important trade in the United Kingdom and in America in Bibles, prayer and other books in handsome and rare bindings, they publish a large number of educational and classical works. The Clarendon Press holds the perpetual copyright of Clarendon's *History of the Rebellion*; the profits from this book were the means by which a part of the Clarendon Press buildings at Oxford were erected.

HURST & BLACKETT LIMITED succeeded, about 1840, to the business established by Henry Colburn in 1807. The principal trade of this firm has been the issue of fiction in three-volume form. These works were formerly sold to fiction distributors, who bound them and sold them to the libraries. Upon the establishment of Mudie's Library in 1842 this system broke down, since Mr C. E. Mudie arranged to buy the sheets himself and bind them up according to the demand. Publishers then adopted the method of issuing novels bound up in cloth. The firm is now known for its cheap and well-selected fiction.

NELSON, THOMAS, & SONS.—Thomas Nelson was born at Throsk, in Scotland, in 1780; he received his business training in London, but returned to Edinburgh, where he opened a shop, selling such works as Baxter's *Saints' Rest*, Booth's *Reign of Grace*; and in connexion with Peter Brown published the works of Paley, Romaine, and Newton. The business was greatly increased by the exertions of his two sons, William and Thomas, who were admitted as partners. Among their successes were the issue of popular juvenile literature, especially by A. L. O. E. and R. M. Ballantyne. Thomas Nelson died on 23rd March 1861. Messrs Nelson & Sons have a large and important printing and binding establishment in Edinburgh, but the publishing business is mainly carried on in Paternoster Row. Mr G. M. Brown, M.P., who married the daughter of Thomas Nelson (2), is now the acting partner.

NISBET, JAMES, & CO. LIMITED.—James Nisbet, the son of a Scottish farmer, was born on 3rd February 1785. Early in his career he came to London, and commenced business in Castle Street in 1809, where he was interested in the issue of many religious works, by Edward Irving, Dr Hamilton, and Dr MacDuff. He died on 8th November 1854. Mr James Murray succeeded to the management of the business, and he was followed by Mr Watson. The business is now a limited company, publishing works in all branches of literature.

SIMPKIN, MARSHALL, HAMILTON, KENT & CO. LIMITED.—The founder of this large publishing and distributing agency was Benjamin Crosby. He relinquished business in 1814 in favour of his two assistants, W. Simpkin and R. Marshall. In 1828 Simpkin retired, and Mr John Miles took the financial management of the concern. This firm were the London agents for Tennyson's first poems, publishing in 1827 *Poems by Two Brothers*. Marshall died on 17th November 1863, and the business remained entirely in the hands of Mr Miles's sons, under whose management it greatly developed. The firm published, among other works, O'Meara's *Napoleon at St Helena*, and *Dame Europa's School*; but their business is principally as distributing agents for the supply of miscellaneous books to the booksellers of town and country. In 1889 an amalgamation was effected between Simpkin, Marshall & Co., Hamilton, Adams & Co., and Kent & Co., being converted into a limited company, to which in 1891 was added a large wholesale newspaper distributing agency.

DENT, J. M., & CO.—As a pioneer of cheap but tastefully produced reprints in all classes of literature this firm is pre-eminent. Mr Dent was born at Darlington, and at eighteen came to London,

where he commenced business as a bookbinder. With the instincts of a true book-lover, he felt the want of cheap but well-edited books, and this induced him to commence the publishing business which he has carried on with such marked success. The "Temple" Bible, Shakespeare, and classics have had immense sales. The business was started at Great Eastern Street, but is now carried on at 29 Bedford Street, W.C., the premises once occupied by Macmillan & Co. With Mr J. M. Dent is associated his son Mr Hugh Dent.

LANE, JOHN (The Bodley Head, Vigo Street). Mr John Lane originally started publishing with Mr Elkin Mathews during the 'eighties, and by degrees their devotion to *belles lettres*, and particularly their successful discernment in encouraging the young poets of the day, made their establishment famous. The "Bodley Head" became identified with this new generation of literature, and with such writers as Mr William Watson, Mr Richard Le Gallienne, and Mr John Davidson. In 1898 the partnership was dissolved, and Mr Lane continued to carry out the same publishing policy on his own account.

CLARK, T. & T. (38 George Street, Edinburgh), originally founded by Thomas Clark in 1821, publishers of works in theology, philosophy, and general literature.—HODDER & STOUGHTON (27 Paternoster Row), publishers of theological, devotional, and general literature; also *The Bookman, The British Weekly, Expositor*, &c.—HUTCHINSON & Co. (34 Paternoster Row), with a large export and colonial trade. Publish principally fiction, biography, and travel.—METHUEN & Co. (36 Essex Street, Strand), founded 1889; principal publications, fiction, poetry, and biography.—NUTT, DAVID (57–59 Long Acre), founded 1829, dealer in foreign, classical, and general literature; publishes works in philology, folk-lore, &c.—PAUL (KEGAN), TRENCH, TRÜBNER & Co. LIMITED (20 and 22 Charing Cross Road), exporters and dealers in scientific and general literature, and publishers of works in various branches of science. This firm succeeded to the business of Nicholas Trübner and Kegan Paul, Trench & Co.—RICHARDS, GRANT (Leicester Square), founded 1897, publisher of fiction, juvenile, and most departments of literature.—SONNENSCHEIN (SWAN) & Co. LIMITED (6 White Hart Street, Paternoster Square), founded 1878, educational, scientific, and general publishers.—STANFORD, EDWARD (12, 13, and 14 Long Acre), founded 1852, military and geographical publishers, agents for the Geological Survey maps.—UNWIN, T. FISHER (11 Paternoster Buildings), founded 1883, publisher of "The Story of the Nations," and works in fiction and general literature. WARD, LOCK & Co. LIMITED (Salisbury Square), founded 1861, publishers of cheap and miscellaneous literature. With this firm is incorporated Moxon & Co., S. O. Beeton, and A. D. Innes & Co.—ARNOLD, EDWARD (37 Bedford Street, Strand), publisher of fiction and general educational literature.—BRADBURY, AGNEW & Co. LIMITED (Bouverie Street, Fleet Street), publishers of sporting and general literature; also proprietors and publishers of *Punch*.—CONSTABLE (ARCHIBALD) & Co. LIMITED (2 Whitehall Gardens), publishers of the Victorian County Histories, fiction, and other works in general literature. — WARNE (FREDERICK) & Co. (Bedford Street, Strand), founded 1865, publishers of fiction, poetry, and cheap reprints.—CHURCHILL, J. & A. (7 Great Marlborough Street, W.), the oldest publishing house which deals exclusively with medical books; it was established in 1825 by John Churchill.

AMERICAN PUBLISHERS.

APPLETON, D., & Co., was founded in 1825 by Daniel Appleton, who opened a small store in Exchange Place, New York, for the importation of foreign publications. His son, William H. Appleton, became a partner in 1838. In 1831 they published their first book, entitled *Daily Crumbs from the Master's Table*, of which they sold 2000 copies. In 1835 Mr William H. Appleton went abroad as the representative of the firm. He was entertained in England by John Murray, of whom he became a lifelong friend, and by Thomas Norton Longman. In Germany he met Baron Tauchnitz. In 1838 the firm assumed the familiar title of "D. Appleton & Co.," which it has borne ever since. In 1848 Daniel Appleton retired, dying the following year. The firm was reorganized by his sons, with William H. Appleton at its head. Under his direction several important enterprises were undertaken: the publication of the *New American Cyclopædia*, under the editorship of George Ripley and Charles A. Dana; and the publication of scientific and educational books, which has since been a feature of the house. William H. Appleton died in 1899, being the last of the second generation. The business, a large one, is now conducted by his son, William W., and the sons of his brothers, John A. and Daniel Sydney. Their growing business caused many removals, until they entered their present quarters in Fifth Avenue in 1902. Their most noted publication of recent times has been *David Harum*, which has been through nearly 100 editions, reaching the enormous total of over 650,000 copies. A branch house is maintained in London.

CENTURY CO., THE.—In 1870 Mr Roswell Smith and Dr J. G. Holland united with Charles Scribner & Co. to found *Scribner's Monthly*, Dr Holland being the editor. In 1873 *St Nicholas*, an illustrated magazine for children, was started, with Mrs Mary Mapes Dodge as editor. In 1881 the Scribner interest was bought out, a new company (The Century Co.) formed, and the name of *Scribner's Monthly* changed to *The Century Magazine*. The most notable series of articles that have appeared in the magazine are: the "Civil War Series," contributions by the surviving officers of the war, including several by General Grant; Mr Kennan's articles on "Siberia and the Exile System"; and the "Life of Abraham Lincoln," by his private secretaries Nicolay and Hay. The business of the Century Co. has steadily grown since its founding. Its best known publications are: *The Century Dictionary* (1888–91), the cost of which was nearly $1,000,000; *The Century Cyclopædia of Names, The Century Atlas*, and the series of hymn-books prepared by Dr Robinson. In 1892 the first president of the company, Mr Roswell Smith, died. His successor, Mr Frank H. Scott, is still president.

DODD, MEAD & Co. was established in New York in 1839 by M. W. Dodd and John S. Taylor, in the old Brick Church Chapel, a building then standing on what is now the site of the *New York Times*, and in that year published Cruden's *Concordance*. Various changes have occurred in the personnel of the firm, which, when it assumed its present title in 1876, included Frank H. Dodd, Edward S. Mead, and Bleecker van Wagoner. Mr Mead died in 1894. Notable publications of the house are E. P. Roe's books, *The International Cyclopædia* (1885), and *The Bookman*, started in 1895.

HARPER & BROTHERS was established in New York in 1817 by John and James Harper, under the name of J. & J. Harper. In 1825 their two younger brothers, John Wesley and Fletcher Harper, were admitted to partnership, and in 1833 the firm name was changed to Harper & Brothers. In 1840 their mechanical establishment occupied several buildings on both sides of Cliff Street, just behind their present quarters on Franklin Square; and in 1850 they erected in Franklin Square a large and commodious structure, which was connected with the Cliff Street buildings. In 1853 the entire establishment was destroyed by fire. It was at once rebuilt, with increased facilities, on the same site, and is still occupied. For many years the business was carried on as a partnership, the members of the firm being the sons and grandsons of the original founders. Their best known publications are: *Harper's Magazine, Harper's Bazaar*, and *Harper's Weekly*. In 1893 the firm was incorporated as a stock company, and so continued until its reorganization in 1901, when the control and the presidency was turned over to Colonel George Harvey, editor and proprietor of the *North American Review*. The house has a London branch.

HOUGHTON, MIFFLIN & Co.—The publishing firm of Hurd & Houghton was established in 1864, consisting of Melanchthon M. Hurd of New York and Henry Oscar Houghton of Boston. Mr Houghton already owned the "Riverside Press" in Cambridge, Mass., which he had established in 1849, and in which the manufacture of books published by the firm has since been carried on. In 1866 Albert G. Houghton, elder brother of the founder, was admitted to the firm; and in 1872 Horace E. Scudder and George H. Mifflin became members, the former retiring after three years. In 1873 the house bought *The Atlantic Monthly*. In 1878 Albert G. Houghton and Mr Hurd retired, and the firm was consolidated with James R. Osgood & Co., successors to Ticknor & Fields, and the name changed to Houghton, Osgood & Co. Two years later Mr Osgood retired, and the firm became Houghton, Mifflin & Co. In 1895 H. O. Houghton, the founder, died. As now constituted, Mr Mifflin is senior partner, and has associated with him sons of Henry O. and Albert G. Houghton, James Murray Kay, and L. H. Valentine. The manufacturing business at the "Riverside Press" is carried on under the name of H. O. Houghton & Co., although identical with the publishing firm. Among the publications of the firm are the works of Emerson, Lowell, Holmes, Longfellow, Whittier, Hawthorne, and Fiske. They also published the *Narrative and Critical History of America*.

LEE & SHEPARD.—A partnership between William Lee and Charles A. B. Shepard was formed in Boston in 1861. Beginning as booksellers, they developed into a publishing business. Mr Shepard died in 1889, and Mr Lee continued as sole partner until 1897, when he sold his entire business, including the firm name, to E. Fleming & Co., bookbinders. Mr Lee continued with the firm until 1898.

LIPPINCOTT Co., J. B.—In 1794 Jacob Johnson opened a small book-store in Market Street, Philadelphia. Later, as Johnson & Warner, Warner & Grigg, and Grigg, Elliot & Co., the business was successively and successfully carried on until 1850, when it was purchased by Joshua B. Lippincott and became known as Lippincott, Grambo & Co. A large building was erected at Market and Filbert Streets during the Civil War. In 1885 a

joint-stock company, capitalized at $1,000,000, was formed and given the present name. In January of the following year Mr Lippincott died. In 1899 a fire destroyed not only the Market Street building, but also a large stock of books and plates. In 1901 the company built and equipped a new five-storey building at Locust and Sixth Streets. *Chambers's Encyclopædia* and *Lippincott's Magazine* are two of their important publications.

LITTLE, BROWN & Co. was founded in 1784 in Boston by E. Batelle. He was succeeded by Benjamin Guild, Samuel Cabot, William T. and Samuel Blake. In 1806 William Andrews succeeded to the business, and later, Jacob A. Cummings and William Hilliard. In 1821 the firm became Carter, Hilliard & Co. In 1827 a new firm was formed, under the title of Hilliard, Gray & Co., the company being Charles C. Little. The name for a time was Hilliard, Gray, Little & Wilkins. In 1837 Mr Little and James Brown became the proprietors, under the name of Charles C. Little & James Brown. In 1847 Augustus Flagg was admitted to the firm. Mr Little died in 1869, and Mr Brown in 1855. Mr Flagg continued as managing partner until his retirement in 1884. The present firm consists of John Murray Brown, Charles W. Allen, Hulings C. Brown, and James W. M'Intyre. Besides law-books, the firm has published several standard works both of American and of foreign authors.

PUTNAM'S SONS, G. P.—In 1836 George Palmer Putnam became a partner in the firm of Wiley & Long, which a year later became Wiley & Putnam. In 1849 he established the first American bookselling house in London. In 1848 he separated from Mr Wiley and instituted the firm of G. P. Putnam & Co. In 1853 *Putnam's Monthly* was established, which in 1872, after the death of Mr Putnam, was transferred to Scribner's, and was an important factor in the foundation of the first *Scribner's Monthly* (now *The Century Magazine*). In 1866 the firm became G. P. Putnam & Son. In 1841 Mr George Haven Putnam organized the first of the committees charged with the work of securing an American international copyright law. In 1872 the firm became G. P. Putnam's Sons, the additional partners being John Bishop Putnam and Irving Putnam. In 1879 they reinstituted a branch in London, and their publications have since borne the imprint "New York and London." In 1893 they established, at New Rochelle, New York, the "Knickerbocker Press." In 1896 they assumed the publication of the literary monthly *The Critic*. The present head of the house is George Haven Putnam.

SCRIBNER'S SONS, CHARLES, was established in New York City in 1846 by Charles Scribner, sen., and Isaac D. Baker, as Baker & Scribner. Mr Baker retired after a few years, and Charles Scribner continued the business until 1857, when he united with Charles Welford. This partnership, under the name of Scribner & Welford, was separate from the main house, and was organized for the purpose only of importing books. On the death of Mr Welford in 1885 the two departments were combined. In 1864 Mr Scribner admitted to partnership Andrew C. Armstrong, and in 1869 Edward Seymour. Mr Scribner died in 1871, and was succeeded by his eldest son, John Blair Scribner, and the firm now became Scribner, Armstrong & Co., and that of the importing house Scribner, Welford & Armstrong. Mr Seymour died in 1877, and a year later John Blair Scribner and Charles Scribner, his younger brother, purchased the interest of Mr Armstrong, and the present firm name was adopted. The death of John Blair in the next year left Charles the only partner until 1884, when his brother Arthur H. joined him. In 1894 the firm erected a handsome edifice in Fifth Avenue, which it now occupies. In 1881 they sold their interest in *Scribner's Monthly*, the name of which was changed to *The Century Magazine*, the Scribners agreeing to abstain for five years from the publication of a similar magazine. In 1887 the present *Scribner's Magazine* was started. Among the notable achievements of the house was the importation and sale of the *Encyclopædia Britannica* (9th edition).

Other important American publishing houses are: LOTHROP PUBLISHING Co., which succeeded D. Lothrop & Co., founded by Daniel Lothrop in 1850.—DOUBLEDAY, PAGE & Co. succeeded Doubleday, M'Clure & Co. The firm consists of F. N. Doubleday, Walter H. Page (formerly editor of *The Atlantic Monthly*), Henry W. Lanier, J. Leslie Thompson, and S. A. Everitt. Their publications include books by Kipling, Crockett, Anthony Hope, and others, and two monthly magazines—*The World's Work* and *Country Life in America*.—E. P. DUTTON & Co., established in Boston in 1852, but removed to New York in 1869. Their publications are largely of a religious nature.—A. C. M'CLURG & Co., a Chicago firm, established in 1848 by S. C. Griggs, which developed, after several changes, into the present firm. The guiding spirit for nearly forty years was General A. C. M'Clurg, who died in 1899. The firm suffered from three great fires, the last in 1899, after which the present corporation was formed. They are the largest publishers in the West.—At the head of educational publishers stand THE AMERICAN BOOK Co., incorporated under the laws of the state of New Jersey in 1890, with a capital of $5,000,000. It purchased the school and college text-books previously owned by Ivison, Blakeman & Co., A. S. Barnes & Co., Van Antwerp, Bragg, & Co., D. Appleton & Co., and the common school-books owned by Harper & Brothers. Two of these firms closed their business, and the new corporation started with stockholders, directors, and officers largely made up from the partners in the former houses. They now publish various series of school-books, which are most widely used throughout the United States, and have issued many new books that have met with wonderful success. Their annual output approximates ten million volumes. The main offices of the company are at New York, Chicago, and Cincinnati, with distributing centres at other important points.—D. C. HEATH & Co., Boston, established in 1886, publish a considerable number of educational works.—MAYNARD, MERRILL & Co. are publishers of school and college text-books.

FOREIGN FIRMS.

TAUCHNITZ, BERNHARD (Leipzig).—The founder of this famous house, Baron Christian Bernhard von Tauchnitz, was born in 1816, the nephew of the noted German printer and bookseller, Karl C. T. Tauchnitz. His establishment at Leipzig was founded by him in 1837, and his name is associated with the Library of British Authors, now numbering between 2000 and 3000 volumes. In 1860 he was ennobled, and in 1877 was made a life member of the Saxon Upper Chamber. He held for many years (1866–95) the office of British Consul-General for the kingdom and duchies of Saxony. He died on the 13th of August 1895, and the publishing business is carried on by his son, Baron Christian Karl von Tauchnitz, Dr. Juris., who is likewise British Consul-General.

BROCKHAUS, F. A. (Leipzig).—The founder, Friedrich Arnold Brockhaus, was born in 1772 and died in 1823. This business was first started at Altenburg in 1811, but removed to Leipzig in 1818. It is now under the management of Messrs Albert (president of the Publishers' Association, 1901) and Rudolf Brockhaus, who carry on an immense publishing and manufacturing business. They issue *Ersch and Gruber's Encyclopædia*, the important *Konversations-Lexikon*, and many historical and bibliographical works.

Other important German houses are:—TEUBNER, BAEDEKER, MEYER, TRÜBNER, and BREITKOPF & HÄRTEL.

DIDOT (Paris).—This house was founded by François Didot, who was born in 1689 and died 1757, being succeeded by his sons F. A. and P. F. Didot, who greatly distinguished themselves by the improvement they made in printing. The house has a long and distinguished history, and is associated with bookselling, paper-making, and bookbinding in all its branches.

HACHETTE & Co. (79 Boulevard St Germain, Paris, and 18 King William Street, W.C.).—Established in 1826 by Louis Hachette, born 5th May 1800 and died 31st July 1864. He founded several series of works, including the notable "Bibliothèque Populaire," the "Bibliothèque Variée," and many others. M. René Fouret is the present (1902) head of this firm.

The following are also important French houses:—A. COLIN & CIE (Paris), CH. DELAGRAVE (Paris), CALMANN LÉVY (Paris), G. MASSON (Paris), HETZEL & CIE (Paris), DESCLÉE DE BROUWER ET CIE (Paris, Lille, Brussels, and Tournai), A. MAINE & FILS (Tours).

Pudsey, a municipal borough of Yorkshire, England, in the Pudsey parliamentary division of the West Riding, 6 miles south-west of Leeds, on the Great Northern Railway. Since 1894 it has been controlled by an urban district council. Recent buildings include Baptist, Free, and Primitive Methodist chapels. A small public park was opened in 1889. Part of the parish, Tyersall, is in the borough of Bradford. Population (1881), 12,314; (1891), 13,444; (1901), 14,907.

Pudukota, a state of southern India, in subordination to Madras, lying between the British districts of Tanjore and Madura. Area, 1101 square miles. Population (1881), 302,127; (1891), 373,096, showing an increase of 23 per cent.; average density, 339 persons per square mile. In 1901 the population was 380,582, showing an increase of 2 per cent.

The chief, whose title is Tondaman, is of the Kallar or robber caste. His ancestor received a grant of territory for loyal services during the wars in the Carnatic at the end of the 18th century. The present raja, aged twenty-three, has been educated by an English tutor, and visited England in 1898. Estimated gross revenue, Rs.10,00,000, exclusive of land revenue granted to junior branches of the family, to Brahmans, and to temples; no tribute. In 1897–98 the expenditure on public works was Rs.1,18,000; number of schools, 368. The town of PUDUKOTA is situated in 10° 23′ N. and 78° 52′ E. Population (1891), 16,885.

Puebla, a town of Spain, island of Majorca, on the north coast, with a railway station. The population was 5681 in 1887, and 5877 in 1897. It is a clean, well built town. In the neighbourhood there are marshes, lagoons, and flat alluvial plains that afford excellent grazing ground for live stock. Puebla has a parish church and several convents.

Puebla, a state of Mexico, bounded on the N. and E. by Vera Cruz, on the S. by Oaxaca and Guerrero, on the W. by Morelos, Mexico, and Hidalgo. Area, 12,207 square miles. Population (1879), 784,466; (1900), 1,024,446. Agriculture is the principal industry; the chief products are cereals, sugar-cane, coffee, vanilla, and a variety of fruits. The value of the cereals produced in 1897 is given as $8,746,999 (Mexican currency), and of sugar-cane, $786,307. The state is divided into twenty-one districts. The capital, PUEBLA, or Puebla de los Angeles, with a population of 88,684, is one of the oldest and most important cities of Mexico, possessing many handsome buildings, among others the cathedral, and the state college with a large library, the palace of justice, school of medicine with the Palafoxiana Library of over 100,000 volumes. It is an important commercial and industrial centre, with numerous cotton and woollen mills, glass factories, foundries, and other establishments. The Mexican Railway and the Inter-Oceanic Railway pass through it. Among the chief towns are: Teziutlan (9776), Tlatlauquitepec (8754), Atlixco (7698), Tehuacan (7275), Matamoros (7184), Zautla (7053), Cholula (7031), Chalchicomula (6913), Ixtamaxtitlan (6699), Zacatlan (6226), Acatlan (5883), San Juan de los Llanos (5742), Cuetzalan (5176).

Pueblo, a city of Colorado, U.S.A., capital of Pueblo county, on both sides of the Arkansas river, at the mouth of Fountain creek, south-east of the centre of the state, at an altitude of 4656 feet. It is regularly laid out, mainly in the level bottom land of the river, is divided into eight wards, has Holly system waterworks, owned by the city, and is sewered. It is, next to Denver, the largest city in the state, and is an important railway centre, being entered by the Atchison, Topeka, and Santa Fé, the Chicago, Rock Island, and Pacific, the Denver and Rio Grande, the Colorado and Southern, and the Missouri Pacific. In 1900 it contained 241 manufacturing establishments, with a total capital of $12,374,248. They employed on an average 4911 wage-earners, and the product was valued at $30,795,481. Pueblo is the largest smelting point west of Missouri river, and besides smelters and blast furnaces, contains rolling and other mills for the manufacture of iron and brass. The assessed valuation of real estate was, in 1898, $7,980,327, and the net debt was $1,108,052. Population (1880), 3217; (1890), 24,558; (1900), 28,157, of whom 4705 were foreign-born and 1213 negroes.

Pueblo Nuevo del Mar, a seaport of Spain, in the province of Valencia, on the Mediterranean coast to the north of the mouth of the river Guadalaviar, near the Valencia and Tarragona Railway. It has straight, regular, well-built streets, divided in two by the little river Rinet. There is a lighthouse installed in a tower of the church of Los Angeles. The theatre and casino are only used in summer, when the Valencians come down. Population (1887), 11,291; (1897), 13,100, but these figures are much increased from June to September.

Puenteareas, a town of Spain, province of Pontevedra, south-east of Vigo, on the river Tea, in a hilly country abounding in vines, hemp, wheat, rye, oats, oranges, and fruit, where live stock is extensively reared. The industries are porcelain manufactures, tanning, and distilling. The town has a large, handsome square, well-built streets, good shops, and an old parish church. Close by are the ruins of the castle of Sobroso, that played an important part in mediæval civil wars. Population (1887), 13,286; (1897), 13,342.

Puente Genil, a town of Spain, in the province of Cordoba, on the banks of the Genil. It is on the Cordoba-Malaga line, and is the starting-point of the line to Linares. A bridge joins the lower part of Puente Genil with the higher, built on rising ground extending to the olive groves above. The principal industry is the manufacture of olive oil in eighty mills. There are also flour-mills and linen factories. The *alhondiga* or permanent market is always well stocked with grain, vegetables, and live stock. The streets and squares are all regular and well built. The suburbs extend far into the country. There are two large parish churches and several convents, schools for primary and higher education, hospitals, a municipal library, and a theatre. Population (1887), 11,406; (1897), 11,645.

Puerto Cabello, a town of Venezuela, the third port of the republic, situated on the Caribbean Sea, about 45 miles from Valencia by rail and 65 miles from La Guaira. Population, over 15,000. There are some handsome buildings, among others the custom-house, the city hall, the theatre, the hospital, the railway station, and two churches. In 1900 the port was visited by 267 ships, of 218,788 tons burden. The value of the imports for the same year was £340,693, and the exports were: coffee, 12,994 tons; cacao, 455 tons; hides and skins, 1276 tons; and lumber, 274 tons.

Puerto de Santa Maria, a seaport and town of Spain, in the province of Cadiz, on the right bank of the river Guadalete, with a station on the railway from Cadiz to Seville. The most important industry is the wine trade, and there are modern glass, liqueur, alcohol, starch, and soap manufactures. There is a bull-ring accommodating 12,000 persons, large markets, town-hall, an iron bridge across the river, and several hospitals. The primary and higher schools are in the hands of the Jesuits. The parish church, begun in the 13th century, was completed in the 17th. It resembles the Seville Cathedral. Population (1877), 22,125; (1897), 20,630.

Puerto Principe, the chief interior town of the province of Camaguey, in Cuba. It was founded by Velasquez, lieutenant of Diego Columbus, governor of Hispaniola, in 1515, and claims to be the most creole of Cuban towns. It stands upon a plain about midway between two coasts, and is connected by rail with Nuevitas to the north-east. Population (1899), 25,102.

Puerto Real, a town of Spain, province of Cadiz, to the north of San Fernando, at the end of the Bay of Cadiz, with a station on the line from Seville to Cadiz. It is a bathing resort in summer. The port has good quays, a dry dock of the Spanish Transatlantic Company, connected with their important works, and safe anchorage close to the wharves for the largest steamers. The town has fine squares, and broad, well-built streets, a noble town-hall, many schools, a bull-ring, fine promenades, several convents, and a parish church that is a good specimen of architecture of the 16th century, with three naves and a remarkable atrium. The industries are important, and there is an active trade in wine and oils. Puerto Real was founded in 1488 by Ferdinand and Isabella. Population (1897), 9772.

Puket, known to the Chinese as TONGKA, the capital town of the island of Junkseylon and the chief Siamese

port on the west coast of the Malay Peninsula. It is situated on the eastern side of the island, in 7° 54′ N. and 98° 24′ E. It is the residence of the chief commissioner of the west coast, and has a population, chiefly Chinese, of about 20,000. The town may be briefly described as a gigantic tin-mine. The output declined, owing to a variety of causes, during the 'nineties, and may be stated at from 2000 to 3000 tons annually. The improvement in the price of tin and the lowering of the royalty demanded by the Siamese Government, assisted by the establishment of a branch office of the Mining Department in the place, should all tend to restore the former prosperity of the port.

Pulkovo (PULKOWA), a village of Russia, in the province and 10 miles from the city of St Petersburg. It contains the Pulkovo Observatory, on a hill 248 feet high, consisting of a main building, with several towers for various instruments, and a special small observatory for the officers of the Geodetical Section of the General Staff Academy. (See OBSERVATORY in the ninth edition of this work for an account of the instruments.) Attached to the university there is a library of 15,000 volumes and 20,000 pamphlets. Sixteen volumes of "Observations" and about 500 separate works have been published by the Observatory since its foundation.

Pulley Block.—Pulley blocks are now very generally made of metal, the block being built up of light steel or wrought iron stampings bolted together, and the sheaves being of cast iron or steel, or of bronze in the smaller sizes.

In order that the sheaves may turn freely on the pin and not become set hard by corrosion, they should, if made of iron or steel, have an inner bearing surface or "bush" of bronze. Although hempen rope may be and is used with metal pulley blocks, steel wire rope frequently takes its place, and this conduces to a further reduction in the weight of the block. Hempen ropes are, however, generally used when hand power is applied directly to the rope, as wire rope is not suitable for handling. A very effective pulley tackle is known as the differential pulley or "Weston's pulley." It depends for its efficiency on the mechanical principle involved in the old Chinese windlass. Chains are necessarily used with this tackle in place of rope, both for the sake of handling and to prevent the chain from slipping and the load from falling. The sheaves of the upper and lower blocks are recessed to suit the links of the chain. The two sheaves of the upper block are fixed together and turn as one; these sheaves slightly differ in diameter, so that one sheave may have one more recess for a link than the other. The chain, passing over the larger sheave of the upper block, is led through the sheave of the lower block, returned in the opposite direction over the smaller sheave of the upper block, and the free ends connected together. From this arrangement it results, that if by means of the free end of the chain the sheaves of the upper blocks are revolved once, the chain is wound on the large sheave and off the small sheave, the load at the same time being lifted an amount equal to half the difference. This pulley block is largely used in factories and workshops, and generally for lifting loads of a few tons. Its chief defect lies in the tendency of the chains to kink and jam the pulleys, and this has led to the introduction of other devices for weight lifting. Conspicuous among these is an arrangement of tackle in which the upper sheave is rotated by a worm and worm wheel, the lifting chain passing from an upper sheave to the pulley block below, from which it is returned and made fast to the upper block. The worm of the worm wheel is turned by a hanging chain which passes loosely over a wheel in the worm shaft. Tackle of this kind sometimes has the upper sheaves actuated by an epicyclic train of toothed wheels. All the above devices possess the great advantage of holding the load in suspension, but in consequence they necessarily work with much frictional loss. (G. H. BA.)

Pullman, formerly a town of Cook county, Illinois, U.S.A., now a part of Chicago. It was built entirely by the Pullman Car Company, and was composed of the car-shops and homes of the employés. The company owns all the property, and formerly exercised jurisdiction over it. In many respects it was a model town, with excellent municipal institutions. The population has never been separately returned by the census.

Pulszky, Franz Aurel (1814–1897), Hungarian politician and author, was born on the 17th of September 1814, at Eperjes. After studying law and philosophy at the high schools of his native town and Miskolcz, he travelled abroad. England particularly attracted him, and his fascinating book, *Aus dem Tagebach eines in Grossbritannien reisenden Ungarns* (Pesth, 1837) gained for him the membership of the Hungarian Academy. Elected to the Reichstag of 1840, he was in 1848 appointed to a financial post in the Hungarian Government, and was transferred in like capacity to Vienna under Esterhazy. Suspected of intriguing with the revolutionists, Pulszky fled to Budapest to avoid arrest. Here he became an active member of the Committee of National Defence, and when obliged to fly the country he joined Kossuth in England and with him made a tour in the United States of America. He was condemned to death (1852) *in contumaciam* by a council of war. In 1860 he went to Italy, took part in Garibaldi's expedition to Aspromonte (1862), and was interned as a prisoner of war in Naples. Amnestied by the Emperor of Austria in 1866, he returned home and re-entered public life; was from 1867–76, and again in 1884, a member of the Hungarian Reichstag, joining the Déak party. In addition to his political activity, he was president of the literary section of the Hungarian Academy, and director of the National Museum at Budapest, where he became distinguished for his archæological researches. He employed his great influence to promote both art and science and Liberal views in his native country. He died on the 9th of September 1897. Among his literary works must be mentioned *Die Jacobiner in Ungarn* (1887), *Ideen zur Philosophie der Geschichte Ungarns* and *Eletem és Levrom* (4 vols., 1882).

Pułtusk, a town of Russian Poland, in the government of Warsaw, 56 miles south-west of Łomża and 36 miles from Ostrolenka railway station, on the right bank of the Narew. It is well built, and has woollen, linen, and hosiery mills, copper works, and potteries. Population (1897), 15,878.

Punjab, The (*panj-ab* = "five rivers"), a province of British India, under the administration of a lieutenant-governor. It includes three classes of native states: (1) a number of old rajput principalities in the Himalaya, some of which are very small; (2) a collection of scattered states in the eastern plains, mostly under Sikh rulers; and (3) the Mahommedan state of Bahawalpur, running along between the river Sutlej and Rajputana. Kashmir is excluded from the Punjab, as being in direct political relations with the Governor-General. Total area (including native states), 148,966 square miles. Total population (1891), 25,130,127; (1901), 26,888,300. The capital is Lahore. In November 1901 the area of the Punjab was reduced by the creation of the North-West Frontier province.

Population.—The table on next page gives the area and population of the Punjab, according to the census of 1891 and that of 1901. Between 1881 and 1891 the rate of increase was 10·71 per cent. for British districts and 10·42 for native states, and between 1891 and 1901, 7·6 per cent. for British districts and 4·1 per cent. for the native states. In both cases the highest rate of increase was to be found in the western plains and in the submontane tracts, where irrigation has been most extended. In the eastern plains, where population is already dense, the increase has been less. The average density in British districts is 173 persons per square mile, ranging from 633 in Jullundur and 620 in Amritsar to only 74 in the Derajat. Classified according to religion, in British districts only, Mahommedans in 1891 numbered 11,634,192, or 55·8 per cent. of the population, being proportion-

Area and Population of the Punjab, 1891 and 1901.

British Territory.		Area in Square Miles.	Number of Towns and Villages (1891).	Population, 1891.	Population, 1901.			Density of Population to Square Mile (1891).
Divisions.	Districts.			Total.	Males.	Females.	Total.	
Delhi	Delhi	1,290	702	638,689	371,529	317,450	688,979	495
	Gurgaon	1,984	1,167	668,929	390,219	355,658	745,877	337
	Karnal	2,440	938	683,718	479,157	404,300	883,457	280
	Hissar	5,163	967	776,006	418,029	363,546	781,575	150
	Rohtak	1,797	483	590,475	333,590	297,121	630,711	329
	Umballa	2,754	2,114	1,033,427	451,768	364,342	816,110	375
	Simla	102	160	44,642	26,210	14,143	40,353	437
		15,530	6,531	4,435,886	2,470,502	2,116,560	4,587,062	286
Jullundur	Jullundur	1,433	1,223	907,583	497,018	420,878	917,896	633
	Hoshiarpur	2,244	2,097	1,011,659	525,502	463,674	989,176	451
	Kangra	9,574	778	763,030	399,282	369,020	768,302	80
	Ludhiana	1,453	858	648,722	369,546	303,956	673,502	446
	Ferozepore	4,302	1,527	886,676	524,519	433,699	958,218	206
		19,006	6,483	4,217,670	2,315,867	1,991,227	4,307,094	222
Lahore	Lahore	3,678	1,522	1,075,379	635,768	520,780	1,156,548	292
	Amritsar	1,601	1,036	992,697	560,186	463,716	1,023,902	620
	Gurdaspur	1,889	2,242	943,922	510,155	430,440	940,595	500
	Multan	6,079	1,397	631,434	388,569	321,979	710,548	104
	Jhang	5,871	800	436,841	200,470	178,330	378,800	74
	Montgomery	5,754	1,867	499,521	248,903	214,682	463,585	87
	Lyallpur	...	...	...	454,278	338,388	792,666	...
		24,872	8,864	4,579,794	2,998,329	2,468,315	5,466,644	184
Rawalpindi	Rawalpindi	4,844	1,688	887,194	415,151	364,929	780,080	183
	Jhelum	3,995	971	609,056	300,276	293,742	594,018	152
	Gujrat	2,051	1,338	760,875	390,161	361,877	752,038	371
	Shahpur	4,840	705	493,588	273,530	251,042	524,572	102
	Gujranwala	3,017	1,188	690,169	409,898	346,851	756,749	229
	Sialkot	1,991	2,202	1,119,847	574,010	510,505	1,084,515	562
		20,738	8,092	4,560,729	2,363,026	2,128,946	4,491,972	220
Derajat	Dera Ismail Khan	9,440	766	486,201	283,342	244,363	527,705	52
	Dera Ghazi Khan	5,606	655	404,031	242,800	202,363	445,163	72
	Bannu	3,847	472	372,276	212,882	190,190	403,072	97
	Muzaffargarh	3,422	699	381,095	220,263	185,480	405,743	111
		22,315	2,592	1,643,603	959,287	822,396	1,781,683	74
Peshawar	Peshawar	2,444	690	703,768	427,518	358,888	786,406	288
	Hazara	2,991	1,288	516,288	379,826	330,842	710,668	173
	Kohat	2,771	297	203,175	122,378	95,796	218,174	73
		8,206	2,275	1,423,231	929,722	785,526	1,715,248	173
Baluch Trans-frontier		...	5	5,934	58,978	40,803	99,781	...
Total British Territory		110,667	34,842	20,866,847	12,095,711	10,353,773	22,449,484	188
Native States		38,299	20,115	4,263,280	2,417,932	2,020,884	4,438,816	111
Grand total		148,966	54,957	25,130,127	14,513,643	12,374,657	26,888,300	173

ately more numerous than in any other part of India except Sind and Kashmir. They are found chiefly along the valley of the Indus, where they represent immigration from Afghanistan. In the neighbourhood of the old Moghul capital of Delhi they form only 23 per cent. Hindus numbered 7,743,477, or 37 per cent., being most numerous in the hills and along the Jumna. In the native states the proportion rises to 58 per cent. Sikhs numbered 1,389,934, or 6·6 per cent., being most numerous in the neighbourhood of Amritsar and Ferozepore, but they nowhere form as much as one-third of the inhabitants. Since 1881 they have increased more rapidly than the general population, except in the native states, where they show an actual decrease. But the distinction between a Sikh and a Hindu Jat is not very easy to determine. Buddhist and Jains numbered 45,245, or ·2 per cent., of whom the Buddhists are to be found almost entirely in Kangra, and the Jains in the eastern plains. Christians numbered 53,587, or ·3 per cent., of whom 30,839 were Europeans and 3111 Eurasians, leaving 19,637 for native converts, chiefly in the districts of Sialkot, Gujranwala, and Gurdaspur. "Others" numbered only 412, aborigines not being distinguished in the Punjab census.

Agriculture.—Out of a total area of 70,718,720 acres, the area assessed to land revenue is 49,598,193 acres, at the average rate of a little more than 8 annas (say 8d.) per acre. In 1897–98 the total cultivated area was 18,515,957 acres, of which 8,720,408 acres were irrigated from canals and wells in almost equal proportions. The principal crops are wheat, millet, pulse, barley, maize, oil-seeds, rice, cotton, and sugar-cane. In 1897–98 the area under indigo was 94,615 acres, chiefly in Multan and Muzaffargarh; the area under tea was 10,064 acres, almost entirely in Kangra. Irrigation has been greatly extended. Perhaps the most important work of this kind in India is the Chenab canal, which has altogether changed the face of the Rechna Doab, a thirsty upland tract between the Chenab and the Ravi. An elaborate system of colonization has been successfully introduced, and rail-

way extension has proceeded at the same time. During the five years between 1893 and 1898 the area irrigated from the Chenab canal rose from 157,197 to 810,000 acres. A new district has thus been created, with its headquarters at Lyallpur, called after a late lieutenant-governor. The entire canal system of the Punjab consists of 3323 miles of main channels and 8089 miles of distributaries, upon which Rs.8,90,93,390 has been expended, yielding a net revenue of Rs.95,29,130, or 10·7 per cent. on the capital outlay.

Industries.—The Punjab possesses no great industries, like the cotton of Bombay or the jute of Bengal. There are four cotton mills, at Delhi and Lahore, with 406 looms and 46,932 spindles, employing 2014 persons, of whom 1656 are adult males. The out-turn in 1897–98 was more than 6 million ℔ of yarn, chiefly of counts between Nos. 11 and 17, and 1 million ℔ of woven goods, chiefly *dhutis*, T-cloths, and grey goods. There is also one woollen mill at Dhariwal, with 128 looms and 4320 spindles, employing 834 persons, and producing 700,000 ℔ of goods, valued at Rs.813,550. There are seven breweries, mostly at hill stations, the oldest of which dates from 1852, with a total out-turn of about 2¼ million gallons of beer. Coal is mined for railway purposes at two places in the salt range in Jhelum district. In 1898 the total output was 85,862 tons, valued at Rs.7,18,950, and the number of persons employed was 1803. The development of both collieries is hindered by the difficulty of procuring labour. Factories for cleaning and pressing cotton are numerous. There are flour-mills at Delhi, carpet factories at Amritsar, and a sugar factory at Gurdaspur. The Punjab is well supplied with railways, which have their central terminus at Delhi. One main line of the North-Western runs from Umballa through Lahore and Rawalpindi to Peshawar, on the extreme frontier; another main line runs from Lahore to Multan, and thence to the sea at Karachi; while a third will run along the left bank of the Indus, from Attock southwards. From Delhi to Umballa there are two lines, one of the North-Western through Meerut and Saharanpur in the North-West Provinces, and a more direct one of a company, which is continued to Kalka, at the foot of the hills, whence a further continuation to Simla is under construction. The south-east of the province is served by two branches of the Rajputana system, which have their termini at Delhi and Ferozepore; and also by the Southern Punjab, which runs from Delhi to Bhawalpur. The total length of railways in British districts is about 2000 miles.

The *foreign trade* is registered with six countries—Tirah, Kabul, Bajaor, Kashmir, Ladakh, and Chinese Tibet. The total value of both imports and exports is about Rs.2,50,00,000, of which more than half belongs to Kashmir. The chief imports are *ghi* (clarified butter), timber, wool, *charas* (an intoxicating preparation of hemp), fruits, rice, and skins. The chief exports are cotton piece-goods, cotton twist and yarn, sugar, tea, salt, indigo, brass, and copper. The internal trade with other provinces of India is valued at about Rs.12,00,00,000 for imports and Rs.8,00,00,000 for exports. Almost the whole of this is conducted by rail, the river-borne trade on the Indus having dwindled to only Rs.10,00,000 for imports and Rs 40,00,000 for exports. The wheat trade is almost entirely conducted by rail with Karachi, and depends upon the demand in Europe. It is liable to great fluctuations, the quantity exported in 1897–98 being more than double that in the preceding year.

The *administration* is conducted by a lieutenant-governor, who is appointed by the governor-general, subject to the approval of the Crown. The secretariat consists of a secretary, a junior secretary, and two under secretaries. Two financial commissioners take the place of the board of revenue in most other provinces. A survival of the "non-regulation" system is to be found in the title of deputy-commissioner for the district officer elsewhere called collector. The highest judicial authority is styled the chief court, now consisting of six members, which corresponds to the high court elsewhere. A legislative council of nine nominated members, of whom four are natives of India, was created in 1897; but the privileges of interpellation and of discussing the financial statement have not yet been extended to the council. The province is distributed into six divisions or commissionerships and thirty-one districts. Most of the commissioners also exercise political functions over the native states within their jurisdiction. In 1897 the total number of police of all kinds was 19,506, of whom just half were provided with fire-arms. The number employed on police duty proper was 7938, being one policeman to every 13·9 square miles of area and to every 2628 of population.

In 1897–98 the total *revenue* of the province amounted to Rx.3,916,031, of which Rx.2,438,671 was derived from land. The total civil expenditure amounted to Rx.2,023,821, the whole of which was covered by profits from railways and irrigation. Since the reorganization of the Indian army in 1894 the Punjab has formed an independent command, under a lieutenant-general, with headquarters at Murree, a hill sanitarium not far from the great military station of Rawalpindi. The command consists of three first-class districts (including the Punjab frontier force) and two second-class districts. The Punjab frontier force is composed of five batteries of artillery, four regiments of cavalry, and nine regiments of infantry—all natives. The remaining native regiments retain their former numbers in the Bengal army. In 1898 the Punjab command consisted of 20,337 British and 46,232 native troops: total, 66,569. In addition, there were three battalions of volunteer rifles, with an enrolled strength of 2020.

The total number of *municipalities* is 148, with an aggregate population of 2,120,372 (1891). In the majority of these at least two-thirds of the municipal committee are elected by the ratepayers, who take considerable interest in the privilege. At the contested elections in 1897 more than half the ratepayers voted. The total number of members is 1671, of whom 1546 are Indians, and 815 are elected. In 1897–98 the aggregate municipal income was Rs.44,22,324, of which Rs.31,41,078 was derived from taxation, chiefly octroi, the average incidence of taxation being R.1.7.6 per head. The aggregate expenditure was Rs.43,96,972, of which Rs.18,76,462 was devoted to public health and convenience, Rs.6,71,420 to public safety, and Rs.5,98,499 to education. The aggregate amount of debt outstanding was Rs.37,14,738, chiefly raised by the four municipalities of Lahore, Delhi, Simla, and Dera Ghazi Khan. In every district except Simla there is a district board, and in most of the districts there are also subordinate local boards; out of a total of 2494 members, 1153 are elected. The district boards, on the whole, work satisfactorily; but the local boards are of little use. In 1897–98 the total local fund income was Rs.31,23,315, of which Rs.24,09,900 was derived from provincial rates. The total expenditure was Rs.31,12,528, of which Rs.8,57,438 was devoted to public works, Rs.6,64,651 to education, and Rs.4,03,418 to medical and sanitary charges.

Education.—The following table gives the chief statistics of education for the two years 1886–87 and 1896–97:—

Class of Institution.	1886–87.		1896–97.	
	Schools.	Pupils.	Schools.	Pupils.
Colleges . . .	5	509	10	1,409
Secondary schools . .	245	44,808	346	61,128
Primary schools . .	1,934	89,702	2770	119,046
Special schools . .	19	995	18	2,155
Private institutions .	16,527	145,145	5363	82,184
Total .	18,730	281,159	8507	265,922

The totals in this table are misleading, for they include private institutions, such as Koran schools attached to mosques, which are specially numerous, but cannot be said to give any valuable instruction. As a matter of fact, schools under the Education Department, and particularly those which teach English, have progressed more rapidly than in any other province. The pupils in them have increased during the five years ending 1897 by no less than 31 per cent., while students in arts colleges have nearly doubled. Including private institutions, the proportion of male pupils to the estimated male population of school-going age (15 per cent. of the total male population) is 14·5 per cent., compared with 22·3 per cent. for India generally. The proportion of female pupils is 1·5 per cent., compared with 2·3 per cent. for India generally.

The following table gives the expenditure on education according to sources for the same two years:—

Source of Revenue.	1886–87.	1896–97.
	Rs.	Rs.
Provincial revenues	7,47,746	7,27,394
Local funds	4,89,269	6,41,001
Municipal funds	3,06,270	3,37,203
Fees	2,48,951	7,98,590
Other sources	4,64,927	5,68,526
Total . .	22,57,163	30,72,714

The increase in expenditure has fairly kept pace with the increase in pupils; but during the last few years almost the whole of the increase has been borne by fees, which now contribute no less than 26 per cent. of the total. In secondary schools alone the proportion rises to 60 per cent., and in colleges to 43 per cent. This is another indication of the extent to which English education has been accepted by the people. The Punjab University, which was founded in 1882, differs from other Indian

universities in being more than a merely examining body. It is responsible for the management of the Oriental College at Lahore, and it takes a part in the improvement of vernacular literature. It also conducts Oriental examinations side by side with those in English, and has been the first to introduce a series of examinations in science from matriculation to the degree, as well as a final school examination in clerical and commercial subjects. During the five years ending 1897 the total number of students who matriculated was 4397; 437 graduated B.A. and 51 M.A., while 34 passed examinations in law and 181 in medicine.

The Punjab has not altogether escaped recent visitations of plague and famine. Plague, fortunately, never spreads in an epidemic form, being almost entirely confined to a few villages in Jullundur district, where it persisted for more than a year. The total number of deaths from plague throughout the province from October 1897 to April 1899 was 1920. In the winter of 1901–02 a severe outbreak of plague occurred, causing as many as 2000 deaths in a week. The famine of 1896–97 was most severely felt in the Delhi division, and especially in Hissar district adjoining the desert of Rajputana, where at one time 15 per cent. of the inhabitants were in receipt of relief. For the province generally the maximum number on relief was 127,758 in the middle of March 1897. The total expenditure was Rs.22,34,004. The famine of 1899–1900 was more widely spread, but was again most severe in Hissar, where the cattle died in hundreds through scarcity of fodder. The maximum number on relief in May 1900 was 180,000 in British districts and 50,000 in native states.

(J. S. CO)

Punta Arenas, a town of Chile, capital of the territory of Magallanes, situated in 53° 10′ S. and 70° 54′ W. Population (1895), 3227. The estimated population in 1900 was 6419. It is the only free port in Chile. It has grown with phenomenal rapidity; a few years ago a poor village, it has now fine buildings, broad streets, is lighted by electricity, and bids fair to become a large city. Its principal commerce is in wool, skins, beef (salted and dried), lard, and tallow. Numerous steamers belonging to European lines touch there monthly. A highroad 170 kilometres in length joins the town to the Argentine colonies of Gallegos and Santa Cruz.

Puri, or JAGANNATH, a town and district of British India, in the Orissa division of Bengal. The town is on the seacoast, and has a railway station. Population (1881), 22,095; (1891), 28,794. As containing the world-famous shrine of Jagannath, Puri is perhaps the most holy and most frequented of all Hindu places of pilgrimage. Sanitation is effected by the Puri Lodging-House Act, which provides for the appointment of a special health officer, and for the licensing of lodging-houses both in the town and along the pilgrims' route. It has a high school, with 159 pupils, a literary club, and a students' association.

The district of PURI has an area of 2473 square miles; population (1881), 888,592; (1891), 944,998; (1901), 1,017,286, showing an increase of 6 per cent. between 1881 and 1891, and of 7·6 between 1891 and 1901; average density, 411 persons per square mile. Classified according to religion, Hindus in 1891 numbered 927,514; Mahommedans, 15,597; Christians, 841, of whom 41 were Europeans; "others," 1046. Land revenue and rates (1897–98) were Rs.6,58,325; number of police, 388; boys at school (1896–97), 22,310, being 31·3 per cent. of the male population of school-going age; registered death-rate (1897), 39 per thousand. In the Orissa famine of 1866 more than one-third of the population of Puri is said to have perished. The district suffered from drought in 1897, but it is now protected by the East Coast Railway, which was opened throughout from Calcutta to Madras in 1891, with a branch to Puri town.

Purnea, a town and district of British India, in the Bhagalpur division of Bengal. The town is on the left bank of the little river Saura, with a railway station. Population (1881), 15,016; (1891), 14,555. It has a bad reputation for fever. The high school had 249 pupils in 1896–97, and there is a technical school with 15 pupils.

The district of PURNEA has an area of 4993 square miles. Population (1881), 1,849,073; (1891), 1,944,658; (1901), 1,877,072, showing an increase of 5 per cent. between 1881 and 1891, but a decrease of 3·5 per cent. between 1891 and 1901; average density, 376 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,138,738; Mahommedans, 805,267; Christians, 387, of whom 114 were Europeans; "others," 266. Land revenue and rates (1897–98) were Rs.12,80,230; number of police, 570; boys at school (1896–97), 20,035, being 13·4 per cent. of the male population of school-going age, compared with 28·3 per cent. for Bengal generally; registered death-rate (1897), 32 per thousand. Jute is grown to some extent, but the principal industry is indigo. There are 7 indigo concerns and 14 factories, with a capital of Rs.13,45,000, employing 8000 persons, with an out-turn of 5000 maunds, valued at Rs.9,00,000. The district is traversed by two branches of the Eastern Bengal Railway, running out north, and a third branch, parallel to the Ganges, is under construction.

Purulia, a town of British India, headquarters of Manbhum district in Bengal, situated in 23° 19′ N. and 86° 24′ E., with a station on the Bengal–Nagpur Railway. Population (1881), 9805; (1891), 12,128. It is a growing centre of trade, with large imports of rice during the scarcity of 1896–97, and has a high school, with 339 pupils in 1896–97.

Purus. See AMAZON.

Putnam, a town and included city of Windham county, Connecticut, U.S.A. It has an area of 27 square miles of hilly country, situated in the north-eastern part of the state. The city of Putnam is on the Quinebaug river, at the intersection of two branches of the New York, New Haven, and Hartford Railway, and at an altitude of 287 feet. In 1900 it contained 93 manufacturing establishments, with a capital of $2,019,685, 1631 employés, and products valued at $1,928,803. Population of the town (1880), 5827; (1890), 6512; (1900), 7348: of the city in 1900, 6667, of whom 2012 were foreign-born and 81 negroes.

Putney, a district in the county of London, in the borough of Wandsworth (to which parliamentary division it has since 1885 belonged), on the right bank of the Thames about 8 miles above London Bridge by river, with a station on the South-Western Railway. In 1890 a new cemetery was opened to meet the needs of the district. Population (1881), 13,221; (1891), 17,771; (1901), 24,139.

Putumayo. See AMAZON.

Puvis de Chavannes, Pierre Cécile (1824–1898), French painter, was born at Lyons, 14th December 1824. His father was a mining engineer, the descendant of an old family of Burgundy. Pierre Puvis was educated at the Lyons College and at the Lycée Henri IV. in Paris, and was intending to follow his father's profession when a serious illness interrupted his studies. A journey to Italy opened his mind to fresh ideas, and on his return to France he announced his intention of becoming a painter, and went to study first under Henri Scheffer, and then under Couture. On leaving this master in 1852, he established himself in a studio in the Place Pigalle (which he did not give up till 1897), and there organized a sort of academy for a group of fellow-students who wished to work from the living model. Puvis first exhibited in the Salon of 1850 a "Pietà," and in the same year he painted "Mademoiselle de Sombreuil drinking a glass of blood to save her father," and "Jean Cavalier by his Mother's Deathbed," besides an "Ecce Homo," now in the church of Champagnat (Saône-et-Loire). In 1852 and in the two following years Puvis's pictures were rejected by the Salon, and were sent to a private exhibition in the Galeries Bonne-Nouvelle. The public laughed at his work as loudly as at that of Courbet, but the young painter was none the less warmly defended by Théophile Gautier, and Banville. For nine years Puvis was excluded from the Salons. In 1857 he had painted a "Martyrdom of St Sebastian," "Meditation," "Village Firemen," "Julie," "Herodias," and "Saint

St Geneviève Watching over Sleeping Paris. By Puvis de Chavannes.

(In the Pantheon, Paris.)

Camilla" — compositions showing a great variety of impulse, still undecided in style and reflecting the influence of the Italian masters as well as of Delacroix and Couture. In 1859 Puvis reappeared in the Salon with the "Return from Hunting" (now in the Marseilles Gallery). But not till he produced "Peace" and "War" did he really impress his critics, inaugurating a vast series of decorative paintings. For these two works a second-class medal was awarded to him, and the State offered to purchase the "Peace." Puvis, not choosing to part the pair, made a gift of "War" to the State. He then set to work again, and in 1864 exhibited "Autumn" and "Sleep," but found no purchasers. One of these pictures is now in the Lyons Museum, and the other at Lille. "Peace" and "War" were placed in the great gallery of the Museum at Amiens, where Puvis completed their effect by painting four panels: a "Standard-Bearer," "Woman Weeping over the Ruins of her Home," a "Reaper," and a "Woman Spinning." These works were so much admired that further decorations were ordered for the same building, and the artist presented to the city of Amiens "Labour" and "Repose," for which the municipality could not afford to pay. At their request Puvis undertook another work, intended for the upper landing of the staircase, and in 1865 a composition entitled "Ave Picardia Nutrix," allegorical of the fertility of the province, was added to the collection. In 1879 the city wished to complete the decoration of the building, and the painter, again at his own expense, executed the cartoon of "Ludus pro Patria," exhibited in the Salon of 1881 and purchased by the State, which at the same time gave him a commission for the finished work, which gained for the artist in the following year the first-class medal of the Society of French Artists. While toiling at these large works, Puvis de Chavannes rested himself by painting easel pictures. To the Salon of 1870 he had sent a picture called "Harvest," a work introductory to his paintings in the Picardy Gallery; the "Beheading of John the Baptist" figured in the Great Exhibition of 1889; a "Magdalen" is in the collection of M. Chéramy (Paris). Then followed "Hope" (1872), the "Family of Fisher-Folk" (1875), and "Women on the Seashore" (1879). Still, these canvases, however interesting, are not to be named by the side of his grand decorative works. Among these must be noted those in the Palais Longchamp at Marseilles. These two paintings, ordered in 1867, represent "Marseilles as a Greek Colony" and "Marseilles, the Emporium of the East." After these, Puvis executed for the town-hall of Poitiers two decorative paintings of historical subjects: "Radegund, in seclusion at the convent of Sainte-Croix, affords a refuge to poets," and "Charles Martel, in the year 732, saves Christendom by defeating the Saracens at Poitiers." The Pantheon in Paris also possesses a decorative work of great interest by this painter: "The Life of Saint Geneviève," treated in three panels. In the first we see the saint's childhood, and in the second and third her life as a shepherdess, the two being surmounted by a frieze, also divided into two subjects. In 1876 the Department of Fine Arts in Paris gave the artist a commission to paint "Saint Geneviève giving Food to Paris" and "Saint Geneviève watching over Sleeping Paris" (see Plate), in which he gave to the saint the features of Princess Cantacuzene, his wife, who died not long before he did. At the time of his death—24th October 1898—the work was almost finished. After completing the first paintings in the Pantheon, which occupied him for three years and eight months, Puvis de Chavannes undertook to paint the staircase leading to the gallery of fine arts in the Lyons Museum, and took for his subjects the "Vision of the Antique," a procession of youths on horseback, which a female figure standing on a knoll points out to Pheidias; the "Sacred Grove"; and two allegorical figures of "The Rhône" and "The Saône." It was in the same mood of inspiration by the antique that he painted the hemicycle at the Sorbonne, an allegory of "Science, Art, and Letters," a work of great extent, for which he was paid 35,000 francs (=£1400). In this he has symbolized Eloquence, Philosophy, History, Geology, Mineralogy, and Physics with wonderful artistic feeling and sense of decorative treatment. At the Hôtel de Ville in Paris, again, Puvis decorated the grand staircase and the first reception-room. These works employed him from 1889 till 1893. In the reception-room he painted two panels: "Winter" and "Summer," the mural paintings on the staircase, which had previously been placed in the hands of Baudry and of Delaunay, are devoted to the glory of the attributes of the city of Paris; "Patriotism," "Charity," "Artistic Gifts," "Learning," "Wit," "Fancy," "Beauty," "Courage," "The Worship of the Past," "Industry," "Urbanity," and "Poetry." On the ceiling we see Victor Hugo offering his lyre to the city of Paris. The pictures in the Rouen Museum (1890–92) show a different vein, and the artist's power of conceiving and setting forth a plastic scheme enabling him to decorate a public building with beautiful human figures and the finest lines of landscape. He took for his theme the three sections of the museum: "Antiquities," "Ceramics," and "The Fine Arts," entitling his allegory "Inter Artes et Naturam." We see here toilers raising a colossal monolith, part of some ancient monument, to add it to other architectural pieces; then the busy scene of a pottery; and finally artists painting in the open air. Puvis, as a rule, adhered to the presentment of the nude or of the lightest drapery; here, however, in response to some critical remarks, he has clad his figures exclusively in modern dress. The importance given to the landscape in this work is also worthy of note; it is broadly treated, and in a purely decorative manner. Nor was it for France alone that Puvis de Chavannes executed decorative works. After prolonged negotiations, begun so early as in 1891, with the trustees of the Boston Library, U.S.A., he accepted a commission to paint nine large panels for that building, to be inserted in separate compartments, three facing the door, three to the right, and three to the left. These pictures, begun in 1895, were finished in 1898. For the centre panel, to which the others are subsidiary, he chose as the title "The Inspiring Muses hailing the Herald Genius of Light." In the eight others we find "Bucolic Poetry," "Dramatic Poetry," "Epic Poetry," "History," "Astronomy," "Physics," and "Chemistry." In these works of his latest period Puvis de Chavannes soars boldly above realistic vision. In the figures which people the walls with poetic images he endeavours to achieve originality of the embodying forms, and at the same time a plastic expression of ideas born of a mind whose conceptions grew ever loftier, while yet the artist would not abandon the severe study of nature. Such works as the great paintings at Amiens, Rouen, Marseilles, the Pantheon, the Sorbonne, and the Hôtel de Ville are among the most important productions of French art in the 19th century. Puvis de Chavannes was president of the National Society of Fine Arts (the New Salon). His principal pupils and followers are Ary Renan (died 1900), Baudouin, J. F. Auburtin, and Cottet.

See also A. Michel. "Exposition de M. Puvis de Chavannes," *Gazette des Beaux Arts.* Paris, 1888.—Marius Vachon. *Puvis de Chavannes.* Paris, 1900.—J. Buisson. "Puvis de Chavannes, Souvenirs Intimes," *Gazette des Beaux Arts.* Paris, July 1899.

(H. Fr.)

Puy, Le, or Puy-en-Velay, chief town of department Haute-Loire, France, 313 miles south-south-east of Paris,

on the railway to St Étienne. It contains the Montredon asylum for the departments of Loire and Haute-Loire, an institution for deaf mutes, municipal industrial schools of drawing, architecture, and mathematics applied to arts and industries, and schools of lace-making for poor children. About ninety establishments are engaged in the manufacture of lace and guipure, and there is a noted distillery. Electric tramways connect the town with Brives-Charensac and Espalay-St-Mareil. Population (1881), 15,459; (1891), 16,640; (1901), 20,570.

Puy-de-Dôme, a department of central France, traversed by the mountains Dore, Dôme, and Du Forez, and watered by the Allier.

Area, 3090 square miles. The population, 566,064 in 1881, had decreased to 529,181 in 1901. Births in 1899, 9821, of which 396 were illegitimate; deaths, 10,785; marriages, 3872. There were, in 1896, 1371 primary schools, with 79,000 pupils, there being 4 per cent. of the population illiterate. Out of 1,672,190 acres of land cultivated in 1896, 834,860 acres were plough-land and 106,210 acres vineyards. Of the rest two-sevenths were wood land and five-sevenths grass land. The department in 1899 produced wheat valued at £780,000; rye, £520,000; barley, £166,000; oats, £278,000; potatoes, £544,000; mangold-wurzel, £96,000; beetroot, £72,000; vines, £304,000. Its live stock included 15,910 horses, 265,110 head of cattle, 352,040 sheep, 132,100 pigs, and 18,580 goats. Mining in 1898 turned out 384,000 metric tons of coal, valued at £160,000; 750 tons of peat, 1324 tons of lead and copper, and 10,000 tons of alum and bitumen. The metallurgic industry is, however, in a backward state. The well-known cutlery of Thiers employs (1896) 12,000 workmen. Much is done in sugar-refining at Billom, and there is a busy industry in caoutchouc around Clermont-Ferrand, the capital (52,017 in 1901).

Pwllheli, municipal and contributory parliamentary borough (Carnarvon district), seaport, and market-town of Carnarvonshire, Wales, 20 miles south of Carnarvon, on the shore of Tremadoc Bay, with a terminal station on the Cambrian Railway. It has a sandy beach 4 miles in extent. There is a promenade near the sea, and the scenery around is very picturesque. Stone obtained from Gimlet Rock is worked into setts and shipped to various ports. Population (1891), 3231; (1901), 3675.

Pyrenees, a range of mountains in south-west Europe, separating the Iberian peninsula from France. The more careful examination of the chain by members of the English and French Alpine Clubs has considerably modified our views with respect to its general character, the southern versant having been shown to be the more important of the two. It has been recognized, as shown in the maps of MM. Schrader, de St Sand, and Wallon, that, taken as a whole, the range must be regarded, not as formed on the analogy of a fern-frond or fish-bone, with the lateral ridges running down to the two opposite plains, but rather as a swelling of the earth's crust, the culminating portion of which is composed of a series of primitive chains, which do not coincide with the line of partition of the water, but cross it obliquely, as if the ground had experienced a sidewise thrust at the time when the earth's crust was ridged up into the long chain under the influence of contraction. Both the orderly arrangement of these diagonal chains and the agreement which exists between the tectonic and geological phenomena are well shown in the geological and hypsometrical maps published in the *Annuaire du Club Alpin français* for 1891 and 1892 by MM. Schrader and de Margerie. The primitive formations of the range, of which little beyond the French portions had previously been studied, are shown to be almost all continued diagonally on the Spanish side, and the central ridge thus presents the appearance of a series of wrinkles with an inclination (from north-west to south-east) greater than that of the chain as a whole. Other less pronounced wrinkles run from south-west to north-east and intersect the former series at certain points, so that it is by alternate digressions from one to the other series that the irregular crest of the Pyrenees acquires its general direction. Far from having impressed its own direction on the orientation of the chain at large, this crest is merely the resultant of secondary agencies by which the primitive mass has been eroded and lessened in bulk; and though its importance from a hydrographic point of view is still considerable, its geological significance is practically *nil*.

In their primitive state the Pyrenees were composed of synclinal and anticlinal folds, slightly inclined, as a rule, to the general direction of the range, and to be distinguished even at the present day in a long series of valleys which follow each other in a longitudinal direction. But the waters, in their descent from the higher ground in a north and south direction to the plains of France and Spain, have attacked these folds successively, forming, in course of time, transverse watercourses which, broadly speaking, follow the line of greatest inclination in their descent. These watercourses, which must originally have been formed of a chain of lakes and swamps at varying altitudes, united by cascades, have gradually worn down the sills which obstructed their passage, and made their way to the plains by valleys which have become more and more deep and regular. This is how, at least on the French side, the mountains eventually acquired the character of transverse chains running down from a central dividing crest. In Spain, where the lesser humidity of the atmosphere has allowed the primitive folds to retain more of their original form, these may be traced, in spite of the fluvial erosion, to right and left of the principal valleys, which have been merely cut by running water, as by a saw, across the mass of the range.

This mass of ancient formations, with the associated Silurian rocks, constitutes almost the whole of the slopes on the side of France, where the ridges pushed farthest into the plain have lost all importance, or in certain cases have entirely disappeared under the action of erosion. The case is quite different in Spain. On this southern slope the central mass is separated from the plains by two very distinct lines of high ground, which are a characteristic feature of the Pyrenean structure. These are the zone of plateaux and that of the sierras which separate the central mass of the range from the plains at its foot. The zone of plateaux forms a sort of basement, which fringes and supports the more elevated portions. Its maximum elevation scarcely exceeds 1000 metres (3280 feet), and it presents a succession of broad synclinal depressions, in which Tertiary (Miocene and Oligocene) formations, the most recent of the whole range, occupy the surface. This zone does not sink directly towards the plains. It is bordered on the outer side by high chains of sierras with anticlinal strata, which rise at certain points to a height of over 6500 feet, and which enclose the whole Pyrenean region with no further break than the narrow clefts which give passage to the running waters. The plateaux region—completely unknown but a few years ago—thus presents the appearance of a great longitudinal lake, whose waters have been drained off by a series of breaches in the outer wall.

In the zone of the sierras denudation has continued to act until it has exposed on the summits the most ancient rocks, which have been shorn of their Tertiary covering. They have, however, retained their character of longitudinal folds, parallel to the direction of the central mountains. Those which extend farthest towards the plain have been tilted up so that they rise above the latter in a steep escarpment. Originally the French side had also its plateaux and sierras, but the only traces which remain are in the region of the Corbières and the Lesser Pyrenees of the Ariège, the more active denudation nearer the ocean having removed them entirely down to the level of the plains, from before the western Pyrenees.

The arrangement of the Pyrenees in chains, gently inclined near the centre but longitudinal everywhere else, is brought out better still by observing the courses of the streams which flow down towards Spain. On the French side most of the longitudinal valleys have disappeared; and this is why the range has so long been described as sending out transverse spurs, the more important slope remaining unknown. It is, however, still possible to distinguish some traces of this formation towards the east, where atmospheric denudation has been less active. On the south the principal streams, after cutting their way through the highest zone at right angles to the general direction of the range, become involved half-way to the plains in great longitudinal folds, from which they make their escape only after traversing long distances without finding an outlet.

The unexpected importance shown by recent investigations to attach to the Spanish versant has greatly modified the values assigned only a few years back to the area and mean elevation of the Pyrenees. Instead of the 13,440 square miles formerly put down for the former, M. Schrader has obtained a value of 21,044 square miles in the light of our later knowledge. Of this total

6390 square miles fall to the northern slope and 14,654 square miles—*i.e.*, more than double—to the southern, the difference being mainly due to the zone of plateaux and sierras. The mean elevation, estimated by Élie de Beaumont at 1500 metres (4900 feet), has been sensibly diminished by the addition of that zone to the system, and we must now put it at only 1200 metres (3930 feet) for the range as a whole. We thus see the important part played by the above-mentioned plateaux of small elevation in a chain whose highest summit reaches 11,167 feet, while the passes show a greater altitude than those of the Alps. (F. SCH.)

Pyrénées-Basses, a department in the extreme south-west of France, traversed by the Pyrenees, which separate it from Spain, and washed by the Atlantic.

Area, 2978 square miles. The population, 434,366 in 1881, had decreased to 423,164 in 1901, a decrease due to emigration. In 1899 the births numbered 9542, of which 590 were illegitimate; deaths, 7988; marriages, 2738. There were in 1896, 1168 schools, with 59,000 pupils, as many as 9 per cent. of the population being illiterate. The area under cultivation in 1896 comprised 1,113,970 acres, of which only 380,380 acres were laid out in plough-land and 49,400 in vines. The wheat grown in 1899 was valued at £536,000; maize, £600,000; potatoes, £56,000; natural pastures, £444,000; vines, £372,000; chestnuts, £78,000. The live stock numbered in 1899, 25,240 horses, 14,530 asses, 155,800 head of cattle, 410,960 sheep, 130,700 pigs, and 14,300 goats. The department in 1898 raised 720 metric tons of peat, 1920 tons of copper and iron, and 16,750 tons of rock-salt. The alimentary industries are especially developed. Pau, the capital, had in 1901, 34,692 inhabitants; Bayonne, 27,601.

Pyrénées-Hautes, a department of south-western France, traversed by the Pyrenees, which divide it from Spain, and watered by the Adour and the Gave de Pau.

Area, 1750 square miles. The population, 236,474 in 1881, had declined to 212,173 in 1901. Births in 1899, 3969, of which 290 were illegitimate; deaths, 4342; marriages, 1406. There were in 1896, 856 primary schools, with 30,000 pupils, 3 per cent. of the population being illiterate. Out of a total of 674,310 acres cultivated in 1896, 271,700 acres were plough-land and 34,580 acres vineyards. The wheat grown in 1899 was valued at £308,000; meslin, £64,000; oats, £56,000; maize, £144,000; potatoes, £88,000; natural pastures, £440,000; vines, £106,000; walnuts, £24,000. The live stock included (1899) 17,400 horses, 13,000 asses, 121,770 cattle, 364,800 sheep, and 81,000 pigs. Peat is cut, and there are marble quarries. Industry is in a backward state. Tarbes, the capital, had in 1901, 26,055 inhabitants.

Pyrénées-Orientales, a department of the south of France, resting on the chain of the Pyrenees, and washed by the Mediterranean.

Area, 1599 square miles. The population, 208,585 in 1881, was 209,447 in 1901. Births in 1899, 4864, of which 211 were illegitimate; deaths, 4195; marriages, 1670. There were in 1896, 479 schools, with 33,000 pupils, 4 per cent. of the population being illiterate. The area under cultivation in 1896 amounted to 537,405 acres, of which 154,552 acres were arable and 131,594 acres were in vines. The department in 1899 raised wheat valued at £64,000; rye, £108,000; oats, £56,000; maize, £48,000; potatoes, £164,000. The vintage of 1899 was valued at £2,250,000. The department also raised in 1898, 489 cwts. of silkworm cocoons. Its live stock (1899) included 11,270 horses, 23,020 cattle, 364,800 sheep, 81,000 pigs, and 7000 goats. The mining of 1898 turned out 1750 tons of lignite and 32,000 tons of iron. The industries in metals produced 125 metric tons of cast-iron and 208 tons of iron, totalling the value of £4000. Perpignan, the capital, had in 1901, 36,157 inhabitants.

Pyrgos, a town of Greece, in the province of Elis and Achaia, 43 miles south-south-west of Patras. It is the second town in importance in the Peloponnesus, and is connected with its harbour, Katakolon, 7½ miles distant, and also with Patras and Olympia, by rail. It has frequently been injured by earthquakes. Population (1896), 12,705.

Pyrites.—Mineralogically this word is used to denote either a group of metallic sulphides or else cubic iron pyrites; miners use the term rather loosely to indicate mineral matter the bulk of which consists of sulphide of iron, which may be either true iron pyrites, FeS_2, or magnetic pyrites, Fe_7S_8, or both. Iron pyrites is one of the most widely distributed of metallic minerals, and occurs in deposits of all kinds; it is sometimes, *e.g.*, in coal seams, an injurious impurity, whilst in other cases it may be the main object of exploitation. Pyrites is largely worked for the sake of the sulphur it contains, and is used in sulphuric acid manufacture. The material thus employed may be a pure iron pyrites in the sense of containing no other metal except iron, its value then depending wholly on the proportion of sulphur it contains. Pyrites low in sulphur is incapable of sustaining its own combustion without the aid of an external source of heat, and 45 per cent. of sulphur is, for economic reasons, usually looked upon as the lowest admissible for sulphuric acid manufacture. It is also important for this purpose that the ore should be as free as possible from arsenic.

The world's annual production of iron pyrites (that is, of pyrites valuable mainly as a source of sulphur) is about 1,000,000 tons. The largest producer is France, with over 300,000 tons; the greater part of this (about 250,000 tons) comes from the Sain Bel mines in the department of the Rhone, not far from the historic copper mines of Chessy, where the deposits are in the form of large veins and of beds of mica schist highly impregnated with pyrites. Spain produces annually about 200,000 tons of iron pyrites, used merely as a source of sulphur, while the mines in the famous Huelva district produce chiefly copper pyrites—*i.e.*, iron pyrites containing a small amount of copper, the latter probably existing as disseminated chalcopyrite. Pyritic ore free from copper is also exported from the same region; for example, the Aguas Tenidas pyrites is practically free from copper, and is especially valuable on account of its freedom also from arsenic. Germany produces about 135,000 tons of iron pyrites, by far the greater part of which is derived from mines near Meggen on the river Lenne, where the ore occurs in lenticular veins intercalated between Upper Devonian shales. In many of the deposits of cupriferous pyrites in various parts of the world, certain portions which are found to be too poor to be worth treating for copper are sold as ordinary pyrites, in spite of their containing small amounts of copper. Great Britain produces about 12,000 tons of pyrites annually.

A most important group of deposits widely distributed throughout the world is that of cupriferous iron pyrites, usually spoken of commercially as copper pyrites; these are characterized by consisting mainly of iron pyrites with notable amounts of copper, sometimes silver and gold, and frequently the sulphides of lead and zinc in small proportions. The form of the deposits is generally lenticular, and they usually occur in or near the contacts of various eruptive rocks with schists or slates: there is much reason for supposing that the presence of the eruptive rocks is in some way connected genetically with the existence of these deposits. Among the best known are those already mentioned in the Huelva district of the south-west of Spain, extending also into Portugal, of which the Rio Tinto mines are the most famous, including also Tharsis, Catania, Santo Domingo (in Portugal), &c.; the Rammelsberg mines in the Harz Mountains; Agordo and Montecatini in Italy; Szomolnok in Hungary; Röros, Vigsnäs, and Sulitjelma in Norway; Falun in Sweden; Betts Cove, Tilt Cove, and Little Bay in Newfoundland; Ducktown in Tennessee; Sudbury in Canada, where the deposit is remarkable for containing a large proportion of magnetic pyrites and for its richness in nickel; and Mount Lyell in Tasmania. The products of these deposits are treated for the most part as ores of copper, no attempt being made in many cases to utilize their sulphur contents. At Rio Tinto the ore is divided into three classes:—(1) The poorest, containing 2 per cent.

of copper, averaging, say, $1\frac{1}{2}$ per cent., is treated locally by leaching with water and liquor containing ferric sulphate; by this means the copper is gradually dissolved, and is precipitated by means of pig iron; the residue is exported and sold as ordinary iron pyrites. (2) Export ore, containing between 2 and 5 per cent. of copper, in which the sulphur, copper, precious metals, and iron are all utilized, the residual oxide of iron after extraction of the other ingredients being sold under the name of "purple ore." (3) Smelting ore, which averages about 6 per cent. of copper, and is smelted after partial calcination, producing a matte with 30 to 35 per cent. of copper.

In some places the modern process of pyritic smelting is being introduced; it consists of smelting pyrites in a shaft furnace by means of a heated air blast, little or no carbonaceous fuel being used. The heat evolved by the oxidation of the greater portion of the iron and sulphur is sufficient to smelt the remaining iron, sulphur, and copper to a matte, whilst the oxide of iron formed combines with silica to form a slag. (For the further treatment of the matte so formed see COPPER.)

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Pyritz, a town of Prussia, province of Pomerania, 16 miles south-south-west of Stargard by the railway to Küstrin. It is still surrounded by a mediæval wall with towers, and has two parish churches. Close by is the fountain (1824) in which Otto, bishop of Bamberg, baptized the first Pomeranian converts to Christianity in 1124. Excellent wheat is grown in the vicinity. Population (1900), 8188.

Pyrometry. See THERMOMETRY.

Quain, Sir Richard, 1st BARONET (1816–1898), Irish physician, was born at Mallow-on-the-Blackwater, Co. Cork, on 30th October 1816. He received his early education at Cloyne, and was then apprenticed to a doctor in Limerick. In 1837 he entered University College, London, where he graduated with high honours as M.B. in 1840, and as M.D. (gold medal) in 1842. Six years later he was chosen an assistant physician to the Brompton Hospital for Diseases of the Chest, and with that institution he retained his connexion until his death, first as full physician (1855) and subsequently as consultant. He became a fellow of the Royal College of Physicians in 1851, and filled almost every post of honour it could offer except the presidency, in the contest for which he was beaten by Sir Andrew Clark in 1888. He became physician-extraordinary to Queen Victoria in 1890, and was created a baronet in the following year. He died in London on 13th March 1898. Quain, who was elected a fellow of the Royal Society in 1871, was the author of several memoirs, dealing for the most part with disorders of the heart, but his name will be best remembered by the *Dictionary of Medicine*, the preparation of which occupied him from 1875 to 1882 (2nd edition, 1894; 3rd, 1902). He sat on the Royal Commission on Rinderpest (cattle plague) in 1865. He was a cousin of Jones Quain (1796–1865), the author of *Quain's Elements of Anatomy*, and of Richard Quain, F.R.S. (1800–1887), who was president of the Royal College of Surgeons in 1868, and left £75,000 to University College, London, with which the Quain professorships of botany, English language and literature, law, and physics were endowed. A half-brother of the two last, the Hon. Sir John Richard Quain (1816–1876), was appointed a judge of the Queen's Bench in 1871.

Quakers.—Since 1886 the Society of Friends has increased in numbers and has shown many signs of vigorous life. In constitution there has been little change, save in the position of women, who are now accorded an equal rank with men at all deliberative meetings. The society has been actively interested in questions of peace, slavery, and temperance, and has been ready to express its interest by financial help, as in the case of the Doukhobors. Foreign missionary work has grown apace, and the Home Mission Committee (established 1882, and now consisting of 96 members) is actively engaged in evangelistic labour in England. The Quakers' interest in careful religious education is as strong as ever, and the secular training in their schools is well abreast of modern requirements. In 1895 a conference was held at Manchester, for the discussion of Biblical criticism and kindred topics, and has been followed by "Summer Schools" in theology. On the whole, this period has been one of growing interest in evangelization and in the conditions of modern life and culture.

In 1900 there were in *Great Britain* 17,153 members and 7921 adherents; in *Ireland*, 2609 members; in *U.S.A.*, 93,000 "Friends"; in *Australasia*, about 500; in *Europe*, about 200.

There are 79 *missionaries* (men and women) in India, Syria, China, Ceylon, Madagascar; *members*, 3149; *adherents*, 14,377; *children in schools*, 21,145; *medical patients* treated, 24,299. Madagascar had in 1898 about 400 churches and stations, while India came next with about 23. (G. E. N.)

Quarantine.—The last vestige of the British quarantine law was removed by the Public Health Act, 1896, which repealed the Quarantine Act, 1825 (with dependent clauses of other Acts), and transferred from the Privy Council to the Local Government Board the powers to deal with ships arriving infected with yellow fever or plague, the powers to deal with cholera ships having been already transferred by the Act of 1875. The last incident under the old law was in June 1889, when the s.s. *Neva* arrived at Southampton from Brazil, having had two deaths from yellow fever on the voyage: the ship, crew, and numerous passengers were detained at the Motherbank for six days. There had been no case of a plague ship for many years; but, by a singular coincidence, two or more cases of plague arrived in the Thames (and died in hospital near the docks) in the very weeks of 1896 in which the change to the new system was impending. The great endemic centre of plague in Bombay, which has arisen since 1896, has brought that disease once more to the front as the principal object of quarantine measures. The existing regulations are those of 9th November 1896, issued by the Local Government Board under § 130 of the Public Health Act of 1875 (extended and amended); they apply to yellow fever, plague, and cholera. Officers of the Customs, as well as of Coast Guard and Board of Trade (for signalling), are empowered under Acts of 1889 and 1896 to take the initial steps. They certify in writing the master of a supposed infected ship, and detain the vessel provisionally for not more than twelve hours, giving notice meanwhile to the port sanitary authority. The medical officer of the port boards the ship and examines every person in it. Every person found infected is certified of

the fact, removed to a hospital provided (if his condition allow), and kept under the orders of the medical officer. If the sick cannot be removed, the vessel remains under his orders. Every person suspected (owing to his or her immediate attendance on the sick) may be detained on board forty-eight hours, or removed to the hospital for a like period. All others are free to land on giving the addresses of their destinations to be sent to the respective local authorities, so that the dispersed passengers and crew may be kept individually under observation for a few days. The ship is disinfected, dead bodies buried at sea, infected clothing, bedding, &c., destroyed or disinfected, and bilge-water and water-ballast (subject to exceptions) pumped out at a suitable distance before the ship enters a dock or basin. Mails are subject to no detention. A stricken ship within 3 miles of the shore must fly at the main a yellow and black flag borne quarterly from sunrise to sunset. In 1895 thirty-one vessels arrived infected with cholera at three British ports, from none of which did disease spread ashore. In 1897 a troopship with plague on board arrived at Portsmouth, and landed her 1200 troops according to the above rules without any infection being conveyed by their dispersal.

International Conventions. — Since 1852 eight conferences have been held between delegates of the Powers (see Hygiene), with a view to uniform action in keeping out infection from the East and preventing its spread within Europe; all but the last of these (1897) were occupied with cholera. No result came of the four earlier (Paris 1852, Constantinople 1866, Vienna 1874, and Rome 1885), but each of the subsequent four has been followed by an international convention on the part of nearly one-half of the Powers represented. The general effect has been an abandonment of the high quarantine doctrine of "constructive infection" of a ship as coming from a scheduled port, and an approximation to the principles advocated by Great Britain for many years. The principal States which retain the old system are Spain, Portugal, Turkey, Greece, and Russia (the British possessions Gibraltar, Malta, and Cyprus being under the same influence). The aim of each international sanitary convention has been to bind the Powers to a uniform minimum of preventive action, with further restrictions permissible to individual States. The minimum is now very nearly the same as the British practice, which has been in turn adapted to Continental opinion in the matter of the importation of rags. The Venice convention of 1892 is on cholera by the Suez Canal route; that of Dresden, 1893, on cholera within European countries; that of Paris, 1894, on cholera by the pilgrim traffic; and that of Venice, 1897, on plague from the East, both by the ordinary traffic and by the pilgrim traffic.

The international agreement as it now stands may be summarized as follows:—

General Traffic from the East.—Ships arriving at Suez are classified *indemnes, suspects,* or *infectés,* according as they have had no cases (cholera or plague) on the voyage, or have had such cases, or have such on arrival. All arrivals from an infected port are detained for an examination to be made within forty-eight hours. In practice the difference between *indemne* and *suspect* is not clearly drawn. Ships which have had cases on the voyage enter the Canal "in quarantine," *i.e.*, with guards on board to prevent communication with the shore, and under restrictions as to piloting and coaling; they remain in the state of "quarantine" ten days from the last case (being the incubation period of plague, that of cholera being five days), and may be detained in actual quarantine at Brindisi, Naples, Marseilles, Plymouth, &c., if the ten days have not run out on the voyage thither. Ships with actual cases on board at Suez are treated like suspect ships, after landing their sick and those who had been in immediate attendance on them, the period "in quarantine" counting from the time the sick were put ashore. The crew and passengers of a ship in any of these classes are subject further to a "quarantine of observation" at the port of arrival; but instead of this the British practice of taking the addresses of dispersing passengers and crews is admissible as a minimum, and has been adopted at Marseilles in the case of clean ships from infected ports.

Pilgrim Traffic.—There is now an inspection at the port of departure. Under the convention this should be done among the pilgrims on shore, but it is not usually practicable until they are on board. The cubic space for each pilgrim on the main covered deck is increased to 16 square feet. The ship is to report the state of health on arrival at Aden, where the British Government has provided for the landing of sick pilgrims. Turkey has reduced the period of detention for all pilgrim ships at Camaran to three days, whether infected or not, and has improved the buildings for the reception of parties of pilgrims that must be landed as infected or suspected.

Merchandise.—The return of plague has revived the old doctrine of susceptible articles. Under the Venice convention of 1897 it is forbidden to send from an infected country articles of clothing by parcel post. All other postal matter passes unhindered. There is a schedule of articles which may or may not be prohibited from entering, including old and worn clothing and used bedding (but not if they are the passengers' effects), rags, carpets, sacks, human hair, untanned skins and hides, unmanufactured hair and bristles, wools, claws, hoofs, &c. Most of the signatories have used their option to exclude some or all of these articles. The question arose with Great Britain of excluding wool (a large annual shipment) from Bombay and Kurachee, but it was answered in the negative by the Local Government Board. Where goods are not shut out absolutely they may be subjected to disinfection according to modern methods, which are much more expeditious than the exposures and airings for days or weeks under the old quarantine laws. Much that passes under the name of disinfection is mere formality.

Land Quarantine.—This is abolished for Europe under the convention of 1897. The practice in India since the outbreak of plague in 1896 has been tentative and various as regards railway and other land traffic.

In the United States and the Australian states there has been no recent change. The committee of the U.S. Senate on Public Health and National Quarantine, 1898, while approving the system of the marine hospital service by the several states, considers that infection would be kept out more certainly if the exclusive ultimate control were given to one authority, namely, a federal department. Towards the end of the 19th century a project was discussed of federal quarantine for the Australian continent, with suggested stations at Thursday Island, Albany, Adelaide, and Palmerston.

Literature.—The arguments in support of the British practice were ably restated by the late Sir R. Thorne Thorne in *Report (Medical) of Local Government Board*, xxiv. 1892-93. The same writer reports on the Dresden conference in App. 20 of the *Report*, 1893-94, p. 449. (C. C.)

Quaregnon, a town of Belgium, in the province of Hainaut, 4 miles west of Mons by rail. There are important coal-mines in the vicinity, and foundries, forges, and tobacco factories in the town. Population (1890), 14,361; (1900), 16,033.

Quarrying.—Quarrying is the art of winning or obtaining from the earth's crust the various kinds of stone used in construction, the operation being in most cases conducted in open workings. The term in its primary significance implies the production of material with quadrilateral or rectangular faces, as usually is necessary with building stone, and it is for the extraction of this material that quarrying operations are exclusively conducted. The art was necessarily developed at a remote period of human history; and the immense blocks of stone which may be seen in the early monuments of Egypt show that, in results, the ancient inhabitants of that country achieved great success, though their methods were slow and involved much manual labour. In modern times, and especially in countries where manual labour is costly, machinery has been devised to minimize expense.

According to their composition, building stones are broadly classed as granites, sandstones, limestones, and slates. Under the first of these heads is included a number of crystalline rock species, such as granite, syenite,

gneiss, &c., which to the geologist are quite distinct, but which in commerce are all spoken of as granite. They are chiefly composed of one or more minerals of the feldspar group, mingled with one or more of the micas or with hornblende, and usually contain quartz. Occasionally rocks without quartz, such as diabase, are known commercially as granite. Sandstones are chiefly composed of fragments of quartz cemented into solid rock by silica and oxide of iron. They are always stratified, and in commerce include many varieties, as well as flagstone used for foot-pavements. Limestones consist principally of carbonate of lime, and are usually stratified. Their chief variations are the crystalline form known as marble and the deposit from mineral springs known as Mexican onyx. Slates are mudstones or shales hardened by heat and pressure, and rendered fissile by the latter agent. Chemically they consist chiefly of hydrous silicate of alumina. Gneiss is usually a crystalline rock which, by metamorphism under the influence of heat and pressure, has developed a foliated or schistose structure. Its most manifest character is that the component minerals are arranged in parallel planes or warped surfaces, so that wherever the rock is exposed it presents a striped or banded appearance. Some gneisses are impure sandstones in which, through metamorphism, the mineral fragments have been recrystallized, the stratified arrangement being to some extent retained. These are known as sedimentary gneisses. Many of the gneisses used for building in the United States are foliated granites. Theoretically granites are massive, and have no bedding or stratification, like sandstones and limestones; but actually all rock masses are found to be more or less shattered by the movements of the earth's crust, which occur as a result of its constant readjustment to the cooling and shrinking interior, so that all rocks are divided by cracks or fissures, which are commonly known as joints. In the massive granites these joints, which usually occur in two or more planes at right angles to one another, are of the greatest importance to the quarryman, as they enable him to separate masses of stone with approximately parallel faces. In gneisses the parallel arrangement of the minerals usually coincides with a direction of easy cleavage, known to quarrymen as the "rift"; at right angles to this direction is usually one less easy parting, known as the "grain." Sandstones and limestones are stratified rocks which have been formed as sediments in bodies of water; and whether their beds are found in the normal position of horizontality, or whether they have been tilted and folded by earth movements, the direction of easiest separation is coincident with the original planes of sedimentation and parallel to them. This is therefore called the "rift," while the "grain" is at right angles to it. In gneisses, sandstones, and limestones joints also occur; and while frequently convenient for the division of the beds into masses of useful size, they may be a detriment, as when they occur within the limits of a block available for commercial purposes. In commerce the various kinds of building stone are usually designated by the name of the locality or region in which the quarry is situated. In the case of the more important varieties this geographical name usually conveys to the architect or builder full information concerning the colour, texture, and other properties of the material. For example, the names Hallowell or Quincy granite, Medina or Berea sandstone, and Vermont or Tennessee marble convey in the United States full information to those interested.

Kinds of stone quarried.

The methods of quarrying vary with the composition and hardness of the rocks, their structure, cleavage, and other physical properties; also with the position and character of the deposits or rock-masses. The general purpose of the work is to separate the material from its bed in masses of form and size adapted to the intended use. The work of cutting the stone to accurate dimensions, dressing, rubbing, and polishing are subsequent operations not involved in quarrying. The practice of quarrying consists in uncovering a sufficient surface of the rock by removing superficial soil, sand, or clay, or by sinking a shaft or stope, and then with proper tools and, when necessary, with explosives, detaching blocks of form and size adapted to the purpose in view. Frequently the outer surface of the rock has been affected by the action of the weather and other atmospheric agencies, so that it has become discoloured or softened by decay. The weathered outcrop of a rock is usually a good index of its future behaviour when used as a building stone; for one which yields quickly to the action of the sun, rain, and frost in its original mass, cannot be expected to endure when used in construction, unless it is employed solely for interior work. A quarry should, if possible, be opened on a hillside, for in this case it is usually much easier to dispose of the water which necessarily collects in any deep excavation, and which, if drainage by gravity is not afforded, must be removed by pumping, at considerable expense. As it is generally most convenient to operate on a vertical face of rock, the preliminary work of opening a quarry is usually directed toward the production of this result; but its accomplishment involves the waste of a certain amount of stone, which must be broken into irregular and useless pieces. The separation of blocks of building stone is effected ordinarily by drilling holes along the outlines of the block to be removed, and then, by exploding blasting-powder in the holes, or by driving wedges into them, exerting sufficient force to overcome the cohesion of the rock and rend it asunder. In many quarries it is found most convenient to separate a large mass and afterwards divide it into blocks of the required size. When the rock is stratified, or has an easily determined "rift," the holes are drilled at right angles to the plane of separation. When there is no stratification or "rift," or these natural planes of separation are too far apart, or when the position of the joints is not advantageous, a row of horizontal holes must be drilled into the face or "breast" of the quarry, along which separation is effected by the use of wedges. Again, in thinly-bedded sandstones, where vertical joints are frequent, it is often possible to separate the desired slabs and flagstones with crowbars and wedges, without drilling or the use of explosives. When blasting is necessary, some form of gunpowder is generally used, rather than a violent explosive like dynamite, in order to avoid shattering the rock. This, however, applies only to dimension stone. When the production of broken stone for road-making, concrete, or similar purposes is the sole end in view, violent explosives are preferred. In limestones and marbles and in the softer sandstones, channelling machines, driven by steam, are employed, by which vertical or oblique grooves can be cut with great rapidity to a depth of several feet. A level bed of rock is cleared, and on this are laid rails, along which the machine moves. After the channels are cut, a row of holes is bored perpendicular to the former at the desired distance below the surface of the bed, and by driving wedges into these the required blocks are separated. When the beds of stone to be quarried are thin, and when to remove the whole of the overlying mass of earth or rock would be too expensive, it is found convenient to treat the quarry as if it were a mine, and to rely upon methods similar to those practised in mining. A horizontal bed of rock is usually opened at its outcrop on some hillside. If this is impracticable, a shaft or stope is excavated to reach it; and if dimension

Methods employed.

stone is required, a deep horizontal groove is cut near the top or the bottom of the bed. The quarry face is then divided into blocks by saw-cuts, channels, or rows of drill-holes, and the blocks are separated by wedging or blasting. As the excavation progresses, portions of the rock are left in place as pillars to support the roof. In many localities in Europe where roofing slate is quarried, it is found in beds dipping more or less from the horizontal. These deposits are worked by stopes which follow the inclination of the bed, from which, at convenient intervals, levels are driven across, to take advantage of the cleavage of the slate. As in other subterranean quarries, pillars of rock are left to support the roof, since artificial supports would be more expensive. At some of the marble quarries in Vermont, U.S.A., where the strata are very nearly vertical, the beds are worked to a great depth with a comparatively small surface opening.

For details concerning English building stones see *Ency. Brit.* vol. iv. p. 448 and p. 512. For classification of rocks in general see *ibid.* vol. x. p. 229 *et seq.* For methods of underground work see MINING, *ibid.* vol. xvi. See also G. P. MERRILL. *Stones for Building and Decoration.* New York, 1898.—C. LE N. FOSTER. *A Text-Book of Ore and Stone Mining.* London and Philadelphia, 1894.—O. HERRMAN. *Steinbruchindustrie und Steinbruchgeologie.* Berlin, 1899. (F. J. H. M.)

Quatrefages de Bréau, Jean Louis Armand de (1810–1892), an eminent French naturalist, whose work ranges over the whole field of zoology from the annelids and other low organisms to the anthropoids and man. Son of a Protestant farmer who had settled in Holland before the Revolution, but returned to France on the outbreak of the war between the two countries, he was born at Berthezène, near Vallerangue (Gard), on 10th February 1810, and died at Paris on 12th January 1892; studied medicine at Strasburg, where he took the double degree of M.D. and D.Sc., one of his theses being a *Théorie d'un Coup de Canon* (November 1829); next year he published a book, *Sur les Aérolithes*, and in 1832 a treatise on *L'extraversion de la Vessie.* Removing to Toulouse, he practised medicine for a short time, without neglecting the natural sciences, and there contributed various memoirs to the local *Journal de Médecine* and to the *Annales des Sciences Naturelles* (1834–36). But being unable to continue his researches in the provinces, he resigned the chair of zoology, to which he had been appointed by the minister, de Salvandy, and in 1839 settled in Paris, where he found in Milne-Edwards a patron and a friend. Elected professor of natural history at the Lycée Napoléon in 1850, he became a member of the Academy of Sciences in 1852, and in 1855 was called to the chair of anthropology and ethnography at the Musée d'Histoire Naturelle. Other distinctions followed rapidly, and continued to the end of his otherwise uneventful career, the more important being honorary member of the Royal Society of London (June 1879), member of the Institute and of the Académie de Médecine, and commander of the Legion of Honour (1881).

De Quatrefages was an indefatigable worker in all branches of his favourite studies, and amid his professional duties and extensive original research he found time to contribute numerous essays to several scientific periodicals, besides some bulky volumes on various branches of zoology and anthropology, between the years 1840 and 1889. Of these, the more important were: *Considérations sur les caractères zoologiques des rongeurs* (1840); "De l'Organisation des animaux sans vertèbres des Côtes de la Manche" (*Annales des Sc. Nat.*, 1844); "Recherches sur le Système nerveux, l'Embryogénie, les Organs des Sens, et la Circulation des Annélides" (*ibid.*, 1844–50); "Sur les Affinités et les Analogies des Lombries et des Sangsues" (*ibid.*); "Sur l'Histoire Naturelle des Tarets" (*ibid.*, 1848–49). Then there is the vast series issued under the general title of "Etudes sur les Types Inférieurs de l'Embranchement des Annelés," and the results of several scientific expeditions to the Atlantic and Mediterranean coastlands, Italy, and Sicily, forming a series of articles in the *Revue des Deux Mondes*, or embodied in the *Souvenirs d'un Naturaliste*, 2 vols. (1854). These were followed in quick succession by the *Physiologie Comparée*, *Metamorphose de l'Homme et des Animaux* (1862); *Les Polynésiens et leurs Migrations* (1866); *Histoire Naturelle des Annelés Marins et de l'eau douce*, 2 vols. (1866); *La Rochelle et ses Environs* (1866); *Rapport sur les Progrès de l'Anthropologie* (1867); *Ch. Darwin et ses Précurseurs français* (1870), a study of evolution in which the writer takes somewhat the same attitude as A. R. Wallace, combating the Darwinian doctrine in its application to man; *La Race Prusienne* (1871); *Crania Ethnica*, jointly with Dr Hamy, 2 vols., with 100 plates (1875–82), a classical work based on French and foreign anthropological data, analogous to the *Crania Britannica* of Thurnam and Davis, and to Morton's *Crania Americana* and *Crania Ægyptiaca*; *L'Espèce Humaine* (1877); *Nouvelles Études sur la Distribution Géographique des Négritos* (1882); *Hommes Fossiles et Hommes Sauvages* (1884); *Histoire Générale des Races Humaines*, 2 vols. (1886–89), the first volume being introductory, while the second attempts a complete classification of mankind.

De Quatrefages was an accurate observer and unwearied collector of zoological materials, gifted with remarkable descriptive power, and possessed of a clear, vigorous style, but somewhat deficient in deep philosophic insight. Hence his serious studies on the anatomical characters of the lower and higher organisms, man included, will retain their value, while many of his theories and generalizations, especially in the department of ethnology, are already forgotten. Even his fellow-worker, Dr Hamy, has given up the view that the cradle of mankind is to be sought in the Arctic regions; and the astonishing expansion given to the primitive Negrito peoples and to the Norse element in North America are no longer taken seriously. Indeed, his whole scheme of classification must be regarded as a failure, and has not been accepted by any leading systematist. (A. H. K.)

Quebec, a province of Canada, bounded on the E. by Labrador and the Gulf of St Lawrence; on the S. by Chaleur Bay, New Brunswick, and the United States; on the S.W. and W. by the Ottawa river and Ontario; and on the N. by Ungava district.

Rivers.—The principal river is the St Lawrence, which flows through the entire length of the province. Its largest tributary—the Ottawa—730 miles long, forms the boundary between Ontario and Quebec from the head of Lake Temiskaming to Point Fortune, and receives several large branches from the Quebec side. There are many affluents of the St Lawrence from the right bank. The Cape Chat, Ste Anne (de Monts), Magdalen, and York fall into the Gulf of St Lawrence; the Bonaventure, Cascapedia, Matapedia, and Patapedia, into Chaleur Bay; and the Peribonka, 280 miles, Mistassini, 225 miles, Ashwapmuchuan, Ouiatchuan, and Metabetchouan, into Lake St John. North of the Height-of-Land, the Harricanaw, Nottaway, 450 miles long, with its tributaries the Megiskun, Waswanipi, and Broadback, the Rupert, 260 miles, and East Main, 420 miles, discharge their waters into James Bay, and the Hamilton, 630 miles long, with its southern affluents the Ashuanipi, Attikonak, and Kenamou, into Hamilton inlet.

Lakes.—The principal lakes south of the St Lawrence are Champlain, Memphremagog, Megantic, Temiscouata, and Matapedia; between the St Lawrence and the Height-of-Land, Temiskaming, Des Quinze, Expanse, Victoria, Dumoine, Kippewa, Kakabonga, Thirtyone-miles, Whitefish, Piscatong, Simon, Nomining, Nemikachi, Kempt, St John, Pipmaukin, Manuan, Pletipi, Ishimanikuagan; north of the Height-of-Land, Mistassini, 98 miles long and 10 wide and at an elevation of 1350 feet above the sea, Abitibi, Mattagami, Waswanipi, Chibougamau, Obatagamau, Ashuanipi, Attikonak, Menihek, Dyke, and Ossokmanuan.

Climate.—The climate varies from the cold but bracing winters and the long warm summers of the St Lawrence and Ottawa valleys, to the long cold winters and short cool summers of the portion to the north of the Height-of-Land. The following table gives the average temperature and precipitation at a number of places in the southern portion of the province :—

	Latitude.	Longitude.	Altitude.	Mean Temperature.			Precipitation.
				Summer.	Winter.	Year.	
			ft.	°	°	°	in.
Anticosti, W. pt.	49° 52′	64° 32′	15	55·4	12·9	36·9	41·32
Bird Rocks .	47° 51′	61° 08′	106	57·2	18·4	...	27·51
Chicoutimi .	48° 25′	71° 05′	159	58·0	9·8	36·5	30·33
Quebec . .	46° 48′	71° 13′	315	61·6	14·6	38·7	42·96
Cranbourne .	46° 20′	70° 43′	...	58·2	12·6	...	46·77
Montreal . .	45° 30′	73° 35′	187	64·8	17·1	42·3	40·20

The normal percentage of bright sunshine at Montreal is 46, a higher average than northern Europe.

Area and Population.—The original area included within the limits of the province—228,900 square miles—has been increased to 339,360 square miles by the extension of the northern boundary. By Order in Council of 8th July 1896 the boundary-line is traced from the intersection of the then western boundary—produced due north—with the shores of James Bay, along the shores of the bay to the mouth of the East Main river, thence by this river to its source in Patamisk Lake in approximate 52° 55′ N. and 70° 42′ W., thence by a due east line to the Ashuanipi river, and thence by the Ashuanipi and Hamilton rivers and the undefined western boundary of Labrador to the point of intersection of a meridian line from Anse au Sablon with the 52nd parallel. The population (1881) was 1,359,027; (1891), 1,488,535; (1901), 1,648,898 (824,454 males and 824,444 females), or 4·9 per square mile. The urban population increased from 19·5 per cent. in 1871 to 22·8 per cent. in 1881 ; to 29·2 per cent. in 1891 ; and to 39·8 per cent. in 1901. In 1891 there were 212,094 engaged in agricultural pursuits ; mining, 1534 ; fishermen, 3433 ; trade and transportation, 50,588 ; manufacturing and mechanical pursuits, 93,206 ; domestic and personal services, 73,307 ; professional avocations, 16,342 ; and in the non-productive class, 26,396. The chief towns are : Quebec, the capital, population, 68,840 in 1901 ; Montreal, the commercial metropolis of Canada, 267,730 (1901) ; St Henri, 21,192 ; Hull, 13,993 (1901) ; Sherbrooke, 11,765 (1901) ; St Hyacinthe, 9210 ; Three Rivers, 9981 ; Valleyfield, 11,055 ; St Louis de Mile End, 10,933 ; St Cunegonde, 10,912 ; Westmount, 8856 ; Sorel, 7057 ; Levis, 7783 ; Lachine, 5561 ; St Johns, 4030 ; St Jerome, 4132 ; Fraserville, 4569 ; Joliette, 4220 ; Lauzon, 3416 ; and Maisonneuve, 3958.

The following table shows the birth-places of the inhabitants of the province in 1901 :— Canada, 1,560,190 ; England, 20,726 ; Ireland, 14,275 ; Scotland, 7338 ; other British possessions, 2907 : total, 1,605,436. United States, 28,405 ; France, 3181 ; Germany, 1543 ; Russia and Poland, 2670 ; other foreign countries, 7663 : total foreign countries, 43,462. There were 9123 Indians in the province in 1901, as compared with 11,649 in 1892.

Vital Statistics.—The table below gives vital statistics of the province for the period 1871–1900 :—

	1871.	1881.	1891.	1900.
Births . . .	46,286	53,013	55,811	53,815
Deaths . . .	20,873	25,930	28,154	32,778
Marriages . . .	Statistics not collected.			10,103
Still-born, number .	,,	,,	,,	1,606
,, ,, percentage	,,	,,	,,	4·9%

Administration.—The affairs of the province are administered by a lieutenant-governor and an executive council of seven members, with portfolios, the latter being responsible to the Legislative Assembly, which consists of seventy-four members, and to the Legislative Council of twenty-four councillors.

Religion.—The Roman Catholic Church, the adherents of which form 86·7 per cent. of the population, has nine dioceses, namely, the archbishoprics of Quebec and Montreal, and the bishoprics of St Hyacinthe, Sherbrooke, Valleyfield, Chicoutimi, Nicolet, Rimouski, and Three Rivers. The Church of England has two dioceses, namely, Montreal and Quebec. In 1891 the religious denominations were as follows :— Roman Catholics, 1,429,260 ; Church of England, 81,563 ; Presbyterians, 58,013 ; Methodists, 42,014 ; Baptists, 8480 ; Congregationalists, 5173 ; Adventists, 3079 ; Jews, 7498 ; other denominations, 11,692 ; not specified, 2126.

Education.—In 1901 the Roman Catholic committee controlled 4322 elementary schools, 511 model schools, 139 academies, 2 normal schools, 19 classical colleges, 1 university—Laval, in Quebec, with a teaching branch at Montreal—and 3 schools for deaf-mutes and the blind. The Protestant committee controlled 876 elementary schools, 46 model schools, 29 academies, 1 normal school, 3 colleges, 2 universities—McGill, in Montreal, and Bishops College, Lennoxville—and a school for deaf-mutes and the blind. In addition, there were 7 schools of arts and manufactures and 4 of agriculture and dairy-farming. The number of pupils in the Roman Catholic elementary schools was 174,613, and average attendance 119,884 ; in Protestant elementary schools, 26,511 pupils and average attendance, 18,903 ; pupils in schools of all kinds, 326,507. There were 1344 school municipalities ; 5595 schoolhouses ; 7087 lay teachers (791 men and 6296 women) ; 4285 teachers in religious orders (1535 males and 2748 nuns). The local contributions amounted to $2,999,804, supplemented by a Government grant of $241,948 ; total, $3,241,752.

Finance.—The principal sources of revenue are the subsidy from the Dominion Government and moneys received from the sale of timber limits, fees for liquor licences, &c. The principal items of revenue and expenditure for the year ending 30th June 1901 were as follows :—

Revenue.		Expenditure	
Dominion subsidies .	$1,278,987	Interest on debt .	$1,436,510
Woods and forests .	1,471,004	Justice, administration	531,648
Liquor licences .	661,968	Charities and asylums	389,571
Succession duties .	163,511	Education . .	451,590
Law stamps . .	187,724	Civil government .	278,307
Miscellaneous . .	800,238	Miscellaneous . .	1,428,632
Total revenue .	$4,563,432	Total expenditure	$4,516,258

The gross debt in 1901 was $36,146,873, of which $2,549,214 has been assumed by the Dominion ; other assets, not including public buildings, aggregate $11,364,132, leaving a net debt of $22,233,527.

Minerals and Mining.—Gold-washing has been carried on in a desultory manner on the Chaudière river and its tributaries for upwards of sixty years, but the total product only amounts to about $2,000,000. Copper is obtained as a by-product from the pyrites mined in the Capelton district for the production of sulphuric acid. Copper ore has been mined at a number of places in the south-eastern portion of the province, notably at the Harvey Hill and Acton mines. Iron was mined as far back as the latter part of the 17th century. Magnetite and hæmatite, bog and titanic iron ores are found at many points throughout the province. The production of apatite (phosphate), which in 1891 amounted to 26,591 tons, has dwindled to a few tons. Asbestos of excellent quality is mined in the Thetford, Coleraine, and Danville districts. The total value of the mineral production for 1901 was $3,640,000, copper and asbestos being the most important.

Agriculture.—General agricultural instruction is given at agricultural schools at Oka, Notre Dame du Lac, Compton, and Ste Anne de la Pocatiere ; and there is also a housekeeping school for farmers' daughters at Roberval. Two veterinary schools, attached to McGill and Laval universities respectively, and eleven societies for the improvement of horticulture, receive grants. Subventions are given to the dairy association for the inspection of butter and cheese factories, and to the St Hyacinthe dairy school. There were 452 creameries and 1841 cheese factories in the province in 1901. In 1891 the total acreage occupied was 15,961,763 acres ; improved, 8,670,946 acres ; under crop, 5,542,780 ; in pasture, 3,054,539 ; gardens and orchards, 73,627 ; and woodland and forest, 7,290,817. There were 174,996 occupiers of lands, of whom 154,227 were proprietors, 19,479 tenants, and 1290 employés. In 1899 the total acreage assessed was 17,110,770 ; value of taxable real estate, $274,719,408 ; value of non-taxable real estate, $37,390,957.

The following are statistics of live stock in the province in 1891 :—Horses, 345,789 ; working oxen, 49,608 ; milch cows, 546,986 ; sheep, 722,025 ; swine, 348,397.

Fisheries.—The fisheries yielded in 1881 a product valued at $2,751,962 ; 1891, $2,008,679 ; 1900, $1,989,279 ; and in the latter year gave employment to 13,097 men, in 29 vessels and 1483 boats ; capital invested in boats, nets, &c., $830,869 ; fish exported, $515,427. The value of the lobster catch in 1900 was $204,821.

Manufactures.—The following table gives statistics of the principal manufacturing industries of the province for the year 1891 :—

	Number of Factories.	Number of Employés.	Value of Product.
Saw-mills . .	1815	13,241	$10,082,891
Leather manufactures	2270	11,863	12,533,551
Flour and grist mills	871	1,628	8,697,483
Tanneries . . .	354	1,956	5,815,532
Foundries . .	161	4,107	5,755,124
Cotton mills . .	6	3,792	3,656,170

There were 23,037 industrial establishments, with a total fixed capital of $58,449,404; working capital, $59,841,711; hands employed, 117,389; wages per annum, $30,699,115; raw material used, $85,630,496; and a total product valued at $153,255,583.

Exports and Imports.—The following table gives statistics of exports and imports for the period 1879–99:—

	Exports.	Imports.	Duty.
1879 . . .	$29,740,512	$30,924,842	$4,733,249
1889 . . .	37,223,605	49,272,475	10,408,008
1899 . . .	70,311,571	72,230,739	10,002,839

On 1st January 1902 there were 1265 vessels, with a tonnage of 142,664 tons, on the registry books of the province.

Railways.—In 1901 the total length of the steam railways in the province was 3544 miles, 19·4 per cent. of the railway mileage of the Dominion. The principal railway systems in Quebec are the Canadian Pacific, 1017 miles; Grand Trunk, 446; Intercolonial, 452; and Quebec and Lake St John, 241. There are 206 miles of electric railways in the province, principally in Montreal and Quebec. (J. WH*.)

Quebec, the capital of the province of the same name and the third city of Canada, situated on the north bank of the river St Lawrence, in 71° 12′ 19″·5 W. and 46° 48′ 17″·3 N. It is the terminus of the Great Northern, Quebec and Lake St John, Quebec, Montmorency, and Charlevoix, and Canadian Pacific railways; and the projected bridge to Lévis, on the south shore, will also admit the Intercolonial, Grand Trunk, and Quebec Central railways. The harbour is spacious and capable of accommodating ships of the largest tonnage, and, with the Louise basin and Lorne graving-dock—the latter on the opposite shore at Lévis—forms one of the best harbours in America. The Louise basin consists of twin wet-docks and tidal harbours, with areas of 40 and 20 acres respectively, and a minimum depth of 26 feet. The Parliament and departmental building, completed in 1887 at a cost of nearly $2,000,000, is one of the finest buildings in Canada. It forms a perfect square, each side of which is 300 feet in length, with towers at each angle: statues of Wolfe, Montcalm, Frontenac, de Salaberry, de Lévis, Lord Elgin, and other prominent actors in Quebec history occupy recesses in the front façade. It contains an excellent library, and in its vaults are nearly all the original archives of New France prior to the conquest in 1760. The new city hall is a fine building in the Norman style of architecture, and accommodates, in addition to the mayor and civic officials, the recorder's court and central fire and police station. An electric railway affords rapid communication with all parts of the city and vicinity. The total tonnage of shipping entered inwards during the year 1900–01 was 1,326,987 tons; exports, $5,055,336; imports, $6,324,991. Population (1891), 63,090; (1901), 68,840. (J. WH*.)

Quedlinburg, a town of Prussia, province of Saxony, at the north foot of the Harz Mountains, 12 miles by rail south-east of Halberstadt. The municipal museum contains collections of bronze and iron objects, urns, arms, &c. Here is a monument of the war of 1870–71 (1895), also an allegorical group of peace (1898). Ritter, the geographer (1779–1859), was born in Quedlinburg. The abbey church was in part rebuilt in 1882. The town is famous for its nurseries and seed farms. Population (1885), 19,323; (1900), 23,378.

Queenborough, a municipal borough and parish in the Faversham parliamentary division of Kent, England, on the Isle of Sheppey, 2 miles south of Sheerness. On the site of the present town stood a town-castle and free borough which Edward III. named Queenborough in honour of his consort, Philippa of Hainault. Before the Reform Act (1832) the town returned two members to Parliament for a population of 786. By that Act it was disfranchised. In 1890 Portland cement works were built, and there is a large trade in timber. The South-Eastern and Chatham Railway Company have laid down a branch line for their Continental traffic *viâ* Flushing. Continental mails leave twice daily. Population of municipal borough (1901), 1546.

Queen Charlotte Islands.—This compact group lies off the northern part of the coast of British Columbia, and forms part of that province of Canada. It occupies a position similar to that held by Vancouver Island, farther to the south, in regard to the mainland coast and its immediately adjacent islands, but is separated by a somewhat wider sea from that coast. Although the islands promise to become important in the future, because of their excellent harbours, the discovery of good seams of bituminous coal (besides the anthracite already known), their abundant timber of certain kinds, and their prolific fisheries, but little settlement or occupation has as yet taken place. The wonderfully productive halibut fisheries of Hecate Strait, separating these islands from the mainland and its adjacent islands, have attracted the attention of fishing companies, and great quantities of this fish are being taken regularly and shipped across the continent in cold storage. The natives, the Haida people, constituted with little doubt the finest race, and that most advanced in the arts, of the entire west coast of North America. They had developed in its highest degree the peculiar conventional art of the north-west coast Indians, which is found in decreasing importance among the Tshimpsians on the west, the Thlinkeets to the north, and the Kwakiools and other tribes farther south on the Pacific seaboard. The carved totem-posts of the Haida, standing in front of the heavily-framed houses, or at a little distance from them, and constituting mortuary posts upon which the dead were placed, generally exhibited designs treated in a bold and original manner, highly conventionalized, but always recognizable in their purport by any one familiar with the distinctive marks of the animal forms portrayed. These primitive monuments are now, however, rapidly falling to decay, and the people who erected them are becoming reduced in number and spirit. Native population of the islands, less than 700.

Queen's County, an inland county of Ireland, province of Leinster.

Population.—The area of the administrative county in 1900 was 424,690 acres, of which 127,305 were tillage, 228,397 pasture, 147 fallow, 10,685 plantation, 18,914 turf bog, 4338 marsh, 17,009 barren mountain, and 17,895 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, does not include the portion of the town of Carlow formerly situated in Queen's County. The population in 1881 was 73,124, in 1891, 64,883, and in 1901, 57,226, of whom 29,523 were males and 27,703 females, divided as follows among the different religions:—Roman Catholics, 50,461; Protestant Episcopalians, 5946; Presbyterians, 274; Methodists, 411; and other denominations, 134. The decrease of population between 1881 and 1891 was 11·27 per cent., and between 1891 and 1901 10·4 per cent. In 1891 the average number of persons to an acre was ·15, and of the total population, 57,142 persons inhabited the rural districts, being an average of 104 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr. Ep.	Pres.	Meth.
Read and write	22,463	21,775	44,238	72·5	91·1	92·0	94·3
Read only .	3,193	3,409	6,602	12·1	4·6	2·3	2·2
Illiterate .	4,552	3,755	8,307	15·4	4·3	5·7	3·5

The percentage of illiterates among Roman Catholics in 1881 was 22·4. In 1891 there were 10 superior schools, with 360 pupils (Roman Catholics 259 and Protestants 101), and 135 primary schools, with 8811 pupils (Roman Catholics 7648 and Protestants 1163). The number of pupils on the rolls of the National schools on 31st December 1900 was 8825, of whom 7817 were Roman Catholics and 1008 Protestants. The following table gives the number of births, deaths, and marriages in the years specified :—

	Births.	Deaths.	Marriages.
1881 . .	1327	966	219
1891 . .	1311	1024	232
1900 . .	1119	1077	221

In 1900 the birth-rate per 1000 was 9·6, and the death-rate 8·8; the rate of illegitimacy was 1·9 per cent. of the total births. The total number of emigrants who left the county between 1st May 1887 and 31st December 1900 was 56,641, of whom 28,380 were males and 28,261 females. The chief towns in the county, with their populations in 1901, are Maryborough, 2953; Mountmellick, 2751; Mountrath, 1304.

Administration.—The county is divided into two parliamentary divisions, Leix and Ossory, the number of registered electors in 1901 being respectively 6553 and 6613. The rateable value in 1900 was £257,111. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 2 urban and 5 rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county.

	Wheat.	Oats.	Barley, Rye, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881 .	4419	23,614	21,402	16,656	11,745	3497	58,498	130,831
1891 .	618	21,566	22,592	15,162	12,412	3257	55,941	131,548
1895 .	23	22,670	20,525	14,033	12,496	3188	61,102	134,037
1900 .	206	21,487	19,708	13,189	12,016	3634	57,065	127,305

In 1900 the total value of the cereal and other crops was estimated at £728,912. The number of acres under pasture in 1881 was 212,281; in 1891, 222,241; and in 1900, 227,305.

	Horses & Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881 .	14,824	5533	74,277	74,344	28,021	5162	256,324
1891 .	15,624	6318	86,184	95,095	34,350	6250	288,369
1895 .	17,151	5961	79,590	69,685	31,320	5014	287,893
1900 .	14,400	5913	84,420	74,182	30,053	4577	325,444

The number of milch cows in 1891 was 21,156, and in 1900, 19,888. It was estimated that the total value of cattle, sheep, and pigs for 1900 was £1,266,949. In 1900 the number of holdings not exceeding 1 acre was 1695; between 1 and 5, 1600; between 5 and 15, 2238; between 15 and 30, 2004; between 30 and 50, 1322; between 50 and 100, 1213; between 100 and 200, 600; between 200 and 500, 257; and above 500, 36: total, 10,965. The number of loans issued (the number being the same as that of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1126, amounting to £526,031. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 188, and the amount issued was £14,193. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £164,473.

QUEENSLAND.

I. Physical Characteristics and Statistics.

QUEENSLAND, originally a British colony, and now a state of the Australian Commonwealth, occupies the whole of the north-eastern portion of the Australian continent, and comprises also the islands in Torres Strait. It lies between 10° and 29° S., and is bounded on the N. by Torres Strait, on the N.W. by the Gulf of Carpentaria, on the W. by the Northern Territory of South Australia, on the S. by New South Wales, and on the E. by the Pacific Ocean and Coral Sea. It has an area of 668,497 square miles, a coast-line of 2500 miles, is 1250 miles long, and 950 miles wide at its widest part.

Climate.—The rainfall varies greatly in different parts, Geraldton on the Johnstone river standing first with an average of 150 inches for the year, Brisbane totalling 51 inches. The smallest occurs in the extreme west, with an average at Winton of 18 inches and at Birdsville of 6 inches. Rain usually falls from December to March, the monsoons producing a wet season during these months with great regularity in the north, and irregularly throughout the rest of the year, according to locality. The central, say from south of Mackay to north of Bundaberg, is drier than the north, whilst from Bundaberg southwards the rainfall is precipitated at more regular intervals throughout the year. West of the coast range the rainfall diminishes rapidly and droughts are frequent; the absence of dew in the western country allows the sun's heat to convert the native grasses into hay, their nutritive qualities being preserved long after all sign of moisture has left. Sheep and cattle live and keep their condition on such food, provided they get abundance of water. The fertility of the soil is such that two or three good thunderstorms will provide abundance of green grass in a few days. The heaviest losses in stock occur after bush fires have swept off the dry grass. The summer heat is not greater in North Queensland than in the south, but is more constant and lasts longer. West of the coast range the air is dry and hot, and the thermometer rises to 106°; east of that it rarely exceeds 96° in the shade. The monsoons play an important part in cooling the atmosphere near the coast, and are very regular in the north. The winter climate is perfection, especially in the north, but frosts are frequent and regular west of the coast range. Ice is commonly seen at Herberton, 17° S., during winter, and the surrounding highlands are looked upon as the sanatorium of the north. On the Darling Downs frosts are of nightly occurrence. The heat is oppressive during the rains of summer, but manual labour is carried on by miners, timber-getters, stockmen, and labourers of all classes in every part throughout the whole day. Adelaide, Melbourne, and Sydney often show higher temperatures than even the north, and frequently suffer from hot winds, which are almost unknown in Queensland. The diseases which cause the greatest number of deaths are miasmatic, constitutional, digestive, and respiratory, in the order named, the death-rate for the state for 1900 being 11·72 per 1000 inhabitants. The deaths from phthisis are steadily decreasing, and a large sanatorium has been erected at Dalby for the treatment of consumptives, the air there being peculiarly beneficial to such patients. The following are the death-rates per 1000 inhabitants of the principal cities of Australia :—Brisbane, 12·00; Sydney, 12·74; Adelaide, 15·20; Perth, 16·36; Hobart, 14·03; Melbourne, 15·39.

Geology.—Queensland may be divided geologically into two great portions, occupying nearly equal areas, and possessing very different physical features. The one extends along the eastern coast from the New South Wales border northwards to the 12th parallel of latitude, with an average width of about 200 miles from east to west. This division also comprises a large area in the north-west portion of the state. In this district occur the loftiest mountain ranges, the remnants of what was once a high tableland. The rainfall is comparatively large, and the country is well watered and timbered, and in places where the soil is good it is covered with dense scrubs. The drainage is eastwards into the Pacific Ocean. This region contains stratified rocks of different ages from the oldest Palæozoic, the exact relation of the older of which has not yet been determined, up to those of recent origin. There are also granites, porphyries, and syenites, partly of plutonic and partly of metamorphic origin, as well as other intrusive and interbedded igneous rocks. It is in this division that most of the mineral wealth exists. The other large area is what is known as the Western Interior, consisting almost entirely of the Lower Cretaceous rocks, known as the Rolling Downs formation, overlaid unconformably in places by the Desert Sandstone. This presents a vast area of almost treeless plains, though here and there dense Gidia scrubs exist. The rainfall over this area, more especially in the south-western districts, is very small, and consequently the

river beds are generally dry. The want of water renders it impossible to stock to anything like its full extent some of the very best pastoral land in the state. But this difficulty has been largely overcome in recent years by the tapping of the vast supplies of artesian water contained in these beds. The rivers north of the high open downs about 21° 50′ S. flow north into the Gulf of Carpentaria, while to the south they flow southwards towards the Great Australian Bight.

In the *Palæozoic* rocks many of the most important gold, silver, tin, and copper fields are situated, amongst which may be mentioned the Croydon, Etheridge, Eidsvold, Charters Towers, and Cape River goldfields; Kangaroo Hills and Running Creek silver and tin fields; the Herberton, Annan, and Bloomfield tin fields; and the Chillagoe, Mount Perry, and Peak Downs copper fields.

Silurian rocks extend westwards from Cloncurry to the western border, southwards to below Boulia, and right away to the extreme north-west, with the exception of a mass of strata north and east of Camooweal mapped as Devonian (?). In this area are situated the Cloncurry, M'Kinlay, and Leichhardt goldfields; the Cloncurry and Lawn Hill copper fields; and the rich ironstone deposits of Mount Leviathan and other hills in the neighbourhood of Cloncurry.

The principal area of *Middle Devonian* is in the Upper Burdekin, including the Fanning river, Burdekin Downs, and Broken river. Rocks of this age also occur at Chillagoe; Reid's Gap on the Townsville–Charters Towers Railway; south of Clermont; and at Raglan, and in the neighbourhood of Olsen's Caves, north of Rockhampton. The argentine silver field occurs in a series of slates and schists, &c., supposed to belong to this formation.

The *Permo-Carboniferous* system includes five formations, namely, the Gympie, Star, and the Lower, Middle, and Upper Bowen formations. The Gympie formation occupies large areas in the south-eastern and north-eastern portions of the state, and consists of sandstones, grits, conglomerates, shales, and slates, which in parts have undergone considerable alteration, together with bedded volcanic rocks. Interbedded volcanic rocks are especially numerous in the type district. The rocks generally dip at a high angle of inclination. They contain a very scant flora represented by *Calamites*, *Lepidodendron*, and fossil wood; but they have produced the largest fauna of any Queensland rocks. Numerous gold and mineral fields occur in this formation, amongst which may be mentioned:—*Goldfields*, Gympie, Cania, Raglan, and Calliope, and other smaller fields in the Gladstone district, the Rockhampton fields, the Warwick fields, Mount Shamrock, and Mount Biggenden, Eidsvold, Paradise, the Hodgkinson, Mulgrave, Palmer, and Nebo. *Silver*, Montalbion, Chillagoe, Dry river, and Sellheim fields. *Copper*, the Mount Coora mine, Gigoomgan, and Tebar copper mines. *Mercury*, the Kilkivan mines. *Bismuth*, Mount Biggenden and Mount Shamrock. *Antimony*, the Northcote, Mitchell mines. *Tin*, the Cannibal Creek tin mines. *Cobalt*, Mount Coora mine.

There is but little Palæontological evidence for separating the Star beds from the Gympie series. They contain nineteen species peculiar to themselves, and twelve species common to the Gympie beds. They are, however, generally less highly inclined than the latter, and have not been so much disturbed and altered. They are best developed at the following places:—Near the junction of the Great and Little Star rivers, from which they take their name; near Dotswood, Keelbottom Creek; in the neighbourhood of Harvest Home, Lornesleigh, and Mount M'Connell stations, on the latter of which the nearly complete remains of a fish of the genus Palæoniscus was found; and lastly, a large area of these beds exists in the neighbourhood of Drummond's range on the Central Railway, where numerous remains of the teeth and scales of fish have been discovered. The Lower Bowen formation consists of a series of white and yellow sandstones, with beds of conglomerate containing pebbles of quartzite porphyry, the latter being derived from the metamorphic rocks in the vicinity. The lowest beds of this formation consists of volcanic agglomerate seen near the heads of Pelican Creek, south-west of Bowen. This series dips under the bedded trappean rocks of Mount Toussaist. Another area of these rocks occurs north of Mackay. They have here undergone considerable alteration. So far no fossiliferous remains have been found in this formation. The Middle Bowen consists chiefly of alternate white and yellow sandstones, blue and grey shales, and impure arenaceous ironstones. Two seams of coal, known as the Kennedy and Garrick seams, have been met with near Pelican Creek in this series. The Middle Bowen series is mainly marine, although it contains in parts a land flora. Seams of coal occur on the Dawson river both north and south of the railway line, and quite recently a seam of very good coal, 9 feet thick, perhaps the best in Queensland, has been discovered on the Dawson river, about 30 miles south of the Central Railway. The Upper Bowen beds are chiefly fresh-water, and possess but a small flora and fauna. They contain numerous seams of coal, including the Macarthur, Daintree, and Havilah seams, but most of the seams have been destroyed through being burnt by intrusive sheets of dolerite. Beds of this formation occur west of Laura, the terminus of the Cooktown Railway, on the Little river coalfield; at Hamilton, about 20 miles west of Cooktown; at Stewart's Creek, near Townsville; also farther south near Mackay; on the Isaac and Dawson rivers at Dinner Creek near Stanwell, on the Central Railway; and at Blair Athol, about 10 miles north-west of Clermont. Blair Athol is the only place where coal seams in this formation are being actually worked. The coal is one of the best steam coals worked in the state.

The Burrum coal-field is the lowest member of the *Mesozoic* rocks (Lower Trias-Jura), and it extends along the coast from north of Bundaberg down to south of Noosa Heads, occupying an area of about 3000 square miles. The Coal Measures over a large portion of this area are covered with thin sandstones and conglomerates of more recent origin, and to this fact the flat and barren nature of the country is due. The formation consists of white and brown sandstones and grey and black shales. Seams of coal are known to occur from Littabella Creek in the north to near Noosa in the southern portion of the field. The seams have been worked chiefly in the neighbourhood of the Burrum river, near the townships of Howard and Torbanlea, about 28 and 15 miles respectively north-north-west of Maryborough. In the Burrum river above the railway bridge at least five seams of workable thickness can be seen cropping out in the bank within half a mile, and having a regular dip to the north-east at about 12 degrees. The two principal collieries are the Queensland Coal Company's and the Torbanlea. The Burrum is the second largest coal-producing field in the state. The Ipswich coal-field (Upper Trias-Jura) covers an area of about 12,000 square miles in the south-east. In the neighbourhood of Brisbane the base of the Measures is an ash or ashy sandstone, consisting of a felspathic matrix with blebs of quartz and pebbles of schist and quartz, &c. The formation consists of the usual alternating sandstones, shales, and conglomerates. The Coal Measures to the west of this area at Jimbour and Clifton, &c., are on a higher horizon than those in the Ipswich district, from which they are separated by a thick layer of basalt. The Ipswich coal-field has the largest output of any. Several coal seams occur in the Albert and Logan district, and thin coal has been met with in the Brisbane district. The seams that are being worked occur in the Ipswich basin and near Clifton. In the Ipswich area at least sixteen distinct seams either have been or are being worked.

In 1894 Mr R. L. Jack and Mr Gibb Maitland made a survey of the eastern edge of the Lower Cretaceous (Rolling Downs) formation, which was followed along on the western side of the Main Dividing Range, with the result that a porous sandstone, which has been named the Blythesdale Braystone, the chief intake rock of the series, was traced near the base from the neighbourhood of Texas on the southern border to Normanton in the north. The amount of water yielded by the numerous bores is almost infinitesimal when compared with the amount of water taken in by this rock and other porous beds, and the only conclusion to be arrived at is that the water finds its way into the sea at the Great Australian Bight and in the Gulf of Carpentaria. The total number of bores known to the end of June 1899 is 715, and the total continuous yield from 440 of these is 266,377,056 gallons per day. The Rolling Downs formation has been classified under the general term of Cretaceous, but it contains amongst its numerous fauna forms allied to Oolitic.

The Upper Cretaceous (Desert Sandstone) formation at one time covered the greater portion of Queensland, but the work of denudation has left only isolated patches or outliers, which in the western districts overlie unconformably the Rolling Downs beds. Some of these areas are of large extent, especially those in the centre, where they hide the outcrop of the Blythesdale Braystone. The base of the Desert Sandstone is from 1000 to 1800 feet above sea-level in the southern and central portions of the state, but in the Cape York Peninsula it is nearly at sea-level. The Desert Sandstone consists of coarse and horizontal sandstones, shales, magnesite shales, and conglomerates, &c. The conglomerates contain pebbles of quartz, and others derived from the rocks in the vicinity. A series of rocks in the neighbourhood of Maryborough, which overlie the Burrum Coal Measures, against which they are faulted, have been provisionally included in this formation. They have produced a large number of fossils, some of which are allied to those from the Desert Sandstone at Croydon.

The *Tertiary* deposits are very poorly represented; in fact, with the exception of a few old alluvial drifts, no sedimentary Tertiary deposits have been described. There was undoubtedly great volcanic activity in Tertiary times, as is evidenced in numerous parts of the state by the outflows of basalt capping rocks of Desert Sandstone age. The Post-Tertiary and Recent period is represented by bone drifts on the Darling Downs and Peak Downs, at Maryvale Creek, and along the Burdekin river. They have furnished numerous remains of living and extinct marsupials, such as *Diprotodon australis*, *Macropus titan* *Thylacoleo*, *Phascolomys*, *Nototherium*, &c.; a Struthious bird (*Dromornis australis*), and

remains of reptiles and fishes. The deposits of the beautiful Chillagoe caves in the north have also furnished a few bones, and may be expected to be a rich source of interesting organic remains when they come to be thoroughly explored.

Queensland is famous for its rich tin and copper deposits, and with such districts as Chillagoe, Herberton, and Cloncurry she will doubtless take the lead amongst the states in the production of these metals. It is true that the output of both in 1900 was smaller than it was in 1894—when the figures stood at 2871 tons of tin, valued at £102,277, and 415 tons of copper, valued at £9582—but with the advance in prices, which has led to a brisk demand for properties known to contain these metals, the old productivity will doubtless be restored, if indeed it is not exceeded. The following table shows the output of gold and other minerals for 1900:—

	Total Output.		Total Value.	Chief Sources.			
	Ounces	Tons.		Place.	Ounces.	Tons.	Value.
			£				£
Gold	963,189	..	2,871,709	Charters Towers	454,679	.	1,203,166
				Croydon	97,740	..	204,092
				Gympie, &c.	93,522	..	324,154
				Mount Morgan	206,681	..	819,762
Tin	..	1,123	74,041	Herberton	..	789	49,199
				Kangaroo Hills	..	61	4,555
				Stanthorpe	..	64	4,340
Silver	112,990	..	12,712	Charters Towers	4,283	..	482
				Herberton	5,249	..	590
				Ravenswood and Star	7,234	..	812
				Stanthorpe	68,914	..	7,753
Lead	..	205	3,359	Burketown	..	59	1,003
				Herberton	..	47	799
				Stanthorpe	..	63	945
Coal	..	497,132	173,705	Clermont	..	6,774	6,126
				Ipswich and Darling Downs	..	379,504	126,425
				Wide Bay	..	110,849	41,148
Copper	..	384	23,040	Cloncurry	..	13	780
				Herberton	..	21	1,260
				Mount Perry	..	40	2,400
				Stanthorpe	..	48	2,880
Opal	..	..	7,500	Cunnamulla	..	..	1,000
				Fermoy	..	..	1,500
				Inndah	..	..	2,500
				Thargomindah	..	..	2,500
Wolfram	.	189½	6,605	Hodgkinson	..	188	6,550
Manganese	..	75	205	Gladstone	..	55	175
				Rockhampton	..	20	30
Bismuth	..	8	1,865	Hodgkinson	..	5	1,365
				Paradise	.	3	500
Lime	..	3,664	3,862	Charters Towers	..	3,594	3,705
				Etheridge	..	70	157

Up to the end of 1900 there had been won of gold 14,837,049 ounces, valued at £50,101,486; and silver, tin, lead, coal, copper, wolfram, manganese, bismuth, antimony, and opal to the value of £10,176,045.

Flora.—There are no mountain ranges of sufficient altitude to make any appreciable change in the plant-life. Bellenden Ker, the highest mountain in tropical Australia, has a height of only 5200 feet, and the plants growing upon its summit, as well as on the highest parts of the neighbouring mountains, are for the most part similar to those on the low lands in the southern parts of the state, and the plants which may be considered as peculiar to these heights are few in number of species. They consist of a Leptospermum and a (?) Myrtus, which attain a height of about 30 or 40 feet, and have wide-spreading, densely-leaved heads. The most attractive of the tall shrubs are *Dracophyllum Sayeri*, of which there are two forms, *Rhododendron Lochæ*, and *Orites fragrans*. A few orchids of small growth are met with, but the only large species known to inhabit these localities is the normal form of *Dendrobium speciosum*. These high spots have a few ferns peculiar to them, and of others it is the only known Australian habitat; for instance, the pretty white-fronded Java Bristle-fern (*Trichomanes pallidum*) has only so far in Australia been met on the south peak of Bellenden Ker; here also *Todea Fraseri* may be seen with trunks 2 to 3 feet high. The sides of these mountains are clothed by a dense forest scrub growth, some of the trees being very tall, but diminishing in height towards the summits. Palms and fern-trees are plentiful, but the greatest variety are met with at about 4000 feet altitude. So far this is the only known habitat of that beautiful fern-tree *Alsophila Rebeccæ* var. *commutata*, peculiar for the wig-like growth at the summit of its stem, which is formed by the metamorphosed lower pinnæ and pinnules.

The Myrtaceous genus Eucalyptus, of which sixty species are found, furnishes the greater part of what is designated "Hardwoods," the kinds being variously termed "Box," "Gum," "Ironbark," "Bloodwood," "Tallow-wood," "Stringy bark," &c. These are mostly trees of large size. Other large trees of the order which supply hard, durable timber are the broad-leaved Tea-tree (*Melaleuca leucadendron* and others), "Swamp Mahogany" (*Tristania suaveolens*), "Brisbane Box" (*T. conferta*), "Turpentine" (*Syncarpia laurifolia*), "Peebeen" (*S. Hillii*), "Penda" (*Xanthostemon oppositifolius*). These are most generally cut at saw-mills. Other orders, however, furnish equally serviceable, large-sized timber, particularly the following:—"Sour Plum" (*Owenia venosa, Meliaceæ*), "Red Cedar" (*Cedrela Toona*), "Crow's Ash" (*Flindersia australis, Meliaceæ*), "Burdekin Plum" (*Pleiogynium Solandri, Anacardiaceæ*), "Bean-Tree" (*Castanospermum australe, Leguminosæ*), "Johnstone River Teak" (*Afzelia australis, Leguminosæ*), "Ringy Rosewood" (*Acacia glaucescens, Leguminosæ*), "Black Walnut" (*Cryptocarya Palmerstoni, Lauraceæ*), "Hill's Teak" (*Dissiliaria baloghioides*). Many trees yield wood particularly adapted for carving and engraving, such as the "Native Pomegranate" (*Capparis nobilis*), the "Native Orange" (*Citrus australis*), "Sour Plum" (*Owenia acidula*), "Ivorywood" (*Siphonodon australe*). Coachbuilders and wheelwrights use the wood of many myrtaceous trees and several others, with Flindersias (*Meliaceæ*), whilst tool-handles are also formed from these and other trees. There is also a large variety of woods, some very beautifully marked, admirably suited for the requirements of the cabinetmaker, and the list of trees furnishing wood for building materials is a long one. Besides the wood value of the trees and shrubs, a large number furnish tannin barks, gums, &c. The tannin barks are mostly derived from various kinds of Acacia, but the barks of the Queensland varieties, of which there are about 120, are not so rich in tannin as those of species belonging to the more southern parts of Australia. Three spice barks, locally known as Sassafras, are employed for flavouring—in the northern parts, *Daphnandra aromatica*, a Monimiaceous tree, and *Cinnamomum Tamala*; and in the southern parts *Cinnamomum Oliveri*. Many indigenous plants are used in domestic medicines, and several are recognized in the Pharmacopæia, such as Eucalypts, Cinnamomums, Sideroxylons, Alstonias, Duboisias, and Pipers.

With regard to fodder-plants, no country is better furnished; the species of grasses are numerous, and the greater part of them highly nutritious, besides which there are many herbs and a large number of salt bushes and other shrubs, which form excellent auxiliaries to the food supply for stock. It is, however, to the grasses that the excellence of the pastures is mainly due. On the extensive plains where the best species abound may be seen a large number of the genus Panicum, of which the following are looked upon with the greatest favour:—"Vandyke grass," a form of *P. flavidum*, "Cockatoo grass" (*P. semialatum*), on the roots of which a species of cockatoo, in some parts of North Queensland, feeds; "Barley grass" (*P. decompositum* and *P. distachyum*); "Blue grass" (*Andropogon sericeus, A. pertusus, A. refractus*, and *A. erianthoides*); "Russell River grass" (*Paspalum galmarra*, nearly allied to the South American species *P. paniculatum, P. minutiflorum*, and *P. brevifolium, Agropyrum scabrum*); "Tall Oat grass" (*Anthistiria avenacea*); "Landsborough grass" (*Anthistiria membranacea*); *Danthonia racemosa, D. pilosa, D. pallida*, and *D. semiannularis; Sporobolus Benthami*, an excellent species found near the Diamantina and Georgina rivers, and *S. actinocladus; Stipa aristiglumis, Leptochloa chinensis, Microlæna stipoides*; "Early spring grass" (*Eriochloa punctata*), with the following "Love grasses":—*Eragrostis Brownii, E. chætophylla, E. pilosa*, and *E. tenella*. The "Mitchell grasses" (*Astrebla pectinata*) and its varieties, viz., the Wheat (*triticoides*), the weeping (*elymoides*), and the curly (*curvifolia*), are those that have the most extraordinary vitality, but some stockholders consider that the "Sugar grass" or "Brown Top" (*Pollinia fulva*) surpasses them in its quickness of bursting into leaf with the first showers of rain.

Amongst the fruits are *Antidesma Bunius, A. Dallachyanum, A. erostre, A. Ghæsembilla*, and *A. parvifolium*, called cherries or currants according to the size of the fruit they bear, the jelly made from the fruit of some species being in nowise inferior to that made from the European red currant. The Kumquat or lime of Southern Downs country (*Atalantia glauca*) makes a peculiarly nice-flavoured preserve. Of the allied genus Citrus two species are met with in the south, *C. australis*, which has a round fruit 1 to 2 inches in diameter; the other, *C. australasica*, with long finger-like fruits 3 or more inches long and about 1 inch in diameter; of this a red variety (*C. inodora*), which is only met with in the tropics, bears a fruit often 2½ inches long by 1¼ in diameter. All these fruits are juicy, and of an agreeably sharp, acid flavour. "Davidson's Plum" (*Davidsonia pruriens*) is a fruit with a sharply acid, rich, plum-coloured juice, sometimes attaining the size of a goose's egg. Of the genus Eugenia, over thirty are indigenous, and fully one-third produce more or less useful fruits. One Fig (*Ficus gracilipes*) produces a fruit used for jam and jelly. Two Garcinias are recorded as indigenous, but of one only (*G. Mestoni*) is the fruit known. It is of a depressed globular form, sometimes 3 inches in diameter, very juicy, and of

a pleasant flavour. *Leptomeria acida*, one of the very early fruits used by Australian colonists, is met with in some localities. The "Finger Berry" or "Native Loquat" (*Rhodomyrtus macrocarpa*) makes a good jam, but is in bad repute for use in the raw state, perhaps owing to a peculiar fungus at times found to infest the berries. The Queensland Raspberry (*Rubus rosæfolius*) is widely spread and commonly used, but the fruit is rather insipid. The representatives of the genus Vitis all belong to the sub-genus Cissus; several of them, although somewhat acrid, are useful for jam and jelly: probably the best for the purpose is one met with near the Walsh river, *V. Gardineri*, which is said to bear bunches from 1 ℔ to 2 ℔ in weight, the berries being large and of pleasant flavour. A large number of nut-like fruits are used by the aborigines for food, but the only one used by the white population is the fruit of *Macadamia ternifolia*, the Queensland nut.

The foliage of many plants yields by distillation essential oils, particularly Eucalypts, Backhousias, and other Myrtaceous plants, as well as some belonging to Rutaceæ and Labiatæ, especially the genus Mentha. Apart from plants of economic value, there is a profusion of ornamental plants, shrubs, trees, and parasites. Of ferns, one-half of the kinds met with in Australia are found in Queensland as well as in the other states, one-fourth in Queensland alone, the remaining fourth belonging to the other states, but not to Queensland. The indigenous ferns equal in number those of New Zealand, and are three times the number of those of Great Britain.

Fauna.—The land fauna of Queensland is essentially one with that of the entire continent. It presents the same old-fashioned aspect, with its antique transition-forms mingled with a vast number of animals arrested in their development through untold ages. But the geographical position of the state, which exposes it to the climatic and transporting influences of the intertropical Pacific, has to a notable extent impressed on its fauna characters of its own. It has thus been made the headquarters of Australian bird-life on land and fish-life at sea, the moisture of its coastal regions and the warmth of its tidal waters being eminently favourable to that wealth of insect and other low types of life which determines the multiplication of the higher. The barrier reefs are thickets of corals of the most varied forms, in life glowing with colour, in death shrubs of snowy purity. Among the shell-fish conspicuous for beauty or rarity are the exquisitely delicate Paper Nautilus and Venus Comb (*Murex tenuispina*), the orange and other valuable cowries, and the gigantic Clam-shell, which may require a ship's tackle to lift it from its bed. On the land surface, among its lowly organized products, interest centres in the multitudinous forms of insect life, of which, excepting the Butterflies and Moths (Lepidoptera) and Beetles (Coleoptera), comparatively little is known at present. Insects inimical to man, with the exception, in some localities, of ants, flies, and mosquitoes, are inconsiderable in number, and possess few hurtful properties. Centipedes, scorpions, and leeches are less troublesome than in most other tropical regions. Spiders present themselves in astonishing variety, but only one kind, a small black spider with red spots (*Lathrodectus*), is malignant. Among the larger insects proper, the great-winged Phasmas, the Skeleton or Stick-insects, the Leaf-insects, and the splendid Swallow-tailed Butterflies, are especially notable. Many of the Beetles are remarkable for size or brilliancy of colour. Turning to the Vertebrate classes, that of the Fishes is extraordinarily profuse in diversified forms, the coral reefs being the grazing- and hunting-grounds of hosts of gorgeously decorated fish, chiefly of the Wrasse family; these, however, are almost equalled in beauty by the Chætodons, Gurnards, &c., of other habitats. Among the Perches are the enormous Groper, which may attain the weight of 4 cwt., the Murray Cod, and the Giant Perch, both excellent food-fish of about 70 ℔ in weight. Sharks of many species abound, but there is no evidence that the Port Jackson Shark (*Cestracion*), which has been claimed for Queensland, extends its range into her waters. The fish which continues to excite the keenest interest in scientific circles, as a survival from the mediæval period of geological time, is the Ceratodus or Burnett Salmon, which, formerly inhabiting the headwaters of the Murray, still perpetuates its kind in two of the smaller rivers north of the Bunya range. Batrachians are limited to the frogs and their nearest allies—that is, to the tailless division of the order, the tailed batrachians (newts, &c.) being, as far as is known at present, entirely absent. The greater part of the frogs are arboreal in habit, the most familiar being the large Green Tree Frog. The exuberance and diversity of their food have doubtless been the cause of their differentiation into many distinct species, which enables them to play a very useful part in checking the undue increase of noxious insects. Snakes, on the other hand, are in too great variety for human interests, as they live very largely on insect-feeders. The great majority belong to the venomous Colubridæ, but fortunately the kinds of which the bite is more or less deadly are not numerous, and snake-bite is one of the rarest causes of death. Those with the worst reputation are the Black Snake and the Orange-bellied Black Snake (*Pseudechis*), the Brown Snake (*Diemansia*), the Keeled Snake (*Tropidechis*), and the Death Adder (*Acanthopis*). The principal non-venomous species are the Pythons or constricting snakes, *e.g.*, the common Carpet Snake (*Morelia*), the long lithe Tree Snake (*Dendrophis*), and the Fresh-water Snake (*Tropidonotus*). The Black-headed Rock Snake (*Aspidiotes*), one of the Pythons, is said to reach the length of from 20 to 25 feet, but to be perfectly inoffensive. Several kinds of marine snakes occur on the coasts, and all are to be accounted dangerous. Of reptiles, the most numerous group by far is that of the lizards, which have among them representatives of each of the leading families of the class except the Chameleons. All of them are harmless so far as their bite is concerned, and the great majority of them are useful to man, but the largest, the Monitors, or as they are locally called Iguanas, are decided pests in country poultry-yards; these lizards in ancient times grew to the formidable length of 15 feet or more. The common Sleeping Lizard (*Cyclodus*) is a rare example of a plant-eating lizard, and the western border of the country is crossed by the demoniacal-looking but quite innocent *Moloch horridus* of the far west. Tortoises are exemplified by many forms in the fresh-waters; on the coasts by the Leather-back, the Edible Turtle, and the Tortoise-shell Turtle. Queensland waters are not at present infested by any species of Alligator, though in times past one of large size was a scourge on the borders of the then inland sea. The crocodilian of its coasts is the crocodile of the Indian Seas, which ranges over the whole of the western tropical Pacific, and wanders south into Queensland waters as far as Keppel Bay. In the fresh-water pools of the northern tableland is found a small and harmless crocodile (Philas) of a very uncommon form. The avifauna is to the naturalist exceedingly attractive, for it is full of surprises and interesting lines of research, while to the artist it is a storehouse of form and colour. Where flowering and honey-yielding trees prevail, a profusion of birds seek their food either on the insects attracted by the honey, or, if so fitted, on the honey itself. Accordingly, the most striking feature of the bird-life, amid the forests of Eucalypts and Acacias, is its richness in honey-eaters and insect destroyers. The former, however, taken as a whole, are not a natural group, but include a family of perching birds and a portion of the Parroquet family, both furnished with brush-tongues adapted to the extraction of honey. A second characteristic is the great development of that quaint company, the Bower Birds, among them the Regent Bird, Satin Bird, Cat Birds, &c., constructors of the elaborate playgrounds which have excited so much attention. A third is the presence in one small part of the territory of a Cassowary, and on its seaboard of three kinds of Rifle Birds, both extensions southwards of the tropical families of Cassowaries and Paradise Birds. In the same region of prolific vegetation the handsome fruit-pigeons are also outliers of a large family of such pigeons spread through the Papuan jungles. On the other hand, one species of that eccentricity in bird-life, the Lyre-bird, represents in the southern highlands its kinsfolk farther south. The Scrub-turkey (*Catheturus*) heaps its mound of rotting *debris* to ferment in the shade of the jungles and give warmth to its eggs; the Scrub-hen (*Megapodius*) piles up sand on the beach for the sun to furnish the necessary temperature. The Giant Kingfisher, otherwise the Laughing Jackass, salutes the rising and setting sun with its discordant cackle, secure in its ill-deserved reputation for benefits bestowed and in oversight of mischief done by it. The comparative paucity of birds of prey (*Falconidæ*), and the almost total absence of rasorial game- and poultry-birds, may be noted. Birds pursued for sport or profit, however, are not wanting. The Emu and the Bustard or Plain Turkey afford sport in the open country, Quail and Snipe in or near the timber, while rivers and lakes still unvisited by the gun are covered with Ducks and Geese, Swans and Pelicans. It has been said that Australia has no migratory birds: this is an error, founded upon an undue restriction of the term migratory. Several species could be mentioned which are truly migratory in Queensland, as the Drongo-shrike, Bee-eater, Dollar-bird, &c. On the whole, it may be remarked of the Queensland avifauna, as of its fish resources also, that, owing to life-conditions in both cases, its constituents have but little disposition to associate—in the one case in flocks, in the other in schools. One may meet with mobs of White Cockatoos or Kites, but as a general rule a visitor from Europe misses the frequent flights of small birds to which he has been accustomed. As to quadrupeds, the prevalence of Marsupials has led many to suppose that Australia has bred nothing but these. This is quite a mistake. It is true that Queensland has no indigenous cattle, and only one native carnivorous beast, the Dingo, though the Seals of the southern coasts range almost, if not quite, within her boundary. Two classes of the superior mammals, however, are fairly represented, the Bats (*Cheiroptera*) and the Rodents. Of these latter, Rats and Mice of native origin are in considerable variety; among them are the Jumping Rats (*Hapolotis*), Jerboa-like little animals, which are seldom seen. The Bats are of several species; the most notorious of them are the great Fruit-Bats, or Flying-Foxes, which the fruit-grower could well enough spare. The Sirenian Mammal, the Dugong, haunts

nearly the whole of its coast-line. Queensland, in common with the rest of Australia, has those two strange egg-laying beasts, the Echidna, or Porcupine Ant-eater, and the Ornithorhynchus, or Platypus, two most remarkable milk-yielding mammals without mammæ that have not been able to divest themselves of the mode of generation and much of the structure of their reptilian forefathers. With regard to the intermediate and predominant class, the Marsupials, one of the most interesting forms is the Tree-Kangaroo (*Dendrolagus*), as, apart from the habit of climbing trees, which is shared to some extent by the Rock-Wallabies, they afford a proof of the one-time continuity of the fauna with that of the islands to the north, when land communication still existed between the two areas. Of these curious animals, two species at least are known. As to the rest of the Marsupials, there is of course a general resemblance to those of the continent as a whole, but this is accompanied by much evolution of forms, especially among the smaller sorts, recognized by differences which are occasionally sufficient to mark off distinct generic, or even more differentiated groups. The larger Kangaroos are pretty conservative in character everywhere, while the common Wallabies, the Rock-Wallabies, and the Kangaroo-Rats exhibit a greater tendency to differ from their southern and western kindred. The Koala, or native Bear, is almost absolutely invariable, a sign of the antiquity of the race. The Opossums and the so-called Flying-Opossums are not many in species, and are dwarfed descendants from a more flourishing ancestry. The Bandicoot family (*Peramelidæ*) is fairly represented; it includes the Rabbit-Bandicoot, which crosses in its eastern range the western border of the country. Carnivorous Marsupials of destructive powers are few; the largest of them, the spotted-tailed Native Cat (*Dasyurus maculatus*), is the most troublesome. Superior in size to the domestic cat, this pretender to the rank of cat is able to devastate a whole hen-roost in a single night, and is even said by the aboriginals to attack their infants. With the exception of a smaller species of the same kind, and a brush-tailed ally very much smaller, but yet able to kill a fowl with a single bite, the rest (Marsupial mice) are but partly carnivorous, chiefly insectivorous, and therefore useful. This fauna is now fortunately deprived of the Thylacinus (Native Tiger) and Sarcophilus (Native Devil), which have been driven by physical changes southwards to Tasmania, and, it was thought until lately, of the Wombats, but a new species of these inoffensive burrowers has recently been discovered within the southern borders of the state. One other peculiarity in the form of a marsupial mammal is the little Musk-Rat (*Hypsiprymnus*), inhabiting those northern scrubs which are so prolific in other animal forms foreign to the rest of Australia, and seem to have received some of their denizens from the Indian Archipelago and some from the Papuan Islands. The remarkable deposits of fossil bones, extending in patches throughout the length of the country, are sufficient proof that in former times a much larger number of animals were supported by it than are now to be found within its borders. That their diminution was not due to a permanent decrease in the fertility of the land is obvious, since this is now depastured by vast numbers of stock of all kinds. Nor is there any reason to suppose, as has been done, that it ensued from the advent of aboriginal man with his supposed attendant the dog, for these are not exterminating agents, as Africa and America prove. The fact is sufficiently explained by that law of organic life which gives to each individual, species, family, and class, its period (long or short according to its organization) of development, maturity, decay, and death. In the age when these deposits were formed, marsupial life was probably at its best; since then it has, independently more or less of physical conditions, gradually declined. No amount of sustenance can rejuvenate or even uphold a being which age is rendering incapable of sustentation. It is sad to see in this resourceful country a moribund fauna, brute and human, but the obsolete and refractory must pass away, that the country they occupy may be put to better uses.

Fisheries.—Numerous varieties of well-known and undescribed species of fish frequent the coast, which extends from 28° S. for 2000 miles along the Tasman and Coral Seas and the Inner Route to the tropical waters of Torres Strait up to 10° S. One of the best known variety is the sea mullet (*Mugilidæ*), large shoals of which strike the Australian coast 100 miles south of Sydney, and travel northwards, arriving on the southern coast-line of Queensland in the months of April and May, crossing bars and ascending rivers on the appearance of south-easterly weather. These magnificent fish often attain a weight of from 10 ℔ to 12 ℔, and are the great annual harvest of the fishermen, who forward them to cooling and freezing chambers at the principal ports, and, packed in ice, to up-country towns. Small schools of bream succeed the mullet, and are followed in September and October by the poombah or taylor fish, a fish of exceptional flavour, and much esteemed by epicures. These are succeeded by jewfish, specimens of which caught in southern waters have been known to exceed a weight of 50 ℔, whiting, garfish, and flatheads, while flounders, black and tongue soles are occasionally caught by seine or hauling nets. White and black trevally, groper and rock cod, and a variety of bonito identical with the tunny of the Mediterranean Sea, are also frequently met with. Several species of the tassel fish (*Polynemus macrocohoir*), from which isinglass is procured, have been taken by fishermen. The celebrated lung fish or *Ceratodus forsteri*, also known as the Burnett or Dawson river salmon, remarkable for possessing a rudimentary lung in addition to ordinary gills, perhaps enabling it to live independently of a vitiated water supply, attains a length of 6 feet, and is valuable as an article of food, its pink flesh bearing a resemblance to that of the English salmon. Kingfish, batfish, gurnards, and eels of many varieties are also common. Although seine or hauling nets are commonly used for taking fish, fish-traps are largely utilized on the northern seaboard. Schnapper, bream, rock cod, parrot-fish, and groper are caught by hook and line in from 10 to 30 fathoms of water off the rocky headlands of the southern coast, and brought in well-boats alive to market. Sardines, whitebait, and sprats make their appearance in large shoals on the coast at intervals. The barramundi (*Osteoglossum leichardti*), which occurs in the Dawson and western waters, is found also on the east coast,

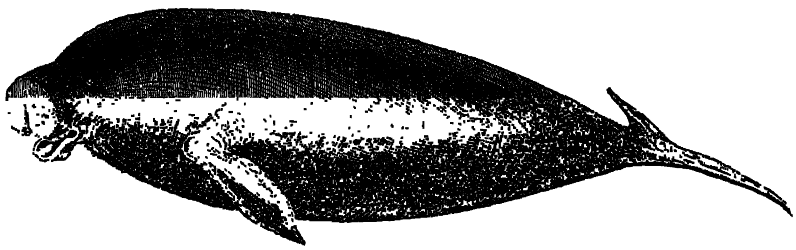

FIG. 1.—The Dugong.

and is one of the most esteemed fresh-water fish in Queensland. Dugong, which are found in herds along the northern coast and as far south as Moreton Bay, are caught in set nets of 36-inch mesh, 100 fathoms in length. A full-grown dugong (Fig. 1) will measure 11 feet, and weigh from 11 to 13 cwt.: they suckle their young, and their food consists of marine grasses; their flesh when cured like bacon is highly valued, and the oil forms a substitute for cod-liver oil; tusks and rib-bones are utilized for handles in cutlery, and the hides when tanned make excellent mill-belts. Different varieties of turtle are plentiful, the green edible turtle being caught by large set nets, and preserved and tinned for export. In Torres Strait and the northern coast the hawksbill turtle, yielding the valuable tortoise-shell of commerce, is said to be captured in a peculiar manner, the sucking-fish or remora (*Echeneis naucrates*) being utilized by the islanders for that purpose. The remora is carried alive in the bottom of the canoe, a long thin line being attached to the fish's tail and another usually to the gill. On a turtle being sighted and approached to within the length of the line, the sucking-fish is thrown towards it, and immediately it swims to and attaches itself by its singular head sucker to the under surface of the turtle, which if of moderate size is easily pulled into the canoe.

Amongst the crustacea may be enumerated the gigantic clams which are found on the reefs of the Inner Route. Occasionally some are met with weighing nearly half a ton, embedded in coral,

FIG. 2.—The Squat Lobster.

and it has been reported that while natives have been wading at half-tide over the reefs, they have stepped into the open shells, which have immediately closed on their feet, from which position they have been rescued with difficulty by their companions cutting the shell open with tomahawks. Fresh-water clams are found in

the rivers in the northern districts. The edible oyster (*Ostrea graminifora*) has for nearly twenty years been largely cultivated in southern Queensland, the exports to the southern states in 1892 rising as high as 18,000 bags, valued at £22,000, producing a revenue for that year of £6200; but this successful return received a severe check in the following years when a small red worm made its appearance amongst the oysters, causing heavy loss (Figs. 3 and 4). Amongst other crustacea, the squat lobster (*Themis orientalis*), is, with giant prawns and quampi, or small golden-lipped pearl shell, obtained by trawling in the southern waters (Fig. 2). Many varieties of crabs are also found on reefs and foreshores at low tide; prawns and shrimps are caught, dried, and form an article for export to China; mussels, pinna or razor-shell, cockles, and eugaries (a species of small shell-fish) are also abundant. The pearl shell fishery, located in Torres Strait, has for over twenty-five years given magnificent returns on the capital invested. Pearls of great value are occasionally obtained, and the shells realize from £100 to £150 per ton in London. As an instance of the value of this industry, it may be stated that in 1898, £100,000 worth of shell was exported to London, bringing in a revenue of £1100 to the Government, the shell having been to a great extent collected off the shallow reefs; diving is now prosecuted in deep water of 25 fathoms and upwards, causing frequent and fatal accidents to divers engaged. Bêche-de-mer, or holothuria, or trepang, has been collected, cured, and exported from the reefs and adjacent seas for over thirty years, the yearly value of the exports occasionally exceeding £30,000, though of late years the industry has not been so remunerative. Schools of whales are occasionally sighted on the coast, but the old fishing grounds at the Bamptons, 450 miles distant across the Coral Sea, are seldom visited. Amongst the dangerous and voracious classes of fish frequenting the warm waters of Queensland, which are common to both temperate and tropical seas, may be enumerated sharks of all varieties, gigantic sword-fish and saw-fish, and immense stinging rays.

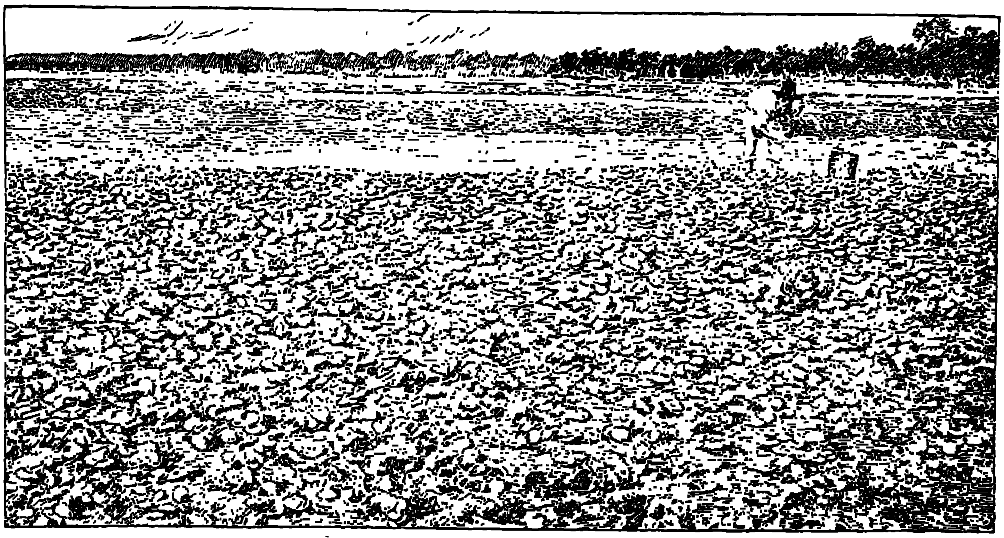

Fig. 3.—Cultivated Oyster Bank, Moreton Bay.

Fig. 4.—Mangrove Oysters, Moreton Bay.

Population.—The population has increased from 326,916 in 1885 to 502,892 (census preliminary count) on 1st April 1901—280,504 males and 222,388 females. Included in these are coloured aliens, estimated to be Polynesians, 8826; Chinese, 10,076; Japanese, 3063; Javanese, 298; other Asiatics, 2357; total, 24,620 persons, or about 5 per cent. of the total population. The density of population in 1901 was 0·75 per square mile, compared with 0·32 in 1881 and 0·59 in 1891. Persons engaged on sheep and cattle runs numbered 17,500; in agriculture, 40,700 males and 7500 females; in mining, 14,000; in industries and manufactures, 20,000 males and 6400 females; in building, road-making, and the like, 13,000. Trade and commerce utilize 19,200 males and 2400 females; transit and transport, 15,800; domestic occupations, 18,000 females and 7200 males; professions, 9100 men and 3700 women. Of the rest, some 20,000 manual labourers are not constantly in any one branch of work, and about 1000 men and 250 women live on their means. The birth-rate is now 30·19 per 1000, showing a gradual decline from 43·07 per 1000 for the period 1861–65, 36·37 per 1000 for 1881–85, and 35·15 for 1891–95. The illegitimates in 1881 were 4·2 per cent., in 1891 4·7 per cent., in 1900 6·40 per cent. In 1900 there were born 7599 boys and 7202 girls (14,801 in all). The death-rate is 11·72 per 1000, showing a remarkable diminution, for in 1861–65 it averaged 21·06 per 1000; in 1871–75, 17·94; in 1881–85, 19·10; and in 1891–95, 12·82. The deaths in 1900 numbered 5747 (males, 3678; females, 2069). The marriage-rate in 1900 was 6·88 per 1000, being a decrease on the figures for 1885, owing to the age-condition of the population having reached a more normal level. In 1890 the poll tax on Chinese was abolished, but their arrival was restricted to one person for every 500 tons of the ship's register. The aborigines have diminished in numbers very fast in the south, and they are no longer wild and ferocious, except in a few remote parts of the north. Protection is afforded to them in their dealings with whites, and several missions at Bellenden Ker, Bloomfield, Cape Bedford, Deebing Creek, Maria Yaamba, Mackay, Mapoon, and Weipa have done good work amongst the children. Their numbers are now estimated to be 10,000 persons.

Agriculture.—Agriculture is a thriving industry, employing a considerable percentage of the population. It has largely taken the place of sheep-raising on the Darling Downs and cattle-raising on much of the coast country in the south, whilst farther north

sugar and other tropical products have led to the cultivation of the rich scrub land at the mouths of coastal creeks and rivers, the total area of land under cultivation for 1900 being 479,716 acres, against 209,130 acres for 1885. Sugar produced in Queensland in 1885 equalled 55,796 tons, and in 1899, 123,300 tons. It is principally grown at Logan, Maryborough, Bundaberg, Rockhampton, Mackay, Bowen, Burdekin, Ingham, Johnstone river, Mossman, and Cairns. There are now two refineries and fifty-eight sugar-making mills in active work. It has long been recognized that only well-equipped mills are able to manufacture sugar at a profit at the low price to which the competition of bounty-fed sugar has now reduced this article, and, whilst many mills are still owned with the plantations, a different system has sprung up by which farmers cultivate comparatively small areas of cane, and either sell to owners of mills or combine and erect a mill themselves (in which they are liberally assisted by the Government), and after receiving a price per ton for their cane, divide whatever profits there are over working expenses, interest, &c., at the close of the season. The central mill system, by extending the growth of cane by small farmers, will, it is believed, solve the troublesome question of black labour in connexion with this industry, besides having the effect of settling a large number of persons on farms of their own. The production in 1900 reached 92,554 tons. Another large agricultural product is wheat, and of this there was produced, in 1897, 1,009,293 bushels, the yield for 1900 being 1,194,088 bushels from 79,304 acres, against 51,598 bushels for 1885. The centres of wheat production are the Warwick and Toowoomba districts. Indeed, the Darling Downs produce nineteen-twentieths of the whole of the wheat grown. Barley, ordinary and malting, is also grown in the same district, and two malting-houses exist for converting it into malt. Maize is grown extensively, but owing to drought in 1900 did not suffice for local requirements. The produce for 1900 was 2,456,647 bushels, against 1,574,294 bushels for 1885. Rice is an industry of comparatively recent introduction, and although small areas are grown at many places, Cairns is the centre of the industry. There were 271 acres, yielding 6870 bushels of paddy grown in 1900. Potatoes are reared principally in the south; there were 20,014 tons grown in 1900, against 8326 tons in 1885. Sweet potatoes are also grown extensively. Arrowroot is grown almost entirely in the south, where, besides supplying local requirements, 463,617 ℔ of manufactured arrowroot were exported in 1900. The production for 1900 was 3978 tons of tubers, and in 1885 it was about 3855 tons. Coffee is attracting attention, its cultivation being principally in the north. Bananas grow along the whole seaboard, and form an important industry; thousands of bunches are exported weekly from the northern ports to the southern states. The production for 1900 was 2,313,108 bunches, against 1,660,180 dozens for 1885. Tobacco yielded 4032 cwt. of cured leaf in 1900, against 1330 in 1885; pine-apples, 424,835 dozens in 1900, against 122,263 in 1885; oranges, 2,356,068 dozens in 1900, against 658,549 in 1885; mangoes, 277,444 dozens in 1900; and strawberries yielded 401,105 quarts. Though grape-vines grow throughout Queensland, they are best suited for wine-making in the south of the state.

Stock-Raising.—Although farming has advanced rapidly and displaced pastoralists near the centres of settlement, the pastoral industry still retains the premier place. The number of sheep increased from 8,994,322 in 1885 to 17,552,608, but has fallen through the severe and protracted drought to 10,339,185 in 1900. Cattle have decreased from 4,162,652 to 4,078,191, whilst the value of wool exported rose from £1,779,682 to £2,199,370. The more thorough opening up of the country, better means of communication, lower rents, and longer tenure have all combined to induce pastoralists (both sheep and cattle) to occupy the more remote districts, leaving the more accessible parts to settlement. The discovery of artesian water has enabled them profitably to stock and use country which, though rich, is devoid of natural water. There are now more than 439 artesian bores in operation, the outflow from which is calculated to exceed 268 million gallons daily. In addition to this creeks are dammed and excavations made in suitable localities, and large sums freely spent in the endeavour to retain a permanent supply of the precious fluid. The character of sheep-farming, too, has altogether changed. Instead of the sheep being herded by a man who accompanied them through the day and yarded them at night, they are allowed to go at large in paddocks many miles in extent and surrounded by wire fences, and only mustered when required. Men are employed to keep the fences in good order and poison the dingoes. This system and the artesian bores together are changing the character of squatting, and good land, where water can be obtained, is now largely sought after in blocks of 20,000 acres. In future smaller holdings of 10,000 sheep will take the place of the larger holdings of 300,000 sheep, the former plan also giving employment to a larger number of persons. Shearing by machinery, too, is having a good effect on the values of wool. Cattle, which a few years ago sank to an almost nominal price, have again risen in value, and promise to increase. A market for frozen meat having been found in England, meat works were established which are able to send fresh meat to any port in the world in a perfect state of preservation. Preserved meat in tins and in extract, and a large variety of subsidiary products are also exported, and no portion of the animal killed is wasted. Fourteen freezing works and eleven preserving and boiling-down works are now running, most of them fitted with the latest appliances for economically reducing cattle to marketable products. The value of frozen meat exported in 1900 was £982,125, whilst preserved and salt meats were £490,811, and extract of beef £89,011, hides and skins £551,752, tallow £397,439, miscellaneous products of the industry £628,277, making altogether £3,049,415, and, including wool, a sum of £5,248,785 as the value of the pastoral produce in excess of the requirements of the state. A small insect pest call the "tick" has caused much loss in the north, and has gradually spread southwards. It is believed that inoculation will render cattle immune, and that the losses sustained in the north will not be repeated in the south. Dairy-farming has latterly received much attention, and promises to attain considerable dimensions. This also depends on the cheapness of cold storage, since the local consumption of butter has been overtaken, and the exportation of that article is largely on the increase. The best breeds of milking cattle have been extensively imported, and feeding and treatment have been assimilated to British methods, whilst co-operation amongst dairy-farmers has led to the establishment of creameries and butter factories in many parts of South Queensland. There were 1,389,250 ℔ of butter exported in 1900, of the value of £51,729. Horse-raising has become an important industry, the number of horses now approximating half a million. There has also been a large increase in pigs, namely, from 55,843 in 1885 to 122,187 in 1900. Within the last few years bacon-curing factories have come into existence, with the result that whilst bacon and ham were imported to the value of £29,969 in 1885, they formed in 1900 exports to the value of £46,866. These factories purchase pigs from the farmer and convert them into bacon, ham, lard, &c. They are all fitted with refrigerating machinery, and carry on their operations throughout the year.

Commerce.—Since 1885 the coastal towns have grown steadily in size and importance, and the trade passing through them has increased. The total exports for 1900 were £9,581,562, or £20 per head (1882 = £3,534,452), of which wool represented £2,199,370 (1882 = £1,329,019); gold, £2,819,495 (1882 = £829,655); tin, £79,958 (£269,904); live stock, £597,474 (£280,466); green fruit, £104,387; sugar, £669,389 (£153,188); tallow, £307,439 (£129,549); preserved meats and extracts, £1,562,197 (£119,343); pearl-shell, £128,524 (£105,869); hides and skins, £551,752; bêche-de-mer, £4376 (£25,032). The principal articles of export for 1900 may be grouped as follows: pastoral products, £5,248,785; mineral, £2,984,689; and agricultural, £904,171. The imports for 1890 were £7,184,112, or £14 13s. 0d. per head (1882 = £6,318,463), and it is noticeable that in 1892, the time of financial troubles, imports fell to less than five millions. The imports for the years instanced show for manufactured cotton, silk, and woollen goods, 1900, £819,118 (1882 = £839,352); unmanufactured, £486,299 (1882 = £194,489); metal goods and hardware, £1,221,145 (£910,029); flour and grain, £390,967 (£453,307); oilman's stores, £77,806; spirits, wines, and beer, £282,460 (£320,925); books and stationery, £184,987 (£113,798); tea, £135,637 (£109,286). During 1900 there entered 713 sea-going vessels with a tonnage of 835,355, and cleared 716 with a tonnage of 819,662. A dry dock with all conveniences exists at Brisbane, and slips for smaller vessels at the larger ports. Dredgers are largely employed in improving and deepening the rivers and harbours, of which the principal are Brisbane, Maryborough, Bundaberg, Gladstone, Rockhampton, Mackay, Bowen, Townsville, Dungeness, Geraldton, Cairns, Port Douglas, Cooktown, and Thursday Island, all on the eastern coast, and Normanton and Burketown in the Gulf of Carpentaria. The project of opening a port at Point Parker has been abandoned.

Manufactures.—The abundance of raw materials, and the free entry of articles imported for manufacture, have tended to develop industries of all kinds, and whilst the number and description in 1885 were few, great progress has taken place in later years. Large foundries and engineering shops exist in all the principal towns, and there are, besides, flour, sugar, and saw mills; breweries; ice, butter, cheese, tobacco, jam, pickle, clothing, and boot factories; meat preserving, boiling down, and soap works; tanneries; distilleries; wine making; and a woollen manufactory. The total number of establishments is 2610, and for 1899 they employ 28,883 hands, and utilize 27,580 horse-power. The value of the output in 1899 was £8,883,231. Electric light is largely employed, and all the principal towns are lighted with gas.

Railways.—Since 1885 good progress has been made, not only in extending the main trunk lines, but in constructing branch and other lines to meet local requirements, the total length of railways open to traffic having increased from 1434 to 2801 miles, at a total cost up to the 30th June 1900 of £19,803,239. The Southern

line, which in 1885 stopped at Stanthorpe, has now been extended to Wallangarra, where it connects with the New South Wales system, affording rail communication from Brisbane with Sydney, Melbourne, and Adelaide. Branch lines exist to Killarney, Allora, and Pittsworth. The Western line passing through Darling Downs has been extended from 415 miles, or 97 miles west of Roma, through the rich pastoral country of the Warrego to Cunnamulla (604 miles), and about 64 miles distant from the New South Wales boundary. Besides branch lines completed to Dugandan, Esk, and Crow's Nest, a line has been built from Brisbane to Southport, 50 miles, with branches to Beaudesert and Nerang, as well as a line to Cleveland. The North Coast line has been built connecting Brisbane with the Gympie-Maryborough Railway, and continuing on to Bundaberg and Gladstone, 328 miles, whence it will shortly be extended to Rockhampton. At present a steamer conveys mails and passengers for Rockhampton and the west from Gladstone to Broadmount, through the smooth water of the Narrows, thence by rail to Rockhampton. Branches exist on the North Coast line to Enoggera, Penkeuba, Sandgate (on Moreton Bay), Kilkivan, Degilbo, Cordalba, Pialba, and Mount Perry. The Central line, which in 1885 extended from Rockhampton to the Alice river, now reaches Longreach on the Thomson river, 427 miles, and in addition to the Clermont branch, other branch lines have been built to Springsure, Emu Park, Broadmount, and Mount Morgan. Passing north, a railway line has been built from Mackay, 23 miles, through the sugar country. The Northern line commencing at Townsville has been extended from Torrens Creek, through Hughendon to Winton, 367 miles, and has a branch to Ravenswood. The respective termini of the Central and Northern lines are now about 110 miles apart, and give railway communication to a vast extent of magnificent open downs of the richest soil, and comprising some of the finest sheep country in Queensland. Since 1885 lines have also been constructed from Bowen to Wangaratta, 48 miles, from Cairns, past the celebrated Barron Falls to Mareeba, from Cooktown, an additional 36 miles, towards the Palmer goldfields, and from Normanton to Croydon goldfield. In addition to the 2801 miles of Government railways open to traffic, the Clullagoe Railway, starting at Mareeba, and several steam tram lines have been built by private enterprise, whilst others are under construction, and proposals have been made for several additional lines. In 1899–1900 the railway earnings amounted to £1,464,399, and the working expenses to £948,691, the net balance being equal to 2·67 per cent. on the invested capital.

Administration.—At the head of affairs is the governor, who is appointed by the Crown. In the conduct of his office he acts through and with an executive council. Parliament consists of two Houses—the Legislative Council of forty-one members (though the number is not fixed), nominated by the governor for life, and the Legislative Assembly of seventy-two members, elected by ballot on practically manhood suffrage from sixty-one electoral districts. Their period of office is three years, and they receive a fee of £300 a year, besides travelling expenses. In these Houses is vested the power of making laws and imposing taxes. For purposes of local self-government the state is divided into thirty municipalities, six shire councils, 117 divisional boards, and 100 petty sessions or police districts. The boroughs and shires control 430 square miles, and in 1900 their revenue was £369,322 and their expenditure £391,578. The divisional board controls 667,823 square miles, and in 1900 their receipts amounted to £271,301, and their outlay to £261,609. Revenue is mainly derived from rates levied on the capital value of assessed properties, which amounted for the state to £41,500,000, representing an annual value of £2,770,000. All improvements are exempt from assessment, and much of the revenue is expended in road-making and the building of bridges. Rates are supplemented by an endowment from the central Government.

Finance.—Revenue is made up to the 30th June each year. In 1900 it was £4,588,207 (in 1884=£2,566,358), being customs £1,461,690 (£866,475), excise £148,423 (£34,442), land sales, &c., £202,281 (£365,536), pastoral rents £323,622 (£254,424), railways £1,422,852 (£582,642), post and telegraph £309,470 (£155,996). The expenditure was £4,540,418 (£2,511,651). In the settled districts pastoralists had so far been replaced by the agriculturists that there were only eleven runs containing 506⅜ square miles under lease, the rent being £737 12s. 2d., against 304 runs, containing 11,162 square miles, paying £21,419 rent in 1883. In the unsettled districts the number of runs had fallen to 2261, containing 351,359 square miles, but paying £290,308 4s. 11d. rent, against 8939 runs, containing 475,601 square miles, paying £216,638 in 1883. Grazing farms numbered 1904, containing 20,375 square miles, paying £83,754 12s. 10d. annual rent, whilst the settled and unsettled portions of runs held under occupation licence numbered 1534, with an area of 54,530¼ square miles, paying £32,292 7s. 3d. annual rent. The absolute public debt in 1900 was £35,898,414 (1884=£16,419,850). Of that amount the indebtedness for railways was over 20 millions (1884=9¼ millions), for immigration 2½ millions (1884=2 millions), and for harbours 2 millions (1884=1 million).

Education.—Public education is free, unsectarian, and compulsory. State or provisional schools are formed wherever an average attendance of twelve children can be got. Theoretically the school age is from six to twelve years, but in practice compulsory attendance is seldom if ever enforced in certain parts, owing mainly to the difficulty of providing suitable schools within reasonable access. In 1900 there were 932 schools in the state, 2217 teachers, and 108,070 scholars. Of private schools the number in 1900 was 173, with 664 teachers and 14,653 pupils. Exclusive of coloured aliens, almost the whole adult population can read and write. In 1900 the sum spent on education was £289,509 13s. 2d. In primary schools the annual cost per scholar, calculated on the net enrolment, was £2 14s. 4¼d. Masters and mistresses of state schools are paid by the Government according to their educational status, the number of children, and the proficiency of instruction. Ten grammar schools are endowed by the state. By a system of competitive scholarships the Government gives free education in grammar schools to scholars in state schools, and also three-yearly exhibitions to universities to students who pass an examination of a high standard. State aid is also rendered to schools of art, schools of design, free libraries, and technical schools. The foundation of a university at Brisbane is now contemplated.

Religion.—There is no state church. Amongst the different denominations the Church of England at the date of the last census numbered 36·21 per cent. of the population, the Roman Catholics 23·56, the Presbyterians 11·59, the Methodists 7·93, the Lutherans 4·43, the Baptists 2·60, the Jews 0·21, and other Christian bodies 13·31. Pagans and Mahommedans 4·43.

Justice.—The law courts comprise a supreme court, with a chief justice and four puisne judges, district courts, and petty sessions courts. In 1899 the number of persons convicted of serious offences was 252, and petty sessions convictions amounted to 18,534. The state police force, including native troopers, exceeds 900 men, and the number of prisons is eighteen.

Defence.—The land force of 6535 men (of whom 321 were fully paid regulars, 4131 militia paid for each day's drill, and 2083 volunteers) costs the state £70,000 a year. Naval defence is provided for by three armed tenders, two gunboats, five naval brigades, and a picket boat. Thursday Island in the Torres Strait has been strongly fortified at the cost of all the states, and is maintained at their expense, the Imperial Government contributing the armament. Queensland's share of the annual charge for the support of the imperial auxiliary squadron in Australian waters came to £14,031 in 1899.

Post and Telegraphs.—Postal communication is well developed. Every vessel is obliged to give notice of intended departure, in order that mails may be shipped. Mail matter is forwarded coastwise by all suitable steamers, whether subsidized or not, and carried on all railways, travelling post offices existing on the main lines to expedite delivery. Coaches carrying mails and passengers connect with all terminal and many other stations, whilst horse mails run wherever the mails to be carried do not warrant coaches. In this manner nearly all pastoral stations are on or near a mail route of one or other kind, whilst the amount of mail matter carried is very great, and continually increasing. In 1898 there were 19,723,905 letters (1885=9,776,407) and 16,778,555 newspapers and packets carried (1885 = 9,949,650) by mail. The number of post offices is 1166, against 623 for 1885. The revenue of the postal department, exclusive of telegraph and telephone, for 1898 was £182,206 (1885=£97,651), whilst the expenses, including telegraph and telephone, amounted to £313,771. Postal notes are largely used, the number of notes issued and paid for 1898 being 481,069, having a value of £183,360. The number of money orders issued and paid was 217,910 (1885=137,479), valued at £835,981 (1885=£514,593). Counting all routes once only, the land distance over which mails are carried is stated to be 32,127 miles. A parcel post was established by the post office in 1892, and has grown to considerable proportions, carrying 238,240 parcels in 1898. Branches of the Government savings bank are opened at each staff post office, besides other places, there being 147 branches now open. Telegraph offices exist in every town, and there are offices in the bush. In most towns they are combined with the post offices. There are 422 offices open (1885=259), there being now 10,088 miles of line open (1885=7533), and 18,565 miles of wire (1885=12,290). The total cost of construction of telegraph lines is £912,175, the revenue for 1898 being £79,831. the number of messages despatched and received being 1,334,846. Telephones are now very largely used in all the principal towns, there being 1516 subscribers. Receipts from telephones amounted to £8896 in 1898. There are eight exchanges, and 1334 miles of wire.

Banks.—Eleven banks have been established. In 1900 treasury notes issued through the banks amounted to £388,833, deposits to £13,653 775, total liabilities to £14,190,560, coin and bullion to

£1,879,326; advances to £12,599,306, total assets to £16,257,443. There were 84,796 depositors in the Government savings bank, with £3,624,740 to their credit.

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II. History.

Queensland was separated from New South Wales by an Order in Council of 13th May 1859. The constitution, which was based upon the New South Wales Act of 1853, provided for 16 electoral districts, with a representation of 26 members. A Legislative Council was also formed, to which the governor of New South Wales, Sir William Denison, appointed 5 members, to hold office for four years, and Sir George Ferguson Bowen, the first governor of the new colony, 8 life members. Mr Robert George Wyndham Herbert was the first premier and colonial secretary, and held office until 1866. Amongst Mr Herbert's colleagues were Mr (afterwards Sir) Maurice Charles O'Connell, president of the Legislative Council and afterwards lieutenant-governor, a representative of the pastoralist interest and a commanding personality; Mr St George Richard Gore; Mr Arthur Macalister; Mr Robert Ramsay Mackenzie, a squatter, and leader of the Brisbane party in the House; the late Mr (afterwards Sir) Charles Lilley, who established free education in 1870; Mr (afterwards Sir John) Bramston; Mr Joshua Peter Bell, treasurer, a prominent squatter and a man of sterling character; Mr T. L. Murray Prior, the father of Mrs Campbell Praed, the novelist; and Mr George Raff, who represented Brisbane trade, and was long an important figure in the financial and commercial life of the colony. There were thirteen appointments in the first administration, and Mr Herbert alone held office uninterruptedly. Of the 39 representatives in the first Parliament, 20 were pastoralists; the others may be roughly classed as barristers, solicitors, and merchants. The pastoralists were the pioneers of settlement in the colony; those best known were the Archers of Gracemere, the Bells of Jimboor, the Gores of Yandilla, the Bigges of Mount Brisbane, Mr (afterwards Sir) Arthur Hodgson, Mr Robert Ramsay, Mr Gordon Sandeman, and Messrs Kent and Wienholt. The white population at the end of 1859 was 25,788, and the exports were valued at £500,000.

Mr Herbert's Administration, 1859–1866.—The first Parliament was opened on 29th May 1860. The providing of revenue and the establishment of immigration were the chief matters for consideration. The treasury was practically empty, but Sir Saul Samuel, treasurer of New South Wales, took a broad and generous view of the situation, and rendered financial aid, whilst in 1861 the first Government loan of £123,800 was authorized, the money being appropriated to public works and European immigration. Labour was so scarce that as early as 1851 the squatters had imported Chinese; various schemes for the introduction of coolies on a large scale were now mooted, but public opinion was decidedly against any increase in the number of coloured aliens then in the colony. Other matters requiring the attention of Parliament were the encouragement of settlement throughout the colony's gigantic territory, the discovery and exploitation of her natural resources, the establishment of connexions with the outside world, the construction of railways and telegraphs, education, State aid to new industries, and exploration of the unknown country in the north and west. In 1859 the educational system was a mixed national and denominational one; there were 10 schools of the latter class, 1 of the former, and 30 private schools. In 1860 a Board of General Education was established, which extinguished the denominational system and placed the schools under State control. In the same year State aid to religion was abolished. At this time there were 18 places of worship existing, and 3523 persons were returned as attending divine service. The governor, in opening Parliament in 1863, pronounced decisively against the reintroduction of convicts. In that year Queensland boldly grappled with the extension of colonizing, and a settlement was established at the northerly point of Cape York peninsula by Mr Jardine. During the following two years ports were opened along the coast, and pastoral occupation spread far into the northern and western interiors. The first sod of the first railway, from Ipswich to the Darling Downs, was turned on 15th February 1864. On 1st February 1866 Mr Herbert retired, and Mr Macalister became premier and Mr Mackenzie colonial secretary. In the following July the failure of the Overend and Gurney and Agra banks, in the latter of which the Government had public moneys, caused the collapse of a loan which was being negotiated in London. A panic followed: the Government could not pay the railway contractors, and the navvies employed by them started for Brisbane, threatening to hang the ministers and loot the town. On arrival, however, they were easily headed off to a reserve. By this time the treasury was empty, general insolvency prevailed, and the community appeared to be wrecked. Treasury bills to the amount of £300,000 were issued, and the governor in council was authorized to legalize Treasury notes, when necessary, as currency, payable in gold on demand, to tide over the crisis. Prior to this, however, the treasurer took preliminary steps to issue £300,000 "Legal Tender Notes"—inconvertible "greenbacks"—but Sir George Bowen informed the premier that he should veto such a scheme, and suggested the issue of Treasury bills. Mr Macalister thereupon resigned, and Mr Herbert, who had made arrangements to proceed to England (where subsequently he became permanent secretary of the Colonial Office), took office again to help the colony through the difficulty. His second ministry lasted for eighteen days, and, having passed the Treasury Bills Act, he retired from the public life of Queensland. The only determined opposition the Herbert ministry met with was from the townspeople's representatives, whose contention was that the squatters dipped too deeply into the public purse for public works expenditure; but an important factor in the early parliamentary days was the opposition between the Brisbane and Ipswich parties in the House, the latter town aspiring to be the capital of the colony.

The Discovery of the Goldfields, 1866–1879.—Mr Macalister returned to power in August 1866, and dealt so vigorously with the after-effects of the financial crisis that by the end of 1867 affairs had approached their normal condition. A new era was now opened for Queensland by the discovery of gold. The Gympie field was discovered by Nash in 1867, and a big "rush" resulted. In 1872 Mr Hugh Mosman discovered Charters Towers, the premier goldfield of the colony; and Hann, the rich Palmer diggings. Other important discoveries were also made, and Queensland has ever since been a gold-producing colony. Mining is the foundation upon which much of the progress of the colony has been built, and the legislation and records show continuous traces of the influence of the gold-getter. In 1873 Mr John Murtagh Macrossan, a digger, was returned to Parliament expressly as a mining representative; and other men of a different stamp from the representatives of the squatters and townspeople, who had hitherto composed the House, now began to enter public life. From 1870 to 1879 progress was satisfactory, trade interests were prosperous, and in this decade the foundations of the public and social structure of Queensland were laid. Agriculture was extended, and sugar growing took the place of cotton cultivation. (The first crop of sugar was grown by the Hon. Louis Hope at Cleveland, about 1862.) Hitherto politics had been non-partisan, and legislation was chiefly of a domestic character. From the time of Mr Herbert's departure until the appearance of Mr Thomas McIlwraith and Mr Samuel Walker Griffith, the two master spirits of Queensland parliamentary life, the political history of the colony was composed of shortlived administrations, with Messrs Macalister, Mackenzie, Palmer, Lilley, George Thorn, and John Douglas (afterwards Government Resident at Thursday Island) as premiers. Mr Arthur Hunter Palmer (whose administration, from 1870 to 1874, had the longest life), a New South Wales squatter, entered the Queensland Parliament in 1866. He was one of the most popular of Queensland's parliamentary leaders, and has left the impress of his labours on the public works, and educational and defence force systems of the colony. In 1870 Queensland was disappointed in her ambition of becoming the connecting point for Australia with the European and Eastern cable systems. A company—the British Australian Telegraph Company—was formed in London to connect Australia by cable with Singapore. The plan provided for a land line from the Queensland telegraphs at Burketown to Port Darwin, in the Northern Territory of South Australia, where the cable was to be landed. Writing on 25th January 1870, the Telegraph Construction and Maintenance Company officially informed the governor of Queensland that it had received a contract from the British Australian Telegraph Company to construct "cables and land lines, to be laid between Singapore and Burketown, in North Australia." The Construction Company deputed Commander Noel Osborn to negotiate with the Governments of South Australia and Queensland in reference to the land line; but on arrival in Adelaide he accepted the offer of the South Australian Government to construct and maintain a telegraph line right across the continent from Port Darwin to Adelaide, and Queensland was informed that the original plan had been abandoned. Although the company was thus saved the expense of making and maintaining the Port Darwin–Burketown line, it was regarded as having broken faith with Queensland, which had specially pushed on her telegraph system to connect with the proposed line. Owing to this feeling Queenslanders have not always had the facilities for cheap cabling to Europe enjoyed by the other colonies, though the subsequent owners of the cable, the Eastern Companies, were in no way responsible for the act of their predecessors.

A resolution in favour of the payment of members was carried in 1871. In 1872 the first Agent-General in London, Mr Richard Daintree, was appointed. The same year the Railways Act Amendment Act was passed, authorizing the construction of railways by private enterprise, land being offered as compensation for the outlay. Electoral representation was increased to 42 members. In January

1874 Mr Palmer resigned, and Mr Macalister came into power for two years, the most important measure of his Government being the State Education Act of 1875, on which the present educational system is based. Both Messrs McIlwraith and Griffith were members of the Macalister ministry, but the former resigned in October 1874, owing to a difference of opinion as to a proposed land-grant railway from Dalby to Normanton. In 1878 Mr (afterwards Sir) James Francis Garrick first became a cabinet minister, joining the Douglas ministry as secretary for public works and mines.

The governors of Queensland from separation to 1901 were:—Sir George Bowen (d. 1899) [1859–68]; Colonel Samuel Wensley Blackall (d. 1871) [1868–71]; the Marquis of Normanby (d. 1890) [1871–74]; Mr (afterwards Sir) William Wellington Cairns (d. 1888) [1875–77]; Sir Arthur Kennedy (d. 1883) [1877–83]; Sir Anthony Musgrave (d. 1888) [1883–88]; Sir Henry Wylie Norman [1889–95]; Lord Lamington [1896–1900]; Sir Herbert Charles Chermside [appointed 1901].

Active Politics, 1879 to 1890.—On 21st January 1879 the first McIlwraith administration came into power, and an important extension of local government was one of the early measures passed, divisional boards being formed to take charge of public works in districts not included in municipalities. In the following session, 1880, the Opposition, led by Mr Griffith, bitterly opposed the Government proposals on Kanaka labour, land-grant railways, and a European mail service *viâ* Torres Straits. The Government, however, concluded an agreement with the British India Steam Navigation Company for a monthly mail service between Brisbane and London for an annual subsidy of £55,000. The Railway Companies Preliminary Act, giving the governor in council power to treat with persons willing to construct railways in return for grants of 8000 acres of land for each mile of rails laid, was also passed. This measure was generally unpopular, and no railways were built under its provisions. During the session Mr Griffith impeached the premier in connexion with contracts for the purchase of 15,000 tons of steel railway metals, and their carriage to the colony, made in London whilst Mr McIlwraith was there in January 1880. A select committee in the colony, and afterwards a Royal Commission in London, subsequently reported in the premier's favour. The discovery of the celebrated Mount Morgan gold mine, and the initiation of artesian well-boring by Mr R. L. Jack, Government geologist, took place in 1881. In 1883 a great drought prevailed, and the compulsory stoppage of public works demoralized the labour market. Early in the year information reached the colony that Germany proposed to annex a portion of New Guinea, which, together with other islands in the Papuan Gulf, was becoming of great strategic value to Australia; and the premier, fearing that it would thus be lost to the empire, instructed Mr H. M. Chester, police magistrate at Thursday Island, to proceed to Port Moresby and take possession of the unappropriated portion of the island in the name of the Crown. This act was afterwards—to the indignation of Australia—repudiated by Lord Derby; and, eventually, under the Berlin Treaty of 1886, England and Germany entered into joint possession of that part of New Guinea lying east of 141° E. In July Sir Thomas McIlwraith (created K.C.M.G. in 1882) was defeated by 27 votes to 16 on a proposal to arrange for the construction of a land-grant railway from Charleville to the Gulf of Carpentaria. The general elections which followed were fought mainly on the questions of coloured labour for the sugar plantations and land-grant railways. The Government was defeated, and Mr Griffith formed his first administration. Later in the year the premier drafted the Federal Council Act at Sydney, and through his efforts Queensland eventually joined the Federal Council of Australasia. In 1884 a 10 million Loan Act was passed, intended to secure continuity in borrowing for railway construction, but many of the lines specified were unsurveyed. According to the view now generally held in Queensland, this loan seriously hampered the colony in after years. In 1887 the number of seats in the Assembly was increased to 72 (the present number), and several reforms were effected in the public service, notably the establishment of the department of agriculture. At the general elections in 1888 Sir Thomas McIlwraith was returned for North Brisbane, defeating Sir Samuel Griffith (who had been created K.C.M.G. in 1886) by a large majority, and resumed office as premier and leader of the "National Party." Ill-health, however, soon compelled him to leave the colony, and he was succeeded by Mr Boyd Dunlop Morehead. Sir Thomas McIlwraith's inflexible nature was evidenced all through his public life. On the death of Sir Anthony Musgrave in Brisbane in 1888, he maintained that the Government should be consulted as to the appointment of the new governor. Lord Knutsford declined to accept this view, and appointed Sir Henry Blake. The premier formally protested, and a deadlock ensued, which was only removed by the resignation of the governor-designate. In 1889 payment of members at the rate of £300 a year, plus 1s. 6d. per mile travelling expenses, was established. In 1890 a financial crisis arose. Sir Thomas McIlwraith had returned to the colony and dissociated himself from the ministry. He conferred on the situation with Sir Samuel Griffith, and a want-of-confidence motion was nearly carried. Mr Morehead resigned, and a coalition ministry, with Sir Samuel Griffith as premier, chief secretary, and attorney-general, and Sir Thomas McIlwraith as treasurer, was formed. An agitation for the separation of Queensland into two or three separate colonies—mentioned as early as 1866—was very marked during this period. It took formidable shape at Townsville in 1882, the chief argument in its favour being that the north and central districts did not get a fair share of the public expenditure. Delegates were sent to London on several occasions to interview the Colonial Secretary, but success did not attend these direct appeals. Sir Samuel Griffith's Decentralization Bill of 1890, which proposed to erect separate legislatures in the three divisions with powers of local government, was a blow to separationists, and the agitation gradually disappeared.

The Labour Party in Politics, 1890 to 1900.—The decade from 1890 to 1900 was chiefly notable, apart from the accomplishment of Federation, for the rise of the Labour party as a power in politics and the gradual disappearance of the squatter as a dominant factor. In 1890 the old opponents, Sir Samuel Griffith and Sir Thomas McIlwraith, were still working side by side. The revenue for the year fell short of the estimates by half a million sterling, and a heavy accumulated deficit had to be grappled with by Parliament. Sir Thomas McIlwraith, the treasurer, proposed a dividend tax and other imposts, which were agreed to, and a Treasury Bills Act authorizing an issue of £500,000 was also passed. A Constitution Act establishing triennial Parliaments, in place of quinquennial, which had hitherto existed, also went through. In August the great maritime strike spread to Brisbane, and crippled trade and commerce for several months. In 1891 a loan for £2,500,000, which was issued in London under the auspices of the Bank of England, failed. Sir Thomas McIlwraith reflected strongly in Parliament on the conduct of the Bank of England, and the governor of the Bank wrote to Sir James Garrick, the agent-general, protesting against Sir Thomas McIlwraith's statements, and breaking off relations with the colony; but mutual explanations afterwards healed the breach.

Litigation was initiated by the London board of the Queensland Investment and Land Mortgage Company against the Queensland directors, on the ground that they had made advances without taking adequate security. The case was tried by the chief justice, Sir Charles Lilley, in 1891 and 1892, the defendants being Sir Thomas McIlwraith, Sir Arthur Palmer, then president of the Legislative Council, and Messrs F. H. Hart and E. R. Drury. The judge submitted 143 questions to the jury, and though these were answered generally in favour of the defendants, judgment was entered largely for the plaintiffs. On appeal, heard before a specially constituted court, presided over by the late Sir William Windeyer of New South Wales, this judgment was reversed, with costs. Lack of employment and a disastrous strike of bush workers paralysed the colony in this year. The strike began in January at Logan Downs station, where 200 shearers refused to sign the Pastoralists' Convention agreement. This strike was remarkable for the determined and aggressive attitude of the men, and the firm, though conciliatory, manner in which it was handled by Mr (afterwards Sir) Horace Tozer, the colonial secretary, who had to provide military forces and artillery to hold the strikers in check. The trouble lasted many months; and after it was over a farcically planned plot to seize the central district and proclaim a republic was revealed in the *Brisbane Courier*. As an outcome of this strike, "New Australia"—a settlement on communistic lines—was founded in Paraguay. About 500 bush workers, largely recruited from Queensland, joined the scheme, and sailed from Sydney in the barque *Royal Tar* in 1893, under the leadership of William Lane. The experiment failed disastrously, and in later years the Queensland Government paid the passages of many of the men back to the colony. The year 1892 was one of gloom and depression: want of money interfered with public works, and the impending stoppage of Kanaka labour and the low price of sugar almost ruined the planters. Sir Samuel Griffith then announced his conversion to the policy of continuing Kanaka labour for the sugar plantations, and also of land-grant railways. An Act was passed authorizing agreements with companies for the extension of the trunk lines on this principle; but the measure was unpopular, and no transactions under the Act are recorded. Financial depression reached its height in 1893: the salaries of ministers and civil servants were reduced, and drastic retrenchments were made in every department. In February 107 inches of rain fell at the head of the Brisbane river, and enormous losses were caused by the resulting floods; several vessels, including the Queensland Government gunboat *Paluma*, were washed into the Brisbane Botanic Gardens, and left high and dry when the waters subsided. A second flood followed hard on the heels of the first and caused further losses. Rockhampton, Bowen, Townsville, and other places also suffered severely from floods. On 13th March Sir Samuel Griffith was

gazetted chief justice, and on the 27th Mr (afterwards Sir) Hugh M. Nelson became premier and treasurer, and Sir Thomas McIlwraith chief secretary and secretary for railways. Parliament was dissolved on 3rd April, and after the general elections the ministry returned with 38 supporters, against Labour, 16, and Opposition and Independent, 18. During the month several financial institutions suspended payment, and on 15th May the Queensland National Bank closed its doors. Parliament was hurriedly summoned to deal with the financial crisis and the question of the Government funds held by the Queensland National Bank. Treasury notes, issued against coin held by the treasurer, were made legal tender throughout the colony; an issue of £1,000,000 Treasury bills to retire the Treasury notes was authorized, and a series of Acts dealing with the suspended banks were passed. To assist the unemployed, labour and co-operative communities were started, but proved failures. An impetus was given to the sugar industry by the Sugar Works Guarantee Act, which authorized the treasurer to guarantee debentures issued by companies for the erection of sugar mills and plant. In 1894 little legislation was achieved, the policy of the Government being directed towards national rehabilitation. In 1895 Sir Thomas McIlwraith left the colony for London, where he died on 17th July 1900. Sir James Garrick, agent-general, retired in 1895, and Mr Charles Shortt Dicken, who had acted as secretary to the agency since 1880, was gazetted acting agent-general, and held the position until the appointment of Sir Henry Norman as agent-general in November 1896. Mr Dicken was also acting agent-general during the interregnum which existed between the resignation of Sir Henry Norman and the appointment of Sir Horace Tozer in 1898. At the general election of 1896 the Labour party slightly improved its position. In that year a committee of investigation reported a heavy deficit in the affairs of the Queensland National Bank, and made certain recommendations. In 1897 the bank was reconstructed a second time upon terms very favourable to the institution. An Act was passed granting powers to a company to construct a railway from the rich mining district of Chillagoe to the terminus of the Cairns railway at Mareeba; at the end of fifty years the State will have the right to acquire the line. In April 1898 the Queensland-born statesman, Mr T. J. Byrnes, whose early death in the following September was lamented throughout Australia, succeeded Sir Hugh Nelson as premier. The late Mr (afterwards Sir) J. R. Dickson, Mr Robert Philp, and the late Mr J. Vincent Chataway, the latter an authority on the sugar industry, were members of this administration. On 24th October the trial of the three ex-directors of the Queensland National Bank, Messrs F. H. Hart, B. D. Morehead, and A. B. Webster, was commenced. The prosecution was instituted by the Government, on the advice of three barristers to whom the report of the committee of investigation into the affairs of the bank, which sat in 1897, was submitted. After a trial lasting 12 days, a verdict of "Not guilty" was returned. Proposals for the acquisition of 250,000 acres of land in New Guinea, made by a syndicate of London capitalists, were provisionally agreed to, but were eventually rejected, owing to a popular outcry raised in the colony and in New South Wales and Victoria.

Federation was a burning question in the neighbouring colonies during the year, but Queenslanders generally took little interest in the movement, and the colony was not represented at the Federal Convention at Melbourne when the Commonwealth Bill was passed. In 1899 Mr Dickson, who had succeeded Mr Byrnes as premier, was enlisted on the side of the "Billites," and in June of that year an Enabling Bill was passed. In September the Referendum supported the Act by the narrow majority of 7492 votes on a poll of 69,484. Towards the end of the second session the ministry narrowly escaped defeat on the Railway Standing Committees Bill, and resigned. Mr Dawson, leader of the Labour Opposition, then formed a ministry, and held office from 1st December to 7th December 1899. He was then defeated on a motion by Mr R. Philp, and resigned, and Mr Philp became premier, and was in power when Queensland joined the Commonwealth. The year was shadowed by the continuance of a terrible drought, which towards the end of 1900 became so aggravated that the revenue began to fall off, owing to decreased receipts from railways and land. In that year Mr Philp's chief policy was the passing of legislation to permit of the construction of railways by private enterprise. The Labour party offered vigorous opposition; but notwithstanding this a certain amount of progress was made. The Government appointed Dr Maxwell, an American sugar expert, to superintend the sugar industry in the colony; a State school of mines was established at Charters Towers; and the compulsory clauses of the Education Act were put in force for the first time. Another Act of importance was the establishment of a Government land bank. A powerful agitation for the extension or renewal of the leases of pastoral lands was raised, but no legislation resulted. A suggestion that Sir Samuel Griffith should retire from the chief justiceship, on a pension of £1750 a year (to be reduced by any emoluments received), to enable him to enter Federal politics, fell through. Some important discoveries of coal were made during the year, and dredging the northern rivers for gold became an established industry. Mr J. R. Dickson represented the colony in London at the conference of Federal delegates in 1900, when the final details of the Commonwealth were settled. Early in 1901 he was created K.C.M.G., but died somewhat suddenly, at Sydney, on 9th January of that year, shortly after he had been made a member of the first Federal ministry.

Alien Immigration.—The geographical position of Queensland, with almost half her territory lying within the tropics, has been fruitful in public questions bearing upon the immigration of Asiatics and South Sea Islanders. The lands lying along the northern coast are well suited for the cultivation of sugar, coffee, and other tropical produce, to grow which, profitably, cheap labour is required. The working classes of Queensland have always objected to the presence of coloured aliens, and successive Governments have legislated against indiscriminate immigration into the colony. In 1876 Governor Cairns reserved an Act imposing certain disabilities upon Chinese working on gold-fields. In that year a poll tax of £10 was imposed upon Chinese arriving. In 1884 another principle was adopted: masters of ships were only allowed to carry to Queensland ports one Chinese for every 50 registered tons, and the poll tax was increased to £30. In 1888 Queensland took the lead in summoning an intercolonial conference on Chinese immigration, the outcome of which was the adoption of uniform legislation: in the Queensland Act passed that year the main provision was that only one Chinese for every 500 registered tons should be permitted to be carried to the colony from Chinese ports. The poll tax was then abolished. This Act was also reserved, but received the Royal Assent on 5th February 1890, after slight modification had been made.

Treaty arrangements with Japan had been carried through by the Imperial Government, at the initiation of Queensland, under which the Japanese Government undertook to prevent the emigration of coolies to the colony; and a Pearl Shell Fisheries Act was passed in 1895 placing restrictions upon the acquisition of vested interests in the industry by Japanese and other aliens. At Federation eight Acts—two Imperial and six local—regulated the importation of Kanakas from the South Seas: that of 1880 was the basis of the system under which Kanakas were recruited in the islands, brought to the colony in schooners, employed there, and returned to their homes at the end of their three years' engagements. The 1884 Act confined Kanakas to field work. In December 1884 a Royal Commission was appointed, consisting of Messrs W. Kinnaird Rose, J. F. Buckland, and Hugh M. Milman, to report upon the system of recruiting Kanakas. Following the report of the Commission, which was in effect that many islanders had been recruited "by force and fraud," Sir Samuel Griffith, then premier, introduced the important Pacific Island Labourers Amendment Act of 1885, which stopped the importation of Kanakas after 1890. It was—and is—an article of faith with the working classes that white labour could be utilized for sugar cultivation. Yet from the passing of the Act the sugar industry began to decay, no fresh capital was put into it, plantations dwindled down in value 50 to 75 per cent., mills were closed, and the magnificent industry threatened to die out. Sir Samuel Griffith, being converted by these signs of the times from his position that sugar could flourish in the colony without coloured labour, issued on 12th February 1892 his "Manifesto to the People of Queensland," in which he acknowledged that to prevent the collapse of sugar-growing it was necessary to resume the immigration of Polynesians. This manifesto was the forerunner of the 1892 Act, which reintroduced Kanaka labour. After 1892 no further legislation on this subject was passed, and the recruiting of South Sea Islanders took place on a reduced scale. The Kanakas in the colony in 1900 numbered 8795, and the Chinese 10,000; the whole of the coloured aliens represented only between 4 and 5 per cent. of the population.

Land Legislation.—In Queensland's early days, with the predominance of the squatting class, the lands were freely leased in large blocks for sheep and cattle grazing. It was the squatter who furnished 50 per cent. of the public revenue with his rents, and who opened up the great interior by his pioneering enterprise. As, however, population increased, the necessity for the agriculturist arose, and it became requisite to legislate in the interests of the small holder. Successive Queensland Governments have had some of their hardest work in adapting their land legislation to the needs of the community, recent policy being to reduce large estates and place the cultivator on the soil. At separation from New South Wales the holding of land was regulated by Orders in Council, under an Imperial Act of 1846: untransferable leases of "runs" for fourteen years were issued, the minimum size of the run was measured in sheep-carrying capacity—4000 sheep being the least number, and £10 the minimum rent. The lessee was able to buy up his holding in blocks of 160 acres at a time, £1 per acre being

the minimum price, and was entitled to a renewal of his lease at its expiry. The minimum lease principle shut out the small agriculturist. The first leading Acts passed by Queensland were the Crown Lands Alienation Act of 1868, dealing with the settled districts, and the Pastoral Leases Act of 1869, dealing with the unsettled districts—these divisions were fixed by the first-named measure. The "resumption" principle was introduced by the 1868 Act: lands in the settled districts were resumed after twelve months from the passing of the measure, and lessees were granted leases of half of their holdings for ten years; the other moiety was thrown open for settlement. The 1869 Act granted new leases for twenty-one years at practically the same low rentals, but 10 per cent. was added to the rent after each period of seven years; the area of a run was fixed at from 25 to 100 square miles. This Act greatly pleased the squatters. In 1884 the Dutton Act was passed. Its importance lies in its dealings with the 1869 Act leases: on their expiry the State resumed from one-quarter to one-half of the area as Crown lands, which were thrown open to selectors, and new leases from ten to fifteen years were granted for the balance. Grazing farms (20,000 acres) and agricultural farms (1280 acres) were established. This measure was very unpopular with the squatters. With the Act of 1897 it forms the basis of the existing land regulations of Queensland. Under the 1897 Act the passing of the land into the hands of agriculturists was further marked by the creation of agricultural homesteads (160, 320, or 640 acres), grazing homesteads (20,000 acres), scrub selections (10,000 acres), and unconditional selections (1280 acres). Some of these classes of selections could be purchased right out, and all were leased at extremely moderate rates. Sales of country lands were established. Two measures were passed, in 1894 and 1897—the Agricultural Lands Purchases Acts—under which the State was authorized to purchase suitable estates of specially fertile land already alienated, to be cut up and thrown open as agricultural farms. These measures confirmed Queensland's determination to encourage agriculture. Owing to the expiration of pastoral leases and the fact that no legislation existed for their renewal for a term long enough to encourage the investment of capital, a formidable agitation prevailed in the colony, the lessees bitterly complaining of the uncertainty of their tenure. The British Australasian Society was formed in Great Britain, to protect the interests of British capital invested in the pastoral industry in Queensland. In 1900, out of the total Queensland area of 427,838,080 acres, no less than 411,793,786 acres remained in the hands of the State unalienated. (J. T. CR.)

Queenstown, a seaport, urban sanitary district, and important naval station, in the county of Cork, Ireland, on the south side of the Great Island in Cork harbour, 13 miles east-south-east of Cork by rail. Of late years the local authorities have expended large sums of money in widening the streets, providing public baths, and improving the water supply. The harbour contains three islands—Spike, the Rocky Island, and Haulbowline, where extensive docks have been erected by the Government. Population, about 9000.

Queenstown, a town of Cape Colony, in the upper valley of the Great Kei river, about midway between East London and Aliwal North, with both of which places it is connected by rail. It is well situated in the abundantly watered and fertile district between the Great Winterberg and Stormberg ranges, which was formerly inhabited by the Tambuki branch of the Ama-Xosa Kaffres. Queenstown is a prosperous agricultural centre, with a population which rose from about 2500 in 1887 to over 3000 in 1900.

Quelimane, Kilimane, or São Martinho de Quelimane, a town of Portuguese East Africa, capital of the district of Zambezia, 14 miles above the mouth of the river Bons Signaes, with anchorage in the stream in over 30 feet of water. It has a trade in copra, almonds, sesamum, indiarubber, coffee, wax, ivory, and skins, and produces rice, millet, and beans. The trade aggregates barely £200,000 per annum. Soap and oil are manufactured here. Population, 3000.

Quelpart (Chai-ju), an island used by Korea as a penal settlement, situated in 126° 10′ to 126° 57′ E., and 33° 11′ to 33° 35′ N. It is 40 miles from east to west and 17 from north to south. It rises gradually from the sea-board, is heavily wooded, and is cleared for cultivation to a height of 2000 feet. There are several crateriform hills, and Hali San (Mount Auckland) has an altitude of 6558 feet. The island is entirely volcanic, and the soil is finely disintegrated lava. Broken black lava forms the beach, and blocks of it are the universal building material. There is no good drinking water. There are no good harbours, and the only anchorage for large vessels is Tai-chong, or Yung-su, at the east end, with from 9 to 13 fathoms of water.

Population and Industries.—The officially estimated population is 100,000, Korean by race, language, and costume. There are 3 magistracies and 90 villages. The valleys and slopes are carefully cultivated in fields divided by stone walls, and produce beans, peas, sweet potatoes, "Russian turnip radish," barley, a little rice, and millet, the last being the staple article of diet. Nuts, oranges, limes, and plums are grown. Small but strong ponies are bred for export, and small cattle and pigs for home use. Apart from agriculture, the industries consist in the manufacture of fine bamboo hats and mats, and wooden combs for export and local use. For fishing the islanders use double-decked raft boats, similar to those of southern Formosa. Their lucrative pearl fisheries have been practically monopolized by the Japanese, who use proper diving apparatus. A valuable product is a species of clam, the shell of which furnishes a specially iridescent mother-o'-pearl, which the natives barter with the Japanese for inlaying lacquer. European goods are not imported, but Japanese articles find ready barter. There are no markets, and only a very few poor shops.

Capital.—Chu-song, the capital and seat of Government, a few miles from Port Pelto, has a black lava wall 25 feet high, with three gates and towers; an imposing audience-hall in Chinese style; and a great bell tower, with a fine bronze bell, sounded to drive off "evil dragons." Its population is estimated at 16,000. The governor has a hereditary army for coercive purposes. The uniform is a complete suit of mail, with a helmet, from which leather curtains fall over the shoulders. The weapons are equally antique. Pelto has ancient breakwaters for the protection of small boats, erected, many believe, by the Mongol conqueror, Khublai Khan, who in 1273 built on Quelpart 100 ships for the invasion of Japan.

Flora and Fauna.—These are scarcely yet investigated. Pines of three species, junipers, larches, oaks, maples, willows, and the *Thuja Orientalis*, have been identified. The known fauna comprise boars, bears, deer, swans, geese, pheasants, and quail. The roads are scarcely passable bridle tracks. Quelpart was introduced to European notice by the Dutchman, Hendrik Hamil, who was shipwrecked there in 1653. (I. L. B.)

Quental, Anthero de (1842–1891), Portuguese poet, was born on the island of St Michael, in the Azores, 18th April 1842. He studied at the University of Coimbra, and soon distinguished himself by unusual talent, as well as turbulence and eccentricity. He began to write poetry at an early age, chiefly, though not entirely, devoting himself to the sonnet. After the publication of one volume of verse, he entered with great warmth into the revolt of the young men which dethroned Castilho, the chief living poet of the elder generation, from his place as dictator over modern Portuguese literature. He then travelled, engaged on his return in political and socialistic agitations, and found his way through a series of disappointments to the mild pessimism, a kind of Western Buddhism, which animates his latest poetical productions. His melancholy was increased by a hopeless spinal disease, which after several years of retirement from the world, eventually drove him to suicide in his native island,

11th September 1891. Anthero stands unquestionably at the head of modern Portuguese poetry after the unrivalled João de Deus. His principal defect, in a strictly poetical point of view, is monotony—his own self is his solitary theme, and he seldom attempts any other form of composition than the sonnet. On the other hand, few poets who have chiefly devoted themselves to this form have produced so large a proportion of really exquisite work. The comparatively few pieces in which he either forgets his doubts and inward conflicts, or succeeds in giving them an objective form, are among the most beautiful in any literature. The purely introspective sonnets are less attractive, but equally finely wrought, interesting as psychological studies, and impressive from their evident sincerity. His mental attitude is well described by himself as "the effect of Germanism on the unprepared mind of a Southerner." He had learned much, and half-learned more, which he was unable to assimilate, and his mind became a chaos of conflicting ideas, settling down into a condition of gloomy negation, save for the one conviction of the vanity of existence, which ultimately destroyed him. He will live not more by the beauty of his style and diction than by the truth of self-portraiture. As a prose writer he displayed almost equal ability, but the same want of balance and sound judgment. A healthy participation in public affairs might have saved him, but he seemed incapable of entering upon any course that did not lead to delusion and disappointment. The great popularity acquired, notwithstanding, by poetry so metaphysical and egotistic is a striking testimony to the artistic instinct of the Portuguese people. Much of the charm necessarily evaporates in translation, yet Quental has been ably rendered by Mr Edgar Prestage in English and by Dr Storch in German.

(R. G.)

Querétaro-Arteaga, a state of Mexico, bounded on the N. by San Luis Potosí, on the E. and N.E. by Hidalgo, on the S.E. by Mexico, on the S. by Michoacan, and on the W. by Guanajuato. Area, 3558 square miles. Population (1879), 203,250; (1900), 228,489. The trade of the state may be estimated at about $10,000,000 (Mexican currency) a year, and consists principally of cereals, fruits, jerked meat, and mineral products. The Mexican Central Railway traverses the state, and there are numerous tramway lines. The capital, Querétaro, or Distrito del Centro, with a population of 34,576 (1895), is situated some 134 miles from the city of Mexico. Besides its commercial importance, this city is interesting historically as the birthplace of Mexican independence, and the last refuge and place of execution of the emperor Maximilian. It has fine public buildings, among which the Federal Palace and the Government Palace (both built of basalt), the Municipal Palace, the Cathedral, and the historic Iturbide Theatre should be mentioned. An excellent aqueduct, 5 miles long, supplies the city with water. Amongst other important towns are San Juan del Rio (9040 inhabitants), Landa (6324), Ahuacatlan (5929), Jalpán (5131), and Toliman, noted for its opals.

Quesada y Matheus, Jenaro de (1818–1889), 1st Marquis of Miravalles, Spanish soldier, was born at Santander, 6th February 1818. He was a son of General Vicente Quesada, a Conservative officer who was murdered and atrociously mutilated in the streets of Madrid by a revolutionary mob in the early days of Queen Isabella's reign. As Quesada belonged to an ancient family connected with the dukes of Fernan Nuñez, he was made a cornet when only six years old, was educated at the seminary for nobles, and in 1833 was promoted lieutenant in the 1st Foot Guards. He served from 1833 to 1836 against the Carlists. When his father was assassinated in 1836 he resigned, went to France, got employment in a merchant's office, and was only induced to return to the army in 1837 by his relatives, who got him a company in the guards. He distinguished himself often in the Carlist war, but his promotion was slow, and he declined to have anything to do with politics. He confined himself to his duties as a soldier, always fighting on the side of Governments against Carlist, Republican, and Progressist risings. He only became a general of division in 1853, and at the head of the Madrid garrison he fought hard in 1854 to avert the triumph of Espartero, O'Donnell, and Dulce, who publicly recognized his gallant conduct. When the war in Morocco broke out, Marshal O'Donnell gave Quesada the command of a division, which played so conspicuous a part in that campaign and at the battle of Wad el Ras that its commander was made lieutenant-general and grand cross of Charles III. He was director-general of the Civil Guard when the military rebellion of 22nd June 1866 broke out in Madrid, and after he had been wounded in the leg he remained at the head of the loyal troops until the insurgents were crushed. He did not accept any military post during the revolution until Marshal Serrano in 1874 offered him the direction of the staff, and he only accepted it after clearly stating that he was a royalist and partisan of Alphonso XII. In his long and brilliant career he never swerved from his steadfast resolve never to be mixed up in any political or military intrigues or pronunciamientos—to use his own words, "not even to restore my king." As soon as the king was restored, the Government of Señor Canovas made Quesada first general-in-chief of the army of Central Spain, and in February 1875 general-in-chief of the army of the North. With the assistance of another officer who also had never dabbled in pronunciamientos, General O'Ryan, Quesada restored discipline in the armies confronting Don Carlos, and for twelve months concerted and conducted the operations that forced the pretender to retire into France and his followers to lay down their arms. The Government confided to the marquis of Miravalles the difficult task of ruling the northern provinces for several years after the war, and he succeeded in conciliating the sympathies of the Basques and Navarrese, though the penalty of their last rising had been the loss of most of their ancient liberties or "fueros." Quesada was made marquis of Miravalles, grandee after the war, minister of war in 1883, and senator. Though he was a strict, stern disciplinarian of the old school and an unflinching Conservative, Catholic, and royalist, even his political and military opponents respected him, and were proud of him as an unblemished type of the Castilian soldier and gentleman. He died at Madrid, 19th January 1889, and was given full military honours.

(A. E. H.)

Quetta, a district and town of Baluchistan, rose to prominence in 1876, when Sir Robert Sandeman founded a residency there, and first represented the Government of India as the practical ruler of Baluchistan. The name is a variation of the word *kwat-kot*, signifying a fortress, and the place was locally known as Shál Kot till adopted officially as Quetta. The name is doubtless derived from the fortified "Miri" or mound, which is the dominant position on the plain whereon the present fort now stands, and beneath which the old town clustered formerly. This prominence is doubtless one of those dead mud volcanoes with which Baluchistan abounds. There are some on the Baluch coast still in active operation. The cantonment and civil station of Quetta, which now cover an area of many square miles, and are ever extending their borders, stand in the open plain at a height of about 5500 feet above sea-level, within a ring of gigantic mountain heads (such

as Takatu, Murdar, and Chiltán) which overlook it from a height of over 11,000 feet. To the north-west the view is open across the base of the Peshin valley to the Khojak and Kandahar. Southwards is the open valley leading to the Bolan Pass, traversed by the railway. North of Quetta is the open plain leading to Peshin and the Harnai, also traversed by the Sibi-Peshin line of railway, which passes through the fortifications. These defensive works, stretching from the base of Takatu to the foot of the Mashelak hills on the west, bar the way to advance from the Khojak. The actual line of valley which contains Quetta and the Bolán was originally rented from the Khan of Kalát on terms which were changed in 1882 to a quit-rent of 25,000 rupees per annum, and a further compensation of 30,000 in lieu of transit duties in the Bolán. This perpetual leasehold was afterwards extended so as to include Nushki and give the Government of India the command of the trade route to Sistan. The Quetta district is now administered, together with the assigned districts of Peshin, Tal Chotrall, and Sibi (assigned by the treaty of Gandamak as being nominally Afghan territory) by a regular staff of civil officials. During the last quarter of the 19th century Quetta grew from a dilapidated group of mud buildings, with an inferior bazaar and a few scattered remnants of neglected orchard cultivation, into one of the most popular stations of the Indian service. A residency was followed by a club-house, and by public buildings of all descriptions, schools, hospitals, and a first-class market-place in the civil station. Drainage, irrigation by artesian wells, and railways followed the extension of military occupation. The Yorktown quarter, the high, level end of Quetta, sprang into existence, taking its name from its first occupants, the Yorkshire Light Infantry. This rapid evolution has been chiefly due to the energy and foresight of Sir Robert Sandeman, with whose name the history of Quetta must be ever associated. Quetta is already the trade mart for western Afghanistan, eastern Persia, and much of central Asia.

Indian Survey Reports, 1878 to 1898. Calcutta.—THORNTON. *Life of Sir Robert Sandeman.* London, 1896. (T. H. H*.)

Quezaltenango, capital of a department of Guatemala, Central America, and the second town of the republic, is situated on the northern slope of the Cerro Quemado volcano, on a high plateau (7700 feet), watered by the Samala, 75 miles west-north-west of Guatemala, and 35 north-east of its port, Champerico. A railway is projected to connect it with San Felipe, the actual terminus of the line which runs inward from Champerico. The town is the centre of the trade (in coffee, sugar, and cereals) of western Guatemala, and it has also cotton and woollen manufactures. There are several important educational establishments, including schools of law and of medicine, a school of art, and higher-class schools for boys and girls. Under the name of Xenahu or Xelaluh it was an Indian town before the conquest. From 1838 to 1840 it was the capital of the three departments of the plateau —Quezaltenango, Solola, and Totonicapum—which during those years combined to form an independent republic. Population, about 27,000, a large proportion being Indians.

Quilon, a seaport town of India, on the Malabar coast, in the state of Travancore; situated in 8° 53′ N. and 76° 36′ E. Population (1891), 15,375. Formerly a British cantonment; now the headquarters of the Travancore army, with a subsidiary battalion. There is a cotton mill, with 25,000 spindles, employing 600 hands. It is proposed to construct a railway across the hills from Tinnevelly.

Quincy, a city of Illinois, U.S.A., capital of Adams county. It is situated in 39° 55′ N., and 91° 25′ W., on the east bank of the Mississippi river, in the western part of the state, at an altitude of 481 feet. It is built largely on the river bluffs, is regularly laid out, is divided into seven wards, has a water-supply pumped from the river, is well sewered, and its business streets are paved with brick. Three railways enter the city, the Chicago, Burlington, and Quincy, the Omaha, Kansas City, and Eastern, and the Wabash; and these, with boats on the river, give it a large trade. It has prominence as a manufacturing place. In 1890 there were 394 manufacturing establishments, employing 5110 hands, and having a total capital of $6,554,810. The product was valued at $10,395,102. The principal items were flour, foundry and machine-shop products, carriages and waggons, and packed meats. In 1899 the assessed valuation of real and personal property was $4,620,353, indicating a very low rate of assessment. The net debt of the city was $1,148,415, and the rate of taxation was $77.20 per $1000. Population (1890), 31,494; (1900), 36,252, of whom 4961 were foreign-born and 2029 negroes. There were 11,543 persons of school age (5 to 20 years). Of 10,276 males 21 years of age and over, 391 were illiterate (could not write).

Quincy, a city of Norfolk county, Massachusetts, U.S.A. It is on the south shore of Boston bay, a few miles south-east of Boston, in the eastern part of the state. It was incorporated as a city in 1888. It is in great measure a residential suburb of Boston, but is noted also for its quarries of Quincy marble, which is widely used as a building stone, and for its manufacture of boots and shoes. It is on a branch of the New York, New Haven, and Hartford Railroad. Population (1890), 16,723; (1895), 20,712; (1900), 23,899, of whom 7662 were foreign-born.

Quito, the capital of Ecuador, Central America, situated on the Andine plain, 9300 feet above sea-level, 165 miles north-east of Guayaquil, to which a railway is under construction. At present trade is still hampered by the difficulties of communication. The exports are chiefly hides and indiarubber. The native manufactures include saddles, tanned leather, shoes, ponchos, woollen and cotton cloth, sandals, common sacking, blankets, wood-carvings, coarse matting, coarse woollen carpets, and also superior hand-made carpets. Electric lighting was introduced in 1898. The population is about 80,000.

Rabah Zobeir (—— –1900), the conqueror of Bornu (an ancient sultanate on the western shores of Lake Chad, included since 1890 in British Nigeria), was a half-Arab, half-Negro chieftain. He was originally a slave of Zobeir Pasha (*q.v.*). In 1879, Zobeir being in Egypt, his son Suleiman and Rabah were in command of Zobeir's forces in the Bahr-el-Ghazal. They persisted in slave-raiding, and denied the Khedive's authority, and Colonel C. G. Gordon sent against them Romulous Gessi Pasha. Gessi captured Suleiman and routed Rabah, who in July 1879 fled westward with some seven hundred Bazingirs (black slave soldiers). During the next fourteen years Rabah overran various states of Central Africa, defeating the sultan of Wadai and establishing himself in Bagirmi, a state south-east of Lake Chad. In 1893 Rabah overthrew the sultan of Bornu. He could not have been

successful in this campaign but for the very strong discontent against the reigning family that had existed for some years in Bornu. To the British, represented by the Royal Niger Company, Rabah gave comparatively little trouble. During 1894–95 he continually (but unavailingly) asked the Company's representatives at Yola and Ibi to supply him with gunpowder. Rabah then tried threats, and in 1896 all communication between him and the Company ceased. Early in 1897 he began an advance in the direction of Kano, the most important city in the Fulani Empire. The news of the crushing defeat by Sir George Goldie of the Fulahs at Bida, and of the capture of Ilorin, induced Rabah to return to Bornu. He gave the British no further trouble, but turned his attention to the French. M. Gentil had in this same year (1897) reached Lake Chad, *viâ* the Congo and Bagirmi, and had installed a French resident with the sultan of Bagirmi. Years before (in 1891) Rabah had killed M. Paul Crampbel, who had led an expedition towards Lake Chad, and now, as soon as M. Gentil had withdrawn, Rabah again fell upon Bagirmi, and forced sultan and resident to flee. In 1899 the French sent an expedition to reconquer the country, but at first they were unsuccessful. In the summer of 1899 Rabah attacked and routed the French advanced post, held by Naval-Lieutenant Bretonnet, and the latter was killed. In October following another battle was fought, in which the French, under Captain Robillot, completely defeated Rabah, who retreated north-east towards Wadai. Gathering a fresh army, he returned to Bagirmi and joined issue with the French a third time. In a battle fought in April 1900 Rabah was slain and his host defeated. The chieftain's head was cut off and taken to the French camp. In this engagement Major Lamy, the French commandant, also lost his life.

The French continued the campaign against Rabah's sons, two of whom were killed. Rabah had left instructions that if his army was finally defeated by the French, his successor should return to Bornu and make friends with the British. Rabah's third son, Fader-Allah, accordingly threw himself entirely upon British protection. He made a favourable impression, and it was contemplated to recognize him as sultan of Bornu. However, in the later part of 1901 Fader-Allah, who had 2500 riflemen, again made aggressive movements against the French. In retaliation, Captain Dangeville pursued him into British territory. A battle was fought at Gujiba, Fader-Allah being defeated. He fled mortally wounded, and died the same night, being buried in the bed of a small river, the course of which had been diverted for the purpose. In consequence of these occurrences General Lugard, High Commissioner of Northern Nigeria, despatched to Bornu, in January, 1902, a force under Colonel Morland, the result being the effective establishment of British rule in that country. The French force which had remained in Bornu retired as Colonel Morland approached Lake Chad. (F. R. C.)

Rabat (*Rîbât el Fateh*) is only of importance in these days as one of the Moorish ports open to foreigners, which is not the case with its older *vis-à-vis*, Salli. A few merchants, some of whom hold consular appointments, and missionaries, form a small foreign colony; but the growth of trade is slow, as the bar in the river hampers the shipping. Exports: 1896, £31,819; 1897, £42,877; 1898, £42,536; 1889, £22,457; 1900, £20,071. Imports: 1896, £140,064; 1897, £110,488; 1898, £111,861; 1899, £110,384; 1900, £95,440. Shipping: 1897, 58,349 tons; 1898, 541,526 tons; 1899, 65,324 tons; 1900, 37,758 tons. Population, probably 30,000.

Racine, a city of Wisconsin, U.S.A., capital of Racine county. It is situated in 42° 43′ N., and 87° 47′ W., on the shore of Lake Michigan, 62 miles north of Chicago and 23 miles south of Milwaukee, on the Chicago, Milwaukee, and St Paul and the Chicago and North-Western railways, at an altitude of 627 feet. It is regularly laid out on a level site, divided into seven wards, and has a water-supply from the lake. It has a good harbour, and a share of the lake commerce. Its manufactures in 1900 were carried on by 252 establishments, with a total capital of $16,753,215. They employed 6785 hands, and the product was valued at $12,502,796. The principal articles of manufacture are agricultural implements, carriages and waggons, for which Racine is widely known. These articles form not far from one-half the value of all the manufactured goods. Population (1890), 21,014; (1895), 24,889; (1900), 29,102, of whom 9242 were foreign-born.

Racing. See HORSERACING.

Radautz, a town in the Austrian duchy of Bukovina. Population (1890), 12,895; (1900), 14,343 (estimated, 68 per cent. Germans, 25 per cent. Rumanians, 4 per cent. Poles, and 3 per cent. Ruthenians. There is a German upper gymnasium and a Protestant church. The Government stud contains over 1400 horses.

Radcliffe, a town, urban district (1894), and parish, in the Radcliffe-cum-Farnworth parliamentary division of Lancashire, England, 7 miles north-west of Manchester by rail. Technical schools were erected in 1896, and a public swimming bath was opened in 1899. Dyeing, paper-making, iron founding, and machine-making have become important industries. Population of urban district (1881), 16,267; of extended area (1891), 24,972; (1901), 25,368: of the parliamentary division (1881), 63,086; (1891), 72,931; (1901), 78,298.

Radeberg, a town of Germany, on the Grosse Röder, 8 miles by rail north-east by east of the town and in the circle of Dresden, kingdom of Saxony. There are important glass-works. Near by is a dairy and cheese institute. Population (1890), 8740; (1900), 12,918.

Radiation, Theory of.—1. The foundation of this subject is the principle, arrived at independently by Balfour Stewart and Kirchhoff about the year 1858, that the constitution (§ 6) of the radiation which pervades an enclosure, surrounded by bodies in a steady thermal state, must be a function of the temperature of those bodies, and of nothing else (see RADIATION, *Ency. Brit.* vol. xx.). It was subsequently pointed out by Stewart (*Brit. Assoc. Report*, 1871) that if the enclosure contains a radiating and absorbing body which is put in motion, all being at the same temperature, the constituents of the radiation in front of it and behind it will differ in period on account of the Doppler effect, so that there will be an opportunity of gaining mechanical work in its restoration to a uniform state; there must thus be some kind of thermodynamic compensation, which might arise (see RADIATION, *Ency. Brit.* vol. xx.) either from æthereal friction, or from work required to produce the motion of the body against pressure exerted on it by the surrounding radiation. The hypothesis of friction is now excluded in ultimate molecular physics, while the thermodynamic bearing of a pressure exerted by radiation has been more recently developed by Bartoli and Boltzmann (1884), and combined with that of the Doppler effect by W. Wien (1893).

The original reasoning of Stewart and Kirchhoff rests on the dynamical principle, that by no process of ordinary reflexion or transmission can the period, and therefore the wave-length, of any harmonic constituent of the radiation be changed; each constituent remains of the same wavelength from the time it is emitted until the time it is again absorbed. If we imagine a field of radiation to be enclosed within perfectly reflecting walls, then, provided there is no material substance in the field which can

radiate and absorb, the constitution of the radiation in it may be any whatever, and it will remain permanent. It is only the presence of material bodies that by continued emission and absorption can transform it towards the unique constitution which corresponds to their temperature. We can define the temperature of a uniform field of radiation, of this special constitution and travelling in all directions indifferently, as the temperature of the material bodies with which it would thus be in equilibrium. Further, the mutual independence of the various constituents of any enclosed field of radiation allows us to assign a temperature to each constituent, such as the part involving wave-lengths lying between λ and $\lambda+\delta\lambda$; that will be the temperature of a material system with which this constituent by itself is in equilibrium of emission and absorption. But to reason about the temperature of radiation in this way we must be sure that it completely pervades the space, and has no special direction; the question of the temperature of a directed wave-train, such as a beam of light, will come up later. The temperature of each constituent in a region of undirected radiation is thus a function of its wave-length and its intensity alone. It is the fundamental principle of thermodynamics, that temperatures tend to become uniform. In the present case of a field of radiation this equalization cannot take place directly between the various constituents of the radiation that occupy the same space, but only through the intervention of the emission and absorption of material bodies; the constituent radiations are virtually partitioned off adiabatically from direct equilibrium. Thus in discussing the transformations of temperatures of the constituents of radiation we are really reasoning about the activity of material bodies that are in thermal equilibrium with those constituents; and the theoretical basis of the idea of temperature, as depending on the fortuitous element in molecular motions, is preserved.

2. *Mechanical Pressure of Undulatory Motions.*—Consider a wave-train of any kind, in which the displacement is $\xi = a \cos m(x+ct)$ so that it is propagated in the direction in which x decreases; let it be directly incident on a perfect reflector travelling towards it with velocity v, whose position is therefore given at time t by $x = vt$. There will be a reflected train given by $\xi' = a' \cos m'(x-ct)$, the velocity of propagation c being of course the same for both. The disturbance does not travel into the reflector, and must therefore be annulled at its surface; thus when $x = vt$ we must have $\xi + \xi' = 0$ identically. This gives $a' = -a$, and $m'(c-v) = m(c+v)$. The amplitude of the reflected disturbance is therefore equal to that of the incident one; while the wave-length is altered on the ratio $\dfrac{c-v}{c+v}$, which is approximately $1-2v/c$ when v/c is small, and is thus in agreement with the usual statement of the Doppler effect. The energy in the wave-train being half potential and half kinetic, it is given by the integration of $\rho(d\xi/dt)^2$ along the train, where ρ represents density. In the reflected train it is therefore augmented, when equal lengths are compared, in the ratio $\left(\dfrac{c+v}{c-v}\right)^2$; but the length of the train is diminished by the reflexion in the ratio $\dfrac{c-v}{c+v}$; hence on the whole the energy transmitted per unit time is increased by the reflexion in the ratio $\dfrac{c+v}{c-v}$. This increase per unit time can arise only from work done by the advancing reflector against pressure exerted by the radiation. That pressure, per unit surface, must therefore be equal to the fraction $\dfrac{2}{c-v}$ of the energy in a length $c+v$ of the incident wave-train; thus it is the fraction $\dfrac{c^2-v^2}{c^2+v^2}$ of the total density of energy in front of the reflector, belonging to both the incident and reflected trains. When v is small compared with c, this makes the pressure equal to the density of vibrational energy, in accordance with Maxwell's electrodynamic formula.

The argument may be illustrated by the transverse vibrations of a tense cord, the reflector being then a lamina through a small aperture in which the cord passes; the lamina can thus slide along the cord and sweep the vibratory motion in front of it. In this case the force acting on the lamina is the resultant of the tensions T of the cord on the two sides of the aperture; this resultant is $\frac{1}{2}\mathrm{T}d(\xi+\xi')^2/dx^2$, which, when v/c is small, is an oscillatory force of amount $2\rho(d\xi/dt)^2$, whose time-average agrees with the value above obtained.

When it is a case of transverse waves in an elastic medium, reflected by an advancing obstacle, the origin of the working pressure is not so obvious, because we cannot easily formulate a mechanism for the advancing reflector like that of the lamina above employed. In the case of light-waves we can, however, imagine an ideal material body, with very small molecules, that would reflect them with the same perfection as a metallic mirror reflects the longer Hertzian waves. The pressure will then be represented, as in the case of the latter waves, by the mechanical forces acting on the screening oscillatory electric current-sheet which is induced on the surface of the reflector. The displacement represented above by ξ, which is annulled at the reflector, may then be taken to be either the tangential electric force or the normal component of the vector whose velocity is the magnetic force. The latter interpretation is theoretically interesting, because that vector, which is the dynamical displacement in electron-theory, usually occurs only through its velocity. The general case of oblique incidence can be treated on similar lines.

The usual formula for the pressure of electric radiation is derived from a theory, namely, that of the ordinary electrodynamic equations, which considers the velocity of the matter, or rather of the electrons associated with it, to be so small compared with that of radiation that the square of the ratio of these velocities can be neglected. The formula above obtained is of general application, and shows that for high values of v the pressure must fall off. It has been urged as an objection to the thermodynamic reversibility of a ray (§ 8) that the work of the radiant pressure exerted at its front is lost, as there is no obstacle to sustain it; but on an obstacle moving with the velocity of the wave-front the pressure would vanish, so that this objection does not hold.

In every such case of an advancing perfect reflector the aggregate amplitude of the superposed incident and reflected wave-trains, of different wave-lengths and periods, will be represented by

$$\xi + \xi' = 2a \sin \frac{mv}{c-v}\left(x - \frac{c^2}{v}t\right) \sin \frac{mc}{c-v}(x - vt);$$

thus the appearance presented will be that of a train of waves each of length $2\pi/m \cdot (1-v/c)$, and travelling with the velocity v of the reflector, which is at one of the nodes of the train. This slowly travelling wave-train corresponds to the stationary train which would be produced by a stationary perfect reflector; but the amplitude is now a varying quantity which, once uniform vibration has been fully established along any path, may itself be described as running on after the manner of a superposed wave-train of very great wave-length $2\pi/m \cdot (c/v - 1)$ and of

very great velocity c^2/v. A somewhat similar state of things arises when a wave-train is incident on a stationary reflector very nearly normally, as may sometimes be seen with incoming rollers along a shelving beach; the visible disturbance at a reflecting ridge, arising from a single wave-crest, then rushes along the ridge at a speed at first sight surprising, as it is enormously in excess of the speed possible for any simple train of waves.

3. *Wien's Law.*—Let us consider a spherical enclosure filled with radiation, and having walls of ideal perfectly reflecting quality so that none of the radiation can escape. If there is no material body inside it, any arbitrarily assigned constitution of this radiation will be permanent. Let us suppose that the radius a of the enclosure is shrinking with extremely small velocity v. A ray inside it, incident at angle ι, will always be incident on the walls after the successive reflexions at the same angle, except as regards a negligible change due to the motion of the reflector (§ 2); and the length of its path between successive reflexions is $2a \cos \iota$. Each undulation on this ray will thus undergo reflexion at intervals of time equal to $2ac^{-1} \cos \iota$, where c is the velocity of light, and it is easily verified that on each reflexion it is shortened by the fraction $2vc^{-1} \cos \iota$ of itself: thus in the very long time T required to complete the shrinkage it is shortened by the fraction vTa, which is $\delta a/a$ where δa is the total shrinkage in radius, and is independent of the value of ι. The wave-length of each undulation in the radiation inside the enclosure is therefore reduced in the same ratio as the radius. Now suppose that the constitution of the enclosed radiation corresponded initially to a definite temperature. During the shrinkage thermal equilibrium must be maintained among its constituents; otherwise there would be a running down of thermal energy if material radiating bodies are present, which would be superposed on the mechanical operations belonging to the shrinkage, and the process would not be reversible. Such a state of affairs is not possible, for it would land us in processes of the following type. Expand the enclosure, gaining the mechanical work of the radiant pressure against its walls, whatever that may be. Then equalize the intensities of the constituent radiations to those corresponding to a common temperature, by taking advantage of the absorptions of material bodies at the actual temperatures of these radiations; when this is done, as it may actually be to some extent by aid of the sifting produced by partitions which transmit some kinds of radiation more rapidly than others, a further gain of work can be obtained at the expense of the radiant energy. Then contract the remaining radiant energy to its previous volume, which requires an expenditure of less work on the walls of the enclosure than the expansion of the greater amount of radiation originally afforded; and, finally, gain still more work by again equalizing the temperatures of its constituents. The energy now remaining, being of smaller amount and under similar conditions, must have a temperature lower than the initial one. This process might be repeated indefinitely, and would violate Carnot's principle by deriving an unlimited supply of mechanical work from thermal sources at a uniform temperature.

Thus, independently of any knowledge of the intensity of the mechanical pressure of radiation, or indeed of whether such a pressure exists at all, it is established that the shrinkage of the enclosure must directly transform the contained radiation to the constitution which corresponds to some definite new temperature. Now we have seen that the wave-lengths of its constituents are all reduced in the same ratio by this process. If, then, we can prove that the intensities of these constituents are also all changed in a common ratio by the reflexions at the shrinking envelope, it will follow that the distributions of the radiation among the various wave-lengths are, at these two temperatures, and therefore at any two temperatures, homologous, so that the intensity curves, after the wave-lengths in one of them have been reduced in a ratio depending definitely on the two temperatures, differ only in the absolute scale of magnitude of the ordinates.

This procedure modifies Wien's argument by employing a uniformly shrinking spherical enclosure. If the enclosure is not spherical, the angles of incidence at successive reflexions of the same ray will differ by finite amounts; we must then estimate the average effect of the shrinkage. In the form of enclosure here employed all rays are affected alike, while by the principle of Stewart and Kirchhoff what is established for any one form is of general validity.

4. *Pressure of Natural Radiation.*—The question reserved above has now to be settled. At first sight it might have appeared that the reflexion is perfect; but, as has been seen in § 2, the advancing perfect reflector does work against the pressure of the radiation, and this work must be changed into radiant energy and thus go to increase the intensity of the reflected ray. Considering electric radiation incident at angle ι, the tangential electric force is annulled at the reflector; hence the amplitude of the vibration is conserved on reflexion, though its phase is reversed when the electric vibration is in the plane of incidence. As already seen, the wave-length is shortened approximately by the fraction $2vc^{-1}\cos\iota$ in each reflexion; thus, as in § 2, the energy transmitted per unit time is increased in the same ratio, and allowing for the factor $\cos \iota$ of foreshortening, there is therefore a radiant pressure equal to the total density of radiant energy in front of the reflector multiplied by $\cos^2\iota$. This argument, being independent of the wave-length, applies to each constituent of the radiation separately; thus their energies are all increased in the same ratio by the reflexion, as was to be proved. When we are dealing with the natural radiation in an enclosure, which is distributed equally in all directions, this factor $\cos^2\iota$ must be averaged; and we thus attain Boltzmann's result that the radiant pressure is one-third of the density of radiant energy, this statement holding good as regards each constituent of the natural radiation taken separately.

5. *Adiabatic Relations.*—Consider the enclosure filled with radiation of energy-density E at volume V, of any given constitution but devoid of special direction, and let it be shrunk to volume $V - \delta V$ against its own pressure; if the density thereby become $E - \delta E$, the conservation of the energy requires

$$EV + \tfrac{1}{3}E\delta V = (E - \delta E)(V - \delta V),$$

so that $\tfrac{4}{3}E\delta V + V\delta E = 0$, or E varies as $V^{-\frac{4}{3}}$.

Again—but now with a restriction to radiation of one wave-length or else of uniform temperature—the performance of this mechanical work $\tfrac{1}{3}E\delta V$ has changed the energy of radiation EV from the state that is in equilibrium of absorption and emission with a thermal source at temperature T to the state in equilibrium with an absorber of some other temperature $T - \delta T$, and that in a reversible manner; thus by Carnot's principle

$$\tfrac{1}{3}E\delta V/EV = -\delta T/T,$$

so that T varies as $V^{-\frac{1}{3}}$, or inversely as the linear dimensions when the enclosure is shrunk uniformly.

Combining these results, it appears that E varies as T^4; this is Stefan's empirical law for the complete radiation corresponding to the temperature, established on these lines by Boltzmann. Starting from the principle that this radiation must be a function of the temperature alone, this adiabatic process has in fact given us the form of the function. These results cannot, however, be extended without modification to each separate constituent of the

complete radiation, because the shrinkage of the enclosure alters its wave-length and so transforms it into a different constituent.

6. *Law of Distribution of Energy.*—The effect of compressing the complete radiation is thus to change it to the constitution belonging to a certain higher temperature, by shortening all the wave-lengths by the proportion of one-third of the compression by volume, the temperature being in fact raised by the same proportion; at the same time increasing in a uniform ratio the amounts corresponding to each interval $\delta\lambda$, so as to get the correct total amount of energy for the new temperature. In the compression each constituent alters so that $T\lambda$ remains constant, and the energy $E_\lambda\delta\lambda$ in the range $\delta\lambda$ in other respects changes as a function of T alone. Hence generally $E_\lambda\delta\lambda$ must be of form $F(T)f(T\lambda)\delta\lambda$. But for each temperature $\int_0^\infty E_\lambda\delta\lambda$ is equal to E and so varies as T^4, by Stefan's law; that is,

$$T^{-1}F(T)\int_0^\infty f(T\lambda)d(T\lambda)\propto T^4,$$

so that $T^{-1}F(T)\propto T^4$. Thus, finally, $E_\lambda\delta\lambda$ is of form $AT^5f(T\lambda)\delta\lambda$ or $A\lambda^{-5}\phi(T\lambda)\delta\lambda$, which is Wien's formula, including nearly all that has hitherto been established theoretically on this subject.

7. *Transformation of a Single Constituent.*—It is of interest to follow out this adiabatic process for each separate constituent of the radiation, as a verification, and also in order to ascertain whether anything new is thereby gained. To this end let now $E(\lambda,T)\delta\lambda$ represent the intensity of the radiation between λ and $\lambda+\delta\lambda$ which corresponds to the temperature T. The pressure of this radiation, when it is without special direction, is in intensity one-third of this; thus the application of Carnot's principle shows, as before, that in adiabatic compression $T\propto V^{-\frac{1}{3}}$, so that a small linear shrinkage in the ratio $1-x$ raises T in the ratio $1+x$. We have still to express the equation of energy. The vibratory energy $E(\lambda,T)\delta\lambda.V$ in volume V, together with the mechanical work $\frac{1}{3}E(\lambda,T)\delta\lambda.3xV$, yields the vibratory energy

$$E\{\lambda(1-x),\ T(1+x\}\delta\lambda(1-x).V(1-3x);$$

thus, writing E for E_λ or $E(\lambda, T)$ we have, neglecting x^2,

$$E(1+x)=(E-x\lambda\frac{dE}{d\lambda}+xT\frac{dE}{dT})(1-4x),$$

so that

$$5E+\lambda\frac{dE}{d\lambda}-T\frac{dE}{dT}=0,$$

a partial differential equation of which the integral is

$$E=A\lambda^{-5}\phi(T\lambda),$$

the same formula as was before obtained.

This method, treating each constituent of the radiation separately, has in one respect some advantage, in that it is necessary only to postulate an enclosure which totally reflects that constituent, this being a more restricted hypothesis than an absolutely complete reflector.

To determine theoretically the form of the function ϕ we must have some means of transforming one type of radiation into another, different in essence from the adiabatic compression already utilized. The condition that the entropy of the independent radiations in an enclosure is a minimum when they are all transformed to the same temperature with total energy unaltered, is already implicitly fulfilled; it would thus appear that any further advance must involve (§ 11) the dynamics of the radiation and absorption of material bodies.

8. *Temperature of an Isolated Ray.*—The temperature of each independent constituent of a radiation has here been taken to be a function of the intensity E_λ, where $E_\lambda\delta\lambda$ is the energy per unit volume in the range between wave-lengths λ and $\lambda+\delta\lambda$; the condition is, however, imposed that this radiation is indifferent as to direction. When a beam of radiation travels without loss in a definite direction across a medium, its form varies as it progresses; but it is reversible inasmuch as it can be turned back at any stage, or concentrated without loss, by perfect reflectors. If the energy of the beam has a temperature, its value must therefore remain constant throughout the progress of the beam, by the principle of Carnot. Now by virtue of a relation in geometrical optics, which on a corpuscular theory would be one aspect of the fundamental dynamical principle of Action, the cross-section δS at any place on the beam, and the conical angle $\delta\omega$ within which the directions of its rays are there included, are such that the value of $V^{-2}\delta S\delta\omega$ is conserved along the beam, V being the velocity of propagation of the undulations. If we represent the amount of radiant energy transmitted per unit time across the section δS of the beam by $I\delta S\delta\omega$, it will follow that in passing along the beam its intensity of illumination I varies as V^{-2}, or as the square of the index of refraction, provided there is no loss of energy in transmission. This condition requires that changes of index shall be gradual, otherwise there would be loss of energy by partial reflexions; in free æther I is constant along the beam. The volume-density of the energy in any part of the directed beam is $V^{-1}I\delta\omega$; it is thus inversely as the angular concentration of the rays and directly as the cube of the index of refraction. Now we may consider this beam, of aggregate intensity $I\delta S\delta\omega$, to form an elementary filament of the radiation issuing in the direction of the normal from a perfect radiator. As such a body absorbs completely and therefore radiates equally in all directions in front of it, the total intensity of radiation from its element of surface δs is $\delta s\int I\cos\theta d\omega$, or $\delta s.\pi I$, while the volume-density of the total advancing and receding radiation in front of it is $2V^{-1}\int Id\omega$, and therefore $4\pi V^{-1}I$. If we take $I\delta\lambda$ to represent the intensity between wave-lengths λ and $\lambda+\delta\lambda$, this density is the quantity E_λ of which the temperature of the radiator is a function. Thus the quantity I, which optically is a measure of the brightness of the beam, and is conserved along it to the extent that μ^2I is the same from whichever of its cross-sections the beam is supposed to be emitted, also determines its temperature, the latter being that of an enclosure filled with undirected radiation of the same range $\delta\lambda$ and of density $E_\lambda\delta\lambda$ given by $E_\lambda=4\pi V^{-1}I$, where V is the velocity of radiation in the enclosure. When a beam of radiation travels without suffering absorption, its temperature thus continues to be that of its source multiplied by the coefficient of emission of the source for that kind of radiation, this coefficient being less than unity except in the case of a perfect radiator; but when its intensity I falls by δI in any part of its path owing to absorption or other irreversible process, this involves a further fall of temperature of the energy of the beam and a rise of entropy which can be completely determined when the relation connecting $\mu^{-3}E_\lambda$ with T and λ is known. Any directed quality in radiation increases its effective temperature. Splitting a beam into two at a refracting surface diminishes the temperature of each part. The direct solar radiation falling on the Earth is almost completely convertible into mechanical effect on account of its very high temperature; there seems ground for believing that certain constituents of it can actually be almost wholly turned to account by the green leaves of plants. But the same solar radiation, when broken up into diffused sky light, which has no definite direction, has fallen into equilibrium with a much lower temperature, through loss of its reversibility. It has been remarked that the temperatures of the planets can be roughly compared by means of this principle, if

their coefficients of absorption of the solar radiation are assumed; that of Neptune comes out below $-200°$ C., if we suppose that it has no internal heat.

To obtain dynamical precision in this discussion an exact definition of the narrow beam such as is usually called a ray is essential. It can be specified as a narrow filament of radiation, which may be isolated within an infinitely thin, impermeable, bounding tube without thereby producing any disturbance of the motion. If either the tube or the surrounding radiation were not present to keep the beam in shape, it would spread sideways, as in optical diffraction. But the function of the tube is one of pure constraint; thus by Poynting's law of energy-flux the change of energy-content of a given length of the tube is represented by energy flowing into it at the end where the radiation enters, and leaving it at the other end, but with no leakage at the sides.

9. *Temperature of the Sun.*—The mean temperature of the radiating layers of the Sun may be estimated from Stefan's law, by computing the intensity of the radiation at his surface from that terrestrially observed, on the basis of the law of inverse squares; the result is about 6500° C. The application of Wien's law, which makes the wave-length of maximum energy vary inversely as the temperature, for the case of a perfectly radiating source, gives a result 5500° C. These numbers will naturally differ because (i.) the Sun is not a perfect radiator, the constitution of his radiation in fact not following the law of that of a black body, (ii.) the various radiating layers have different temperatures, (iii.) the radiation may be in part due to chemical and electrical causes, and in so far would not be determined by the temperature alone. The fair agreement of these two estimates indicates, however, that the radiation is largely regulated by the temperature, that the layers from which the main part of it comes are at temperatures not very different, and that not very much of the complete radiation established in these layers and emitted from them is absorbed by the overlying layers.

10. *Fluorescence.* — When radiation of certain wave-lengths falls on a fluorescent body, it is largely absorbed, but in such manner as directly to excite other radiation of different type which is emitted in addition to the true temperature-radiation of the body. The distinction involved is that the latter radiation is spontaneously convertible with the heat of the absorbing body at its own temperature, without any external stimulus or compensation: it is, in fact, on the basis of this convertibility that the thermodynamic relations of the temperature-radiation have been established. According to the experimental law of Stokes, the wave-lengths of the fluorescent radiation are longer than those of the radiation which excites it. If the latter were directly transformed, in undiminished amount, into the fluorescent kind, this is what would be expected. For such a spontaneous change must involve loss of availability; and, beyond the wave-length of maximum energy in the spectrum, the temperature of a given density of radiation is greater the shorter its wave-length, as it is a function of that density and the wave-length alone, such that greater density always corresponds to higher temperature. But it would appear that the opposite should be the case for radiation of long wave-lengths on the other side of the maximum, in which the tendency would thus be for spontaneous change into shorter waves; this may perhaps be related to the fact that at lower temperatures the lines of longer wave-lengths in spectra often come out brighter. The principle does not, however, have free play in the present case, even when the incident radiation is diffused and so has not the abnormally high temperature associated with a directed beam (§ 8), since part of it might be degraded into low-temperature heat, or there might be other compensation of chemical type for any abnormally high availability that might exist in the fluorescent radiation. It has been found that fluorescent radiation, showing a continuous or banded spectrum, can be excited in many gases and vapours. A milky phosphorescence of considerable duration is produced in vacuum tubes, containing oxygen or other complexly constituted gases, by the electric discharge.

11. *Entropy of a Ray.*—If each definitely constituted beam of radiation has its own temperature and everything is reversible as above, a question arises as to the location of the process of averaging which enters into the idea of temperature. The answer can depend only on the fact, that although the beam is definite as to wave-length and intensity, yet it is far from being a simple wave-train, in that it is constituted of trains of limited lengths and various phases and polarizations, coming from the separate radiating molecules. When such a beam has once emerged, it travels without change, and can be reflected back intact to its source, and is in so far reversible; but when it has arrived there, the molecules of the source will have changed their positions, and it cannot be wholly reabsorbed in the same manner as it was emitted. There must thus be some feature in the ultimate averaged constitution of the beam, emitted from a body in the definite steady state of internal motion determined by its temperature, which adapts it for spontaneous uncompensated reabsorption into a body at its own (or a lower) temperature, but not at a higher one.

The question of the determination of the form of the function ϕ in § 6 would thus appear to be closely connected with the other hitherto imperfectly fathomed problems relating to the statistics of kinetic molecular theory. A very interesting attack on the problem from this point of view has recently been made by Planck. It of course suffices to examine some simple type of radiating system, and the results will be of general validity. He considers an enclosure filled with radiation involving an entirely arbitrary succession of phases and polarizations along each ray, and also containing a system of fixed linear electric oscillators of the Hertzian type, which are taken to represent the transforming action of radiating and absorbing matter. The radiation contained in the enclosure will be passed through these oscillators over and over again, now absorbed, now radiated, and each constituent will thus settle down in a unilateral or irreversible manner towards some definite intensity and composition. But it does not appear that a system of vibrators of this kind, each with its own period, can perform one of the main functions of a material absorber, namely, the transformation of the relative intensities of the various types of radiation in the enclosure to those corresponding to a common temperature. There would be equilibrium established only between the mean internal vibratory energy in the vibrators of each period and the density of radiation of that period; there is needed also some means of interchanging energy between vibrators of different periods, which probably involves doing away with their fixity. In the absence of any method of introducing this temperature equilibrium directly, Planck sought, in the case of each independent constituent, for a function of its intensity of energy and its wave-length, restricted as to form by a certain assumed molecular relation, which has the property of continually increasing after the manner of entropy, during the progress of that constituent of the radiation in such a system towards its steady state. If the actual entropy S per unit volume were thus determined, the relation of Clausius $\delta S = \delta E/T$ would supply the connexion between the temperature and the density of radiant energy E. The procedure of Planck led him, in an indirect and tentative manner, to a relation

$d^2S/dE^2 = a/E$, so that $S = aE \log \beta E$, where a, β are functions of λ; this expression conducts through Clausius's relation to $E = \frac{1}{e\beta}e^{-1/aT}$. The previous argument then gives the formula $E(\lambda,T)\delta\lambda = c_1\lambda^{-5}e^{-c/\lambda T}d\lambda$, which was originally suggested by Wien on the basis of the analogy that it assigns the same distribution for the radiant energy, among the various frequencies of vibration, as for the energy of the molecules in a gas among their various velocities of translation.

Processes may be theoretically assigned for the direct continuous transformation of radiant into mechanical energy. Thus we can imagine a radiating body at the centre of a wheel, carrying oblique vanes along its circumference, which reflect the radiation on to a ring of parallel fixed vanes, which finally reverse its path and return it to the centre. The pressure of the radiation will drive the wheel, and in case its motion is not resisted, a very great velocity may be theoretically obtained. The thermodynamic compensation in such cases lies in the reduction of the effective temperature of the portion of the radiation not thus used up. We might even do away with the radiating body at the centre of the wheel, and consider a beam of definite radiation reflected backwards and forwards across a diameter. It is easy to see that its path will remain diametral; the work done by it in driving the wheel will be concomitant with increase of the wave-length, and therefore with expansion of the length occupied by the beam. The thermodynamic features are thus analogous to those of the more familiar case of an envelope filled with gas, which can change its thermal energy into mechanical energy by expansion of the envelope against mechanical resistances. In the case of the expanding gas $pv = \frac{2}{3}E_0$, where E_0 is the total translatory energy of the molecules, while in adiabatic expansion $p = kv^{-\gamma}$. Thus the work gained in unlimited expansion, $\int pdv$, is $\frac{2}{3}E_0/(\gamma - 1)$. The final temperature being absolute zero, this should by Carnot's principle be equal to the total initial energy of the gas that is in connexion with temperature, constitutive energy of the molecules being excluded; when $\gamma - 1$ is less than $\frac{2}{3}$ there is thus internal thermal energy in the molecules in addition to the translatory energy. In the case of the beam of radiation, of length l, between n and $n + \delta n$ reflexions, where δn is an integer, its *total* energy E is by § 2 reduced according to the law $\frac{\delta E}{E} = -\frac{4cv\delta n}{(c+v)^2}$. Also $\frac{\delta l}{l} = \frac{2v\delta n}{c+v}$; thus $\frac{\delta E}{E} = -\frac{2c}{c+v}\frac{\delta l}{l}$. When v is small compared with c, this gives $E = \kappa l^{-2}$; and p is then $2E/l$, so that $\int pdl = E$, the temperature of the beam being ultimately reduced to absolute zero by the unlimited expansion. This is in accord with Carnot's principle, in that the whole energy of the beam travelling in a vacuum is mechanically available when reduction to absolute zero of temperature is in our power.

12. *Experimental Knowledge.*—Under the stimulus of Wien's investigation, the general character of the curve connecting energy and wave-length in the complete radiation at a given temperature has been experimentally ascertained over a wide range. At each temperature there is a wave-length λ_m of maximum radiation, which travels towards the ultra-violet as the temperature rises, and Wien's law of homology (§ 6) shows that $\lambda_m T$ should be constant. This deduction, and the law of homology itself, as also the law of Stefan and Boltzmann that the total radiation varies as T^4, have been closely verified by the experiments of Lummer and Pringsheim, and of Paschen and others; they established a steady field of radiation inside a material enclosure by raising the walls to a definite temperature, and measured the radiant intensity emitted from it through an opening in the walls, by means of a bolometer or thermopile, this being the radiation of the so-called perfectly black body. It has been remarked by Planck and by Thiesen that the coefficient of T^4 in Stefan's law, and the value of $\lambda_m T$, are two absolute physical constants independent of any particular kind of matter, which in conjunction with the constant of gravitation would determine an entirely absolute system of physical units. The form of the function $\phi(T\lambda)$ adopted by Wien and Planck, namely, $c_1 e^{-c/T\lambda}$, has been found to agree fairly with experiment over the range from 100° C. to 1300° C., when $c_1 = 1\cdot24 \times 10^{-5}$ and $c = 1\cdot4435$ in c.g.s. measure, but not so well when the range is further extended: it appears that a larger value of c is needed to represent the radiation for high values of $T\lambda$, that is, for high temperature or for very long wave-lengths. Thiesen proposed the somewhat more general form $c_1(T\lambda)^k e^{-c/T\lambda}$, and suggests with good reason that the value $k = \frac{1}{2}$ agrees better with the experimental numbers than Wien's value $k = 0$. Lord Rayleigh has been led (*Phil. Mag.*, June 1900) towards this form with k equal to unity from entirely different theoretical considerations, on the assumption of the Maxwell–Boltzmann distribution of the energy of the molecule among its free periods of vibration, infinite in number; in some cases this form appeared to give as good results as Wien's, but it has been shown that it is not adapted to short wave-lengths, and that it is infected with systematic errors.

Acting on a suggestion advanced by Lord Rayleigh, Rubens and Kahlbaum have recently widely extended the test of the formulæ by means of the so-called "Reststrahlen." A substance which exhibits selective absorption of any group of rays also powerfully reflects those rays; and Rubens has been able thus to isolate in considerable purity the rays belonging to absorption bands very far down in the ultra-red, of wave-length of order 60×10^{-5} cm., in the case of substances such as sylvin, by means of five or six successive reflexions of the beam of radiation. By experiments ranging between temperatures $-200°$ C. and $+1500°$ C. it has now been found that the intensity of this definite radiation tends to vary simply as T, with close approximation, thus increasing indefinitely with the temperature, whereas Wien's formula would make it tend to a definite limit. The only existing formula (except the one suggested by Lord Rayleigh) that proved to be in accord with this result was a new one advanced shortly before on theoretical grounds by Planck, namely, $E_\lambda \delta\lambda = C\lambda^{-5}\delta\lambda/(e^{c/\lambda T} - 1)$, which for small values of λT agrees with Wien's original form, known to be there satisfactory, while for larger values it tends towards $C/c.\lambda^{-4}T$; it is, in fact, the simplest and most likely form that satisfies these two conditions. But it should be noticed that the point of Lord Rayleigh's argument was that, at any rate at low frequencies, there should be an equable partition of the energy between the temperature heat and the radiant vibrations, and that therefore the energy of the latter should ultimately vary as T; this prediction, which has thus been verified, may be grafted on either to Wien's form or to a new one after the manner of Planck. Recognizing that his previous hypothesis restricting the nature of the entropy, in addition to its property of continually increasing, had to be abandoned, as leading to results not in accord with experiment, Planck had in fact made a fresh start on the basis of a train of ideas which was introduced by Boltzmann in 1877, in order to obtain a precise physical definition of entropy. According to the latter, for an indefinitely numerous system of molecules with known properties and under given conditions there is a definite probability of the occurrence of each statistical distribution of velocities or "complexion" of the system that is formally possible, when all velocities consistent with given total energy are considered to be equally likely as regards each molecule; the distribution of greatest probability is the state of thermal equilibrium of the system, and the probability of any other state is a function of the entropy of that state. This conception can be developed only in very simple cases; the case of an ideal monatomic gas-system led Boltzmann to take the entropy proportional to the logarithm of the probability. This logarithmic law is in fact required by the principle that the entropy of a system should be the sum of the entropies of its parts. By means of *à priori* considerations of this nature, referring to the distribution

of internal vibratory energy among a system of linear electric vibrators of given period, and its equilibrium with the density of the surrounding radiant energy, Planck has been guided to an expression for the law of dependence of the entropy of that system on the temperature, which corresponds to the form of the law of radiation above stated: whatever may be thought of the cogency of his argument, especially in view of the circumstance that his vibrators cannot change the types of the radiation,[1] the result gains support from the fact that it involves determinations of the absolute physical constants of molecular theory that prove to be of the correct order of magnitude. By an argument based on the theory of dimensions, Lorentz has recently been led to the conclusion that consistency between temperatures as measured molecularly and as measured by the laws of radiation requires that the ultimate indivisible electric charges or electrons must be the same in all kinds of matter.

13. *Modification by a Magnetic Field.*—The theory of exchanges of radiation, which makes the equilibrium of radiating bodies depend on temperature alone, requires that, when an element of surface of one body is radiating to an element of surface of another body at the same temperature, the amounts of energy interchanged (when reflexion is counted in along with radiation) should be equal. This proposition is a general dynamical consequence—on the basis of the analytical method developed in this connexion mainly by Helmholtz, Kirchhoff, and Rayleigh —of the form of the equations of propagation of vibrations in the medium. But in a material medium under the influence of a strong magnetic field these equations are altered by the addition of extraneous terms involving differential coefficients of the third order, and the dynamical consistency of the cardinal principle of the theory of exchanges is no longer thus directly verified. A system of this kind has in fact been imagined by Wien in which the principle is imperfectly fulfilled. A beam coming from a body A, and polarized by passage through a nicol, may have its plane of vibration rotated through half a right angle by crossing a magnetically active plate, and may then pass through another nicol, properly orientated for transmission, so as finally to fall on another body B. On the other hand, the radiation from B which gets through this adjacent nicol will have its plane of vibration rotated through half a right angle by the magnetically active plate, and so will not get through the first nicol to the body A. Such possibilities of unequal exchange of radiation between A and B are the result of the want of reversibility of the radiation in a magnetic field, which might have been expected to lead to proportionate inequalities of concentration; in this example, however, though the defect of reversibility is itself slight, its results appear at first sight to affect the whole radiation. But a closer examination removes this discrepancy. In order to make the system self-contained, reflectors must be added to it, so as to send back into the sources the polarized constituents that are turned aside out of the direct line by the nicols. Then, as Brillouin has pointed out, and as in fact Lord Rayleigh had remarked some years before, the radiation from B does ultimately get across to A after passage backward and forward to the reflectors and between the nicols: this, it is true, increases the length of its path, and therefore diminishes the concentration of a single narrow beam, but any large change of path would make the beam too wide for the nicols, and thus require other corrections which may be supposed to compensate. The explanation of the slight difference that is to be anticipated on theoretical grounds might conceivably be that in such a case the magnetic influence, being operative on the phases, alters the statistical constitution of the radiation of given wave-length from the special type that is in equilibrium with a definite temperature, so that after passage through the magnetic medium it is not in a condition to be entirely absorbed at that temperature; there would then be some other element, in addition to temperature, involved in equilibrium in a magnetic field. If this is not so, there must be some thermodynamic compensation involving reaction, extremely small, however, on the magnetizing system.

14. *Origin of Spectra.*—In addition to the thermal radiations of material substances, those, namely, which establish temperature-equilibrium of the enclosure in which they are confined, there are the fluorescent and other radiations excited by extraneous causes, radiant or electric or chemical. Such radiations are an indication, by the presence of higher wave-lengths than belong in any sensible degree to the temperature, that the steady state has not arrived; they thus fade away, either immediately on the cessation of the exciting cause, or after an interval. The radiations, consisting of definite narrow bright lines in the spectrum, that are characteristic of the gaseous state in which each molecule can vibrate freely by itself, are usually excited by electric or chemical agency; thus there is no ground for assuming that they always constitute true temperature radiation. The absorption of these radiations by strata of the same gases at low temperatures proves that the unaltered molecules themselves possess these free periods, which do not therefore belong specially to dissociated ions. Although very difficult to excite directly, these free vibrations are then excited under the influence of resonance, which naturally becomes extremely powerful when the tuning is exact; this indicates, moreover, that the true absorption bands in a gas must be extremely narrow. There is direct evidence that many of the more permanent gases do not sensibly emit light on being subjected to high temperature alone, when chemical action is excluded, while others give under those circumstances feeble continuous spectra; in fact, the more permanent gases are very transparent to most kinds of radiation, and therefore must be very bad radiators as regards those kinds. The dark radiation of flames has been identified with that belonging to the specific radiation of their gaseous products of combustion. There is thus ground for the view that the impacts of the colliding molecules in a gas, or rather their mutual actions as they swing sharply round each other in their orbits during an encounter, may not be sufficiently violent to excite sensibly the free vibrations of the definite periods belonging to the molecules. But they may produce radiation in other ways. While the velocity of an electron or other electric charge is being altered, it necessarily sends out a stream of radiation. Now the orbital motions of the electrons in an actual molecule must be so adjusted, as appears to be theoretically possible, that it does not emit radiation when in a steady state, and therefore when it is moving with constant velocity. But in the violent changes of velocity that occur during an encounter this equipoise will be disturbed, and a stream of radiation, without definite periods, but such as might constitute the equilibrium thermal radiation of the substance, may be expected while the encounter lasts. At very high temperatures the energy of this thermal radiation in an enclosure entirely overpowers the kinetic energy of the molecules present, for the former varies as T^4, while the latter measures T itself when the number of molecules remains the same. The selective emission of gases, confined as it is to extremely narrow bands in the spectrum, may indeed be expected to possess

[1] The argument has been recast recently by Larmor, so as to avoid the introduction of vibrators.

such intensity as to be thermally in equilibrium with extremely high temperatures. That the same gases absorb such radiations when comparatively cold and dark does not of course affect the case, because emissive and absorptive powers are proportional only for incident radiations of the intensity and type corresponding to the temperature of the body. Thus if our adiabatic enclosure of § 3 is prolonged into a tube of unlimited length which is filled with the gas, then when the temperature has become uniform that gas must send back out of the tube as much radiation as has passed down the tube and been absorbed by it; but if the tube is maintained at a lower temperature, it may return much less. The fact that it is now possible by great optical dispersion to make the line-spectra of prominences in the middle of the Sun's disc stand out bright against the background of the continuous solar spectrum, shows that the intensities of the radiations of these prominences correspond to a much higher temperature than that of the general radiating layer underneath them; their luminosity would thus seem to be due to some cause (electric or chemical) other than mere temperature. On the other hand, the general reversing gaseous layer which originates the dark Fraunhofer lines is at a lower temperature than the radiating layer, and is probably in the same relatively steady thermal state as its surroundings. When the radiation in a spectrum is constituted of broad bands it may on these principles be expected to be in equilibrium with a lower temperature than when it is constituted of narrow lines, if the total intensity is the same in the cases compared; this is in keeping with the easier excitation of band spectra (cf. the banded absorption spectra), and with the fact that various gases and vapours do appear to emit band spectra in equilibrium with the temperature.

15. *Constitution of Spectra.*—In the problem of the unravelling of the constitutions of the very complex systems of spectral lines belonging to the various kinds of matter considerable progress has been made in recent years. The beginning of definite knowledge was the discovery of Balmer in 1885, that the frequencies of vibration (n) of the hydrogen lines could be represented, very closely and within the limits of error of observation, by the formula $n \propto 1 - 4m^{-2}$, when for m is substituted the series of natural numbers 3, 4, 5, $\cdots\cdot$ 15. Soon afterwards series of related lines were picked out from the spectra of other elements by Liveing and Dewar. Rydberg conducted a systematic investigation on the basis of a modification of Balmer's law for hydrogen, namely, $n = n_0 - \mathrm{N}/(m+\mu)^2$. He found that in the group of alkaline metals three series of lines exist, the so-called principal and two subordinate series, whose frequencies fit approximately into this formula, and that similar statements apply to other natural groups of elements; that the constant N is sensibly the same for all series and all substances, while n_0 and μ have different values for each; and that other approximate numerical relations exist. In each series the lines of high frequency crowd together towards a definite limit on the more refrangible side; near this limit they would, if visible, constitute a band. In most series there are, however, not more than six lines visible: helium and hydrogen are exceptions, no less than thirty lines of the principal series of the latter having been identified, the higher ones in stellar spectra only. The principal or strongest series of lines shows reversal very readily. The lines of the first subordinate series are usually nebular, while those of the second subordinate or weakest series are sharp, but with a tendency to broaden towards the less refrangible side. Simultaneously with Rydberg, the problem was attacked by Kayser and Runge, who used the formula $n = \mathrm{A} + \mathrm{B}m^{-2} + \mathrm{C}m^{-4}$, higher terms in this descending series being presumed to be negligible. This cannot be reconciled with Rydberg's form, which gives on expansion terms involving m^{-3}; but for the higher values of m the discrepancies rapidly diminish, and do not prevent the picking out of the lines, the frequency-differences between successive lines then varying roughly as the inverse squares of the series of natural numbers. For low values of m neither mode of expression is applicable, as was to be expected; and it remains a problem for the future to ascertain if possible the rational formula to which they are approximations. Considered dynamically, the question is that of the determination of the formula for the free simple harmonic periods of the vibrating system which constitutes the molecule. Although we are still far from any definite line of attack, there are various indications that the quest is a practicable one. The lines of each series, sorted out by aid of the formulæ above given, have properties in common: they are usually multiple lines, either all doublets in the case of monad elements, or generally triplets in the case of those of higher chemical valency; in very few cases are the series constituted of single lines. It is found also that the components of all the double or triple lines of a subordinate series are equidistant as regards frequency. In the case of a related group of elements, for example the alkaline metals, it appears that corresponding series are displaced continually towards the less refrangible end as the atomic weight rises; it is found also that the interval in frequency between the double lines of a series diminishes with the atomic weight, and is proportional to its square. These relations suggest that the atomic weight might here act in part after the manner of a load attached to a fundamental vibrating system, which might conceivably be formed on the same plan for all the metals of the group; such a load would depress all the periods, and at the same time it would split them up in the manner above described, if it introduced dissymmetry into the vibrator. The discovery of Zeeman that a magnetic field triples each spectral line, and produces definite polarizations of the three components, in many cases further subdividing each component, is explained, and was in part predicted, by Lorentz on the basis of the electron theory which finds the origin of radiation in a system of unitary electric charges describing orbits or executing vibrations in the molecule. Although these facts form substantial sign-posts, it has not yet been found possible to assign any likely structure to a vibrating system which would lead to a frequency formula for its free periods of the types given above. Indeed, the view is open that the group of lines constituting a series form a harmonic analysis of a single fundamental vibration not itself harmonic. If that be so, the intensities and other properties of the lines of a series ought all to vary together; it has in fact been found by Preston that the lines are multiplied into the same number of constituents in a magnetic field, with intervals in frequency that are the same for all of them. When the series consists of double or triple lines the separate components of the same compound line are not affected similarly, which shows that they are differently constituted. The view has also found support that the different behaviours of the various groups of lines in a spectrum show that they belong to independent vibrators.

According to Rydberg, there is ground for the view that a natural group of chemical elements have all the same type of series spectrum, and that the various constants associated with this spectrum change rapidly in the same directions in passing from the elements of one group to the corresponding ones of the following groups, after the manner illustrated in graphical representations of Mendeléeff's law by means of a continuous wavy curve in

which each group of elements lies along this same ascending or descending branch; the chemical elements thus being built up in a series of types or groups, so that the individuals in successive groups correspond one to one in a regular progression, which may be put in evidence by connecting them by transverse curves.

The frequencies of the series of very close lines which constitute a single band in a banded spectrum are connected by a law of quite different type, namely, in the simpler cases $n^2 = \mathrm{A} - \mathrm{B}m^2$. It may be remarked that this is the kind of relation that would apply to a row of independent similar vibrators in which the neighbours exert slight mutual influence of elastic type. If ξ denote displacement and x distance along the row, the equation $\frac{d^2\xi}{dt^2} + k^2\xi = -g\frac{d^2\xi}{dx^2}$ would represent the general features of their vibration, the right-hand side arising from the mutual elastic influences. If the ends of the line of vibrators, of length l, are fixed, or if the vibrators form a ring, the appropriate type of solution is $\xi \propto \sin \mu x \sin pt$, where $\mu l = m\pi$ and m is integral; further $-p^2 + k^2 = g\mu^2$, hence $p^2 = k^2 - \frac{g\pi^2}{l^2}m^2$, which is of the type above stated. Dynamical systems of this kind are illustrated by the Lagrangean linear system of connected bodies, such as, for example, a row of masses fixed along a tense cord, and each subject to a restoring elastic force of its own in addition to the tension of the cord. A single spectral line might thus be transformed into a band of this type as the effect of disturbance arising from slight elastic connexions established in the molecule between a system of similar vibrators. But the series in line-spectra are of entirely different constitution; thus for the series expressed by the formula $p^2 = p_o^2 - \mathrm{B}m^{-2}$ the corresponding period-equation may be expressed in the form $\sin k(p^2 - p_o^2)^{-\frac{1}{2}} = \text{constant}$, which belongs to no type of vibrator hitherto analysed.

The original memoirs by the writers above mentioned are mostly in Wiedemann's *Annalen der Physik*; references are given by P. Drude, *Lehrbuch der Optik*, Leipzig, 1900. There are important reports by the same writers in the collection issued by the International Congress of Physics, Paris, 1900. See also Lord Rayleigh's *Scientific Papers*; and Larmor, in *Brit. Assoc. Reports*, 1900, 1902. In spectrum analysis Kayser's elaborate treatise is the standard authority. Winckelmann's *Handbuch der Physik*, vol. ii. (by Kayser, Drude, &c.), may also be consulted. (J. L*.)

Radiometer.—It has been remarked at various times, amongst others by Fresnel, that bodies delicately suspended within a partial vacuum are subject to apparent repulsion by radiation. The question was definitely investigated by Sir W. Crookes, who had found that some delicate weighings *in vacuò* were vitiated by this cause. It appeared that a surface blackened so as to absorb the radiant energy directed on it was repelled relatively to a polished surface. He constructed an apparatus in illustration, which he called a *radiometer* or *light-mill*, by pivoting a vertical axle carrying equidistant vertical vanes inside an exhausted glass bulb, one side of each vane being blackened and the other side bright, the blackened sides all pointing the same way round the axle. When the rays of the sun or a candle, or dark radiation from a warm body, are incident on the vanes, the dark side of each vane is repelled more than the bright side, and thus the vanes are set into rotation with accelerated speed, which becomes uniform when the forces produced by the radiation are balanced by the friction of the pivot and of the residual air in the globe. The name radiometer arose from an idea that the final steady speed of rotation might be utilized as a rough measure of the intensity of the exciting radiation.

The problem of the cause of these striking and novel phenomena at first produced considerable perplexity. A preliminary question was whether the mechanical impulsion was a direct effect of the light, or whether the radiation only set up internal stresses, acting in and through the residual air, between the vanes and the walls of the enclosure. The answer to this was found experimentally by Schuster, who suspended the whole instrument in delicate equilibrium, and observed the effect of turning on the radiation. If the light exerted direct impulsion on the vanes, their motion would gradually drag the case round after them, by reason of the friction of the residual air in the bulb and of the pivot. On the other hand, if the effects arose from balanced stresses set up inside the globe by the radiation, the effects on the vanes and on the case would be of the nature of action and reaction, so that the establishment of motion of the vanes in one direction would involve impulsion of the case in the opposite direction; but when the motion became steady there would no longer be any torque either on the vanes or on the case, and the latter would therefore come back to its previous position of equilibrium; finally, when the light was turned off, the decay of the motion of the vanes would involve impulsion of the case in the direction of their motion until the moment of the restoring torque arising from the suspension of the case had absorbed the angular momentum in the system. Experiment showed that this was what happened. The important part played by the residual air in the globe had also been deduced by Osborne Reynolds from observing that on turning off the light, the vanes came to rest very much sooner than the friction of the pivot alone would account for; in fact, the rapid subsidence is an illustration of Maxwell's great theoretical discovery that viscosity in a gas (as also diffusion both of heat and of the gas itself) is sensibly independent of the density.

The origin of these phenomena was recognized, among the first by O. Reynolds, and by Tait and Dewar, as a consequence of the kinetic theory of the constitution of gaseous media. The temperature of a gas is measured by the mean energy of translation of its molecules, which are independent of each other except during the brief intervals of collision; and collision of the separate molecules with the blackened surface of a vane, warmed by the radiation, imparts heat to them, so that they rebound from it with greater velocity than they approached. This increase of velocity implies an increase of the reaction on the surface, the black side of a vane being thus pressed with greater force than the bright side. In air of considerable density the mean free path of a molecule, between its collisions with other molecules, is exceedingly small, and any such increase of gaseous pressure in front of the black surface would be immediately neutralized by flow of the gas from places of high to places of low pressure. But at high exhaustions the free path becomes comparable with the dimensions of the glass bulb, and this equalization is only partial. The general nature of the phenomena is thus easily understood; but the problem of the stresses in gaseous media arising from inequalities of temperature, which is thereby opened out, involves some of the most delicate considerations in molecular physics. It remains practically as it was left in 1879 by two memoirs communicated to the *Philosophical Transactions* by Osborne Reynolds and by Clerk Maxwell. The method of the latter investigator was purely *à priori*. He assumed that the distribution of molecules and of their velocities, at each point, was slightly modified, from the exponential law belonging to a uniform condition, by the gradient of temperature in the gas (see Diffusion of Gases). The hypothesis that the state was steady, so that interchanges arising from convection and collisions of the molecules produced no aggregate result, enabled him to interpret the new constants involved in this law of distribution, in terms of the

temperature and its spacial differential coefficients, and thence to express the components of the stress at each point in the medium in terms of these quantities. As far as the order to which he carried the approximations, the result was that the equations of motion of the gas, considered as subject to viscous and thermal stresses, could be satisfied by a state of equilibrium under a modified internal pressure equal in all directions. If, therefore, the walls of the enclosure held the gas that is directly in contact with them, this equilibrium would be the actual state of affairs; and it would follow from the principle of Archimedes that, when extraneous forces such as gravity are not considered, the gas would exert no resultant force on any body immersed in it. On this ground Maxwell inferred that the forces acting in the radiometer are connected with gliding of the gas along the unequally heated boundaries; and as the laws of this slipping, as well as the constitution of the adjacent layer, are uncertain, the problem becomes very intricate. Reynolds, introducing no new form of law of distribution of velocities, uses a linear quantity, proportional to the mean free path of the gaseous molecules, which he takes to represent (somewhat roughly) the average distance from which molecules directly affect, by their convection, the state of the medium; the gas not being uniform on account of the gradient of temperature, the change going on at each point is calculated from the elements contributed by the parts at this particular distance in all directions. He lays stress on the dimensional relations of the problem, pointing out that the phenomena which occur with large vanes in highly rarefied gas could also occur with proportionally smaller vanes in gas at higher pressure. The results coincide with Maxwell's so far as above stated, though the numerical coefficients do not agree. According to Maxwell, priority in showing the necessity for slipping over the boundary rests with Reynolds, who also discovered the cognate fact of thermal transpiration, meaning thereby that gas travels up the gradient of temperature in a capillary tube, owing to surface-actions, until it establishes such a gradient of pressure (extremely minute) as will prevent further flow. In later memoirs Reynolds followed up this subject by proceeding to establish definitions of the velocity and the momentum and the energy at an element of volume of the molecular medium, with the precision necessary in order that the dynamical equations of the medium in bulk, based in the usual manner on these quantities alone, without directly considering thermal stresses, shall be strictly valid, —a discussion in which the relation of ordinary mechanics to a complete molecular theory is involved. (J. L*.)

Radnor, an inland county of South Wales, bounded on the N. by Montgomery, on the N.E. by Shropshire, on the E. by Hereford, on the S. and S.W. by Brecknock, and on the W. by Cardigan.

Area and Population.—The area of the ancient and administrative county is 301,164 acres, or 471 square miles, with a population in 1881 of 23,528, in 1891 of 21,791, and in 1901 of 23,263, the number of persons per square mile being 49, and of acres to a person 12·8. The area of the registration county is 238,715 acres, with a population in 1891 of 17,119. Between 1881 and 1891 the population decreased at the rate of 7·58 per cent., but between 1891 and 1901 there was a recovery, although the total at the latter date was still a fraction less than in 1881. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				No.	Per cent.
1880	130	554	319	74	13·3
1890	103	452	299	58	12·6
1898	173	591	309	35	6·0

The percentage of illegitimacy has greatly diminished. In 1891 there were in the county 52 natives of Scotland, 32 natives of Ireland, and 22 foreigners, while 15,270 persons could speak English, 75 Welsh only, and 924 English and Welsh.

Constitution and Government.—The county returns one member to Parliament. It has neither a parliamentary nor a municipal borough, but the ancient town of Radnor (405) is governed by the provisions of an old charter. The urban districts are Knighton (2139), Llandrindod Wells (1827), and Presteigne (1237). Radnor is in the South Wales and Chester circuit, and assizes are held at Presteigne. The ancient county, which is partly in the diocese of Hereford and partly in that of St Davids, contains 41 entire ecclesiastical parishes and districts and parts of 5 others.

Education.—The total number of elementary schools in the county on 31st August 1899 was 51, of which 10 were board and 41 voluntary schools, the latter including 36 National Church of England schools, and 5 "British and other." The average attendance at board schools was 439, and at voluntary schools 2483. The total school board receipts for the year ended 29th March 1899 were over £1663. The income under the Agricultural Rates Act was over £325.

Agriculture and Industry.—More than half the total area of the county is under cultivation, but of this nearly three-fourths is in permanent pasture, in addition to which about 117,000 acres of hill pasturage are grazed, chiefly by sheep, which are largely kept. About 700 acres are under orchards, and about 11,000 acres under woods. Oats are the principal corn crop, occupying more than three-fifths of that area, while wheat and barley, each having about the same acreage, occupy together less than two-fifths. Turnips occupy five-sixths of the area under green crops, the acreage under potatoes being insignificant. The following table gives the larger main divisions of the cultivated area at intervals from 1880:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	155,895	23,070	7334	15,961	107,370	2160
1885	157,483	21,129	7129	14,055	113,652	1518
1890	163,442	20,407	7305	13,933	120,433	1359
1895	162,550	18,858	7035	14,270	121,619	764
1900	163,240	18,937	6752	16,173	120,718	654

The following table gives particulars regarding the principal live stock for the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	8,879	29,855	9,482	245,559	5131
1885	9,398	32,297	10,706	257,965	6371
1890	9,604	31,493	10,712	272,325	6530
1895	10,266	32,633	10,266	270,761	5692
1900	9,677	34,538	11,048	283,590	4909

In 1898, 65,814 tons of sandstone were raised, 35,372 tons of limestone, and 36,560 tons of igneous rocks.

AUTHORITIES.—INCE. *Views Illustrating the County of Radnor.* London, 1832.—WILLIAMS. *The History of Radnorshire* (reprinted from the *Archæologia Cambrensis*). Tenby, 1858.—Guide-books to South Wales.

Radom, a southern frontier government of Russian Poland, bordering on Galicia. It has an area of 4765 square miles, and a population which numbered 820,363 in 1897, when there were 409,624 women, and the urban population numbered 94,318. Poles formed 80 per cent. of the population, and Jews 17 per cent. The province is divided into 7 districts, the chief towns of which are Radom (see below), Iłża (4168), Konsk (8235), Kozenice (5327), Opatów (6942), Opoczno (6022), and Sędomierz (6534). In 1899 there were 4 gymnasia for boys and girls and 154 primary schools—altogether, 440 schools, including the Jewish *hedars*, with about 20,000 pupils. The soil is mostly fertile, and agriculture, the main occupation of the people, is in good condition; out of 2,461,700 acres of land in 1896, 1,383,600 were under cultivation and 874,000 under woods. The crops in 1900 were: wheat, 805,000 cwt.; rye, 2,548,000 cwt.; barley, 896,000 cwt.; oats, 1,540,000 cwt.; and potatoes, 11,724,000 cwt., chiefly cultivated for distilleries. Grain is exported. Live stock is kept in large numbers, there being, in 1897, 116,000 horses, 241,000 horned cattle, 175,000 sheep, and 120,000 swine. Manufactures have

considerably developed of late years, the province being rich in iron ore. The iron industry occupies more than 60,000 workmen, and in 1898, 2,013,873 cwt. of pig iron, 501,117 cwt. of iron, and 1,058,296 cwt. of steel were produced. There are also several sugar works. The total return from all industries in 1898 was 19,899,000 roubles.

Radom, the capital of the above province, situated 65 miles south of Warsaw, on the railway from Minsk to Vienna. It has several iron and agricultural machinery works and tanneries. Population (1897), 28,749.

Radomysl (formerly MYCHEK), a district town of Russia, in the government and 64 miles north-west of the town of Kieff, on the Tetereff river. It is a very old town, and was mentioned in the annals in 1150; in the 18th century it was the residence of the metropolitans of the United Church. It has several tanneries and flour mills, and exports timber, corn, and mushrooms. Population (1897), 18,154.

Rae Bareli, a town and district of British India, in the Lucknow division of Oudh. The town is on the river Sai, 48 miles south-east of Lucknow, and has a railway station. Population (1881), 11,781; (1891), 18,798; municipal income (1897–98), Rs.27,133, two-thirds derived from octroi; registered death-rate (1897), 75·65 per thousand. The DISTRICT of Rae Bareli has an area of 1751 square miles. Population (1881), 951,905; (1891), 1,036,521, showing an increase of 9 per cent., compared with a decrease of 4 per cent. in the preceding twelve years; average density, 592 persons per square mile. In 1901 the population was 1,033,948, showing a slight decrease. The land revenue and rates are Rs.15,58,430, the incidence of assessment being R.1.5.7 per acre; cultivated area (1896–97), 459,608 acres, of which 285,998 were irrigated from wells, &c.; number of police, 2850; vernacular schools, 136, with 5724 pupils; registered death-rate (1897), 50 per thousand. The principal crops are rice, pulse, wheat, barley, millet, and opium. Rae Bareli town is connected with Lucknow by a branch of the Oudh and Rohilkhand Railway, which in 1898 was extended to Benares. There are no Government canals.

Ragatz, a watering-place in the Swiss canton of St Gall, 12½ miles by rail north of Coire. In 1900 the population was 1861. From Ragatz a funicular railway runs up in ten minutes to the Wartenstein Hotel, above the ruins of the 14th-century ruined castle of that name. A short distance beyond the hotel are the buildings of the ancient abbey of Pfäffers, now turned into a lunatic asylum and hospital. Pfäffers is 2697 feet above the sea.

Ragusa, a city of the province of Syracuse, Sicily, Italy. It embraces two separate communes, RAGUSA SUPERIORE, 76 miles west by south of Syracuse on the railway to Licata, and RAGUSA INFERIORE, 3 miles by rail farther to the east. There are several old churches and rock caves, and various industries, such as asphalt and limestone quarries, cotton, macaroni, and cheese factories. Population of Ragusa Superiore (1881), 24,236; (1899), about 23,000; of Ragusa Inferiore (1889), 6260; (1899), about 8000.

Ragusa, a city on the east coast of the Adriatic, in the Austrian province of Dalmatia. Population (1890) of city, 7143, and of commune, 11,177; in 1900, 13,174, including a garrison of 1122 men. Of these, it is estimated that 93 per cent. are Serbo-Croatians, 4 per cent. Italians, and 3 per cent. Germans; and that 92 per cent. are Catholic, 5 per cent. Protestant, and 3 per cent. Jewish. The industries include the manufacture of oil, silks, leather, and liqueurs. There is some transit trade with Herzegovina. The city is now connected with its hinterland by an extension of the Bosnian railway system to Gravosa, the harbour of Ragusa.

Ragusavecchia, a market-place in the government district of Ragusa, in Dalmatia, about 6 miles south-east of the latter city. It occupies the site of the ancient Epidaurum, destroyed by the Slavs in the 7th century, and contains the ruins of a bath and aqueduct of the Roman period. Population (1890) of village, 723, and of commune, 9949; (1900) 10,690, Serbo-Croatians.

Rahway, a city of Union county, New Jersey, U.S.A. It is situated in 40° 37′ N. and 74° 17′ W., on the Rahway river and on the Pennsylvania Railroad, in the north-eastern part of the state. Its site is level, and the street plan regular. To some extent it serves as a residential suburb of New York, which is distant but 19 miles. It has carriage factories, publishing houses, woollen mills, and other manufactures. Population (1895), 7915; (1900), 7935, of whom 1345 were foreign-born and 349 negroes.

Raid.—A raid, in the language of international law, is an invasion by armed forces, unauthorized and unrecognized by any State, of the territory of a State which is at peace. Piracy is the attack on the high sea of any vessel by an armed vessel, not authorized or recognized by any State, for the purpose of robbery. A raid for the purpose of carrying off movable property and converting it to the use of the captors would still be distinguishable from piracy, because it was committed on territory subject to an exclusive territorial jurisdiction. Where the attack or invasion by an armed ship not authorized or recognized by any State is not for the purpose of capturing property, it is properly speaking a raid and not piracy. An attack though in time of peace, by armed forces authorized or recognized by a regular Government is not a raid but an act of war, there being a Government responsible for the act committed. The fact of any act being authorized, not by the supreme Government, but by a chartered company, or by its governing officer, makes no difference in international law, the directorate of a chartered company exercising its powers by delegation of the State under which it holds its charter. The acts of its armed forces cannot in reason be distinguished from the acts of the armed forces of the State Government. Thus compensation is just as much due for them as for the deliberate acts of the State itself, and any claim of an injured State can only be preferred against the State to which the company belongs. Invasion by the regular forces of a State, or by the regular forces of its delegated authority, being an act of war, the laws of war apply to it, and, on capture, such forces, or any members or part of such forces, are prisoners of war. On the other hand, the State whose subordinate authorities commit acts of war against a friendly State has the option of following them up as a commencement of hostilities, or of giving satisfactory compensation to the invaded State. Where the invasion is not by forces subject to the orders of a State, the invaded State has the right to apply its own laws for the repression of disturbances in its territory. Thus, in the so-called Jameson Raid, the Transvaal Government had no right to treat Dr Jameson, an officer holding his powers under the British Government, and his subordinates, as outlaws, and it was probably so advised, and the British Government owed proper compensation for an act for the consequences of which, under international law, it was responsible.

British domestic law punishes raiding under the Foreign Enlistment Act, 1870 (33 & 34 Vict. c. 90). Section 11 of this Act provides as follows:—"If any person within the limits of His Majesty's dominions, and without the licence of His Majesty, prepares or fits out any naval or military

expedition to proceed against the dominions of any friendly State, the following consequences shall ensue: (1) Every person engaged in such preparation or fitting out, or assisting therein, or employed in any capacity in such expedition, shall be guilty of an offence against this Act, and shall be punishable by fine and imprisonment or either of such punishments, at the discretion of the Court before which the offender is convicted; and imprisonment, if awarded, may be either with or without hard labour. (2) All ships and their equipments, and all arms and munitions of war, used in or forming part of such expedition, shall be forfeited to His Majesty." Section 12 provides for the punishment of accessories as principal offenders, and section 13 limits the term of imprisonment for any offence under the Act to two years. In the Sandoval case (1886), in which Colonel Sandoval, who was not a British subject, bought guns and ammunition and shipped them to Antwerp, where they were put on board a vessel, which afterwards made an attack on Venezuela, it was held that the offence of fitting out and preparing an expedition within British territory against a friendly State, under this section, is sufficiently constituted by the purchase of guns and ammunition in the British Empire, and their shipment for the purpose of being put on board a ship in a foreign port, with knowledge of the purchaser and shipper that they are to be used in a hostile demonstration against such State, though the shipper takes no part in any overt act of war, and the ship is not fully equipped for the expedition within any British port. Under the same section, Dr Jameson, administrator of the British South Africa Company, and his confederates were tried before the Central Criminal Court and sentenced to different terms of imprisonment. The offence committed under a British Act is, of course, that of preparing and fitting out an expedition on British territory. Any acts subsequently committed by any British expedition on foreign soil are beyond the operation of domestic legislation, and fall to be dealt with by the domestic legislation of the State within which they occur, or by diplomacy, as the case may be. (T. BA.)

Raigarh, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 1486 square miles. Population (1891), 168,525; (1901), 174,911, showing an increase of 4 per cent., compared with an increase of 31 per cent. in the previous decade. Estimated revenue, Rs.1,27,870; tribute, Rs.4000. The chief belongs to the old Gond royal family. The state is traversed by the Bengal-Nagpur Railway, with a station at Raigarh town, 338 miles east of Nagpur. Iron ore is said to abound.

RAILWAYS.

STATISTICS.

FOR the early history of railways, a sketch of their development, statistics of the earlier stages of that development, and a picture of the state of the art of carriage by rail as it was in 1883 to 1885, the reader may consult the *Encyclopædia Britannica*, vol. xx. The present article will deal with railways as they were in the year 1900, showing something of their place in modern society, of their relations to each other and to the citizen, of the work they do, and of the present development in building, equipping, and working them. Part of this subject, however, will be covered by articles that are placed alphabetically in other volumes. Thus train brakes are treated in the article BRAKES.

At the end of 1885 there were in the world 302,887 miles of railway; by the end of 1898 the length was 466,524 miles. (In reading and using these figures, and some other general figures which will appear in this article, the fact must be recognized that it is impossible that they should be strictly accurate. They must be in error by some scores or even hundreds; but they are accurate enough for most purposes.) The increase in thirteen years was 54 per cent.; and absolutely it was more than all the railways built in the world from the beginning, in 1828, up to 1872. The increase in the United Kingdom was at less than one-fourth the average rate of the world, namely, 12¾ per cent., for the very good reason that the territory had been well occupied early in the history of railway building. By Table I. it will be seen that, relatively to area, the United Kingdom has more miles of railway than any other country except Belgium. The rate of increase in the United States was considerably below the average, namely, 44½ per cent., that country having also been very enterprising in the early years, and having more railways relatively to population than any other great nation. But the length of railway there had become so great by 1885 that an addition of 44½ per cent. made 35 per cent. of all the increase in the world in the thirteen years. In all Europe the increase was 38 per cent., while in European Russia it was 60 per cent., but that was from a small mileage. The greatest relative growths were: Australia, 80 per cent.; British India, 83½ per cent.; Japan, 750 per cent.; and all Asia, 141 per cent. But in all these cases the mileage in 1885 was but small: in Japan it was only 348 miles. By Table I. it will be seen that in those countries now fairly well supplied with railways the rate of increase is still falling, as one would expect; and the decline in the United States is a fact of tremendous importance to the whole world. For years railway building was one of the chief industries of that country, and absorbed a great part of all the capital available for investment. Probably the railways built in the United States in the four years ending 1883 cost at least $1,000,000,000 more than those built in the four years ending 1898. The release of this vast capital for other uses must affect profoundly the industries and commerce of the civilized world. The student of statistics of railways may consult the yearly census of railways of the world which appears in the May–June issue of the *Archiv für Eisenbahnwesen*, a periodical publication of the Prussian Ministry of Public Works. That census is brought up to two years before the year of its publication, and now covers many years. This publication also gives regularly, throughout each year, special studies of the railways of every nation, which are of great value.

It has been said that nothing is so cheap as the carriage of goods. It is not worth while to try to prove this—perhaps it is not absolutely true; but it is quite true that the transportation of goods is very cheap. The most instructive examples of the charges for carriage by rail may be found in the United States, for several reasons. The length of railway there is 11 per cent. more than the railways of all Europe, including the United Kingdom. The tons of freight carried are 112 per cent. more than in the United Kingdom, and the average haul is much longer than in any other great country. Furthermore, the statistics of the railways of Great Britain do not give the traffic units, tons-one-mile and passengers-one-mile,[1] so that it

[1] The North-Eastern Railway has decided to compile and publish these particulars, which it is believed have been prepared by the London and North-Western for the use of its own officials for some

is impossible to get the average cost of service there. We find, then, in the United States examples of transportation on a great scale, covering a variety of conditions; and because the United States is the most important food-producing country, it is perhaps true that the cost of transportation in the United States more closely affects the rest of the world than the cost of carriage in any other country.

In the United States in 1899 the average charge for carrying one ton one mile was 0·724 cent. In 1888 the charge was 1·001 cent. This difference of twenty-eight hundredths of a cent on each ton carried one mile made a prodigious sum in the aggregate. If the freight rates in 1899 had been as high as they were in 1888, shippers and consumers would have paid to the railways of the United States $342,000,000 more than they did pay in fact. We cannot get the average for all of the lines for any year much further back, but the figures of two representative systems of railway, one in the East and one in the West, will illustrate the fall in freight rates for the whole country. In 1870 the Pennsylvania Railroad received 1·55 cents for one ton one mile, and in 1899, 0·469 cent. In 1870 the Chicago and North-Western received 3·09 cents, and in 1899, 0·878 cent. The rates of 1870 corrected for the premium on gold would have been about 1·35 and 2·69 cents respectively in the money of 1899. This apparent decrease of about two-thirds is partly due to the greater relative growth of low-class traffic, but still it is a rough measure of the benefit which the people of the United States have enjoyed from the fall in freight rates, —a benefit which has been shared by all the world, more particularly because the United States is the great food-producing country.

We may better understand the social meaning of very cheap freight rates if we consider a few commodities of prime necessity to mankind. In 1899 a barrel of flour was carried by rail from the mills at Minneapolis to the warehouse in New York for about 52 cents on the average. The distance is 1332 miles by one of the shortest rail routes. This means that the transportation charge on an ordinary loaf of bread for 1332 miles of carriage is about one-third of a cent. The charge for carrying a barrel of flour from Minneapolis to Liverpool was about 70 cents in 1899. Rates and wages vary somewhat year by year, but in general terms we may say that the supply of bread and meat for one man one year is carried from Chicago to Liverpool for a mechanic's wages for one day. In 1899 the charge for one ton of bituminous coal from the mines of West Virginia to deep water at Newport News was $1·00 for a haul of 400 miles. Anthracite coal was carried from the mines in Pennsylvania to tide-water, 200 miles, for $1·00 a ton. In the same year a quart of milk was carried into New York from gathering grounds 260 miles away for $\frac{8}{10}$ths of a cent. Such examples might be multiplied indefinitely, and might be found in different degrees in all countries which have railways. For railways have immeasurably enlarged the market in which a man may sell his products, and they have equally broadened the field from which he may draw his sustenance. They have made modern society possible. All this is true, to a less degree, of the cost of passenger movement. That has fallen, but not so fast or so far as the charges for goods, nor are low passenger rates so necessary to society as low goods rates. Low passenger rates are important within what may be called suburban zones, that is, in the areas in which people may live and go daily to and from a city.

time. Among English railway managers, however, there is a widespread opinion that, in the conditions which exist in the United Kingdom, such particulars are not of great practical value, or at least are not essential for the proper conduct of a railway's traffic.—Ed. *E.B.*

In ideal conditions the homes of the people, and especially of the poor, must be in the country. Air, light, low rent, ground to till, and wholesome recreation for children can only be had by scattering the working population of a city into the surrounding country to sleep; and the lower the passenger rates and the faster and more frequent the trains, the broader is the zone over which the population of any given city may be scattered. In the United States from $\frac{1}{2}$ to $\frac{8}{10}$ cent a mile are the common suburban rates, good for all trains and all hours. In England the ordinary rate for working men's suburban tickets is probably not far from $\frac{1}{2}$ cent a mile. The use of these tickets is, however, restricted to certain trains and hours. Season ticket rates in England work out considerably higher than suburban rates in the United States.

Enough has been said to suggest the place of railways in civilization: the relative supply and use of railways are one measure of the relative civilization of two countries. In order to indicate the basis for such a comparison, certain statistics are collected in the following tables. The figures, however, change from year to year, and those who wish to make comparative studies should look for information in the annual statistical publications of the various countries. The tables are intended to suggest methods, rather than to serve as material for actual study.

Table I. shows miles of railway, absolute and relative, for several countries for the year 1898. It is obvious that such figures must be subject to some correction, for the reasons (among others) that statistical years and calendar years do not always coincide, and that censuses are not made every year. The table is, however, accurate enough for practical purposes. The countries in this table have been selected (1) to show the relative situation in the great nations, and (2) to compare some of the most important of the British possessions. This table also shows the rate of increase in the various countries from 1894 to 1898. It is not safe to try to reason from this increase in the past to the increase in the future, as accidental conditions may have affected the growth abnormally in any one of these countries: in the United States, for instance, the rate of increase in these four years was perhaps abnormally small, owing to the great business depression which followed the panic of 1893.

TABLE I.—*Miles of Railway in Several Countries at the end of* 1898.

Country.	Miles of Railway.	Per Cent. of Increase, 1894 to 1898.	Miles of Railway per 100 Square Miles.	Population per Mile of Railway.
United Kingdom	21,659	3·0	17·83	1,856
United States (not including Alaska)	186,396	3·9	6·26	399
Germany	30,771	9·0	14·74	1,699
Belgium	3,781	9·8	33·20	1,764
France	25,898	4·3	12·68	1,488
Russia in Europe (including Finland)	26,414	19·6	1·26	4,020
Austria-Hungary	21,805	16·9	8·33	2,059
British North America	16,870	7·0	0·51	308
British India	21,475	17·1	1·35	14,340
New South Wales	2,691	3·0	0·86	490

Table II. compares the work done by the railways of a few of the great nations; from this the United Kingdom must be omitted, since the figures of passenger-miles and ton-miles are not obtainable. Table II. gives results for 1898 in the United States and Germany, and for 1897 in the other countries. Further, the miles of line doing the work in the United States and Germany are not exactly the same as the miles in Table I., for

complete traffic returns were not gathered from all of the railways. The returns of Belgium are from the State railways only, or about seventy per cent. of the whole Belgian mileage. The columns of passenger-miles and ton-miles in Table II. show millions, six ciphers being omitted. These columns give a notion of the prodigious amount of work done by the railways, but the column of daily movement each way (3 and 4) shows the relative density of the work. These give the passengers and the tons that must be moved each way, every day, over the whole mileage in each country, to make up the totals in columns 1 and 2. Here we discover that the density of passenger traffic is least in the United States and greatest in Belgium, which is precisely what one would expect from the relative density of population of the various countries. Columns 5 and 6 show the work done relatively to the population.

TABLE II.—*Work done by the Railways of Several Countries—Absolute and Relative.* (*United States and Germany*, 1898; *other countries*, 1897.)

	Million Passenger-Miles (000,000 omitted). (1)	Million Ton-Miles (000,000 omitted.) (2)	Moved each Way every Day over the whole Mileage. Passengers. (3)	Tons. (4)	Yearly Movement per Inhabitant. Passenger-Miles (5)	Ton-Miles. (6)
United States	13,380	101,855	99	748	180	1,376
Germany	10,934	17,958	500	820	209	343
France	7,228	8,482	386	454	188	221
Austria	2,506	5,830	318	740	98	228
Hungary	1,320	2,423	181	332	70	129
Belgium	1,240	1,711	849	1,170	190	262

Table III. gives the rolling stock of a few countries, showing not only the absolute number of locomotives and cars, but the number for each 100 miles of railway. It is not seriously misleading to compare the equipment per mile in the European countries and New South Wales, for the capacity of each unit of rolling stock is about the same. It would be misleading, however, to make such a comparison with British India, because of the large proportion of narrow gauge stock; and it would be very misleading to make a comparison between the United States and other countries. As will be shown in the section on Rolling Stock, the average freight car of the United States probably carries three times as much as the average freight car of Europe. On that assumption the freight equipment of the United States is much more per mile than that of France or Germany, but only

TABLE III.—*Rolling Stock in Several Countries—Absolute and per* 100 *Miles of Railway.*

Year	1898. United States.	1897. United Kingdom.	1897. France.	1897-98. Germany.	India.	1900. New South Wales.
Locomotives	36,234	19,479	10,611	16,884	4,537	489
Locomotives per 100 miles	20	91	42	57	19	17
Passenger cars	33,595	44,053	27,179	33,664	13,263	1,025
Passenger cars per 100 miles	18	206	107	114	55	37
Freight cars	1,292,579	664,833	279,534	361,506	89,108	10,929
Freight cars per 100 miles	700	3,044	1,096	1,230	375	390

about two-thirds that of the United Kingdom. German statistics often give not only the number of cars but also the number of axles. Even that does not give an exact basis of comparison, for the load on one axle is considerably greater in the United States than in any other country. The same is true, though in a less degree, of comparisons between locomotives. By combining Table II. and Table III. a notion may be obtained of the work done by a unit of equipment in various countries.

Table IV. shows the capital of the railways of several countries, absolute and per mile, giving the latest figures available at the time of writing, which will, however, suffice for the purposes for which it is inserted here, namely, to give a comparison at a particular period.

TABLE IV.—*Capital of the Railways of Certain Countries.*

(Great Britain from Board of Trade Returns; United States from Interstate Commerce Commission; other countries from the *Archiv für Eisenbahnwesen.*)

Country.	Year.	Total.	Per Mile.
Germany	1897–98	£580,225,000	£19,927
Austria	1897	230,053,000	21,260
Hungary; State roads	1897	84,970,000	17,900
France; Main lines	1897	640,186,000	24,790
United Kingdom	1898	1,134,468,462	52,400
United States	1898	2,221,470,000	12,390
British North America	1898	193,343,000	11,470
New South Wales	1898	38,424,000	14,280

Trans-Continental Railways.—A railway line across North America was first completed in 1869, when the Union Pacific, building from the Missouri river at Omaha (1400 miles west of New York), met the Central Pacific, which built from San Francisco eastwards, making a line 1848 miles long through a country then for the most part uninhabited. This was followed by the Southern Pacific in 1881, from San Francisco to New Orleans, 2489 miles; the Northern Pacific, from St Paul to Portland, Or., in 1883; the Atchison, Topeka, and Santa Fé, from Kansas City to San Diego; and the Great Northern, from St Paul to Seattle and New Westminster in 1893. Meanwhile the Canadian Pacific, a true trans-continental line, was built from Montreal, on Atlantic tide-water, to the Pacific at Vancouver, 2906 miles. But these lines have been dwarfed since 1891 by the Siberian Railway, built by the Russian Government entirely across the continent of Asia from Cheliabinsk (1769 miles by rail east of St Petersburg) to Vladivostok, a distance of 4073 miles, with a branch about 500 miles long to the Chinese ports Dalny and Port Arthur. The part of this railway in China had construction trains running over its full length early in 1902, but was not to be ready for public traffic until much later; and there remains to be built about 170 miles in very difficult country around the south end of Lake Baikal, communication being now maintained by ferry-boats, which convey all the carriages of a train across the lake, more than 40 miles, when the ice permits. Besides its connexion with the Chinese Eastern Railway, the Siberian Railway reaches a navigable branch of the Amur at Sryetensk, from which a large fleet of light-draught steamboats maintain communication with Vladivostok by means of a railway from that place north-east 478 miles to the Amur at Khabarovsk. The extent of country made accessible by the Siberian Railway is greatly increased by the thousands of miles of navigable rivers which it crosses—the Ob, the Tom, the Irtysh, and the Yenisei west of Lake Baikal, and the Sungari in Manchuria. Down to 1902 the new railway had brought about a million Russian immigrants into Siberia, and a beginning had been made towards exploiting the coal, copper, and other mines of the country. Mr. Rhodes's project of the Cape-to-Cairo Railway, if ever realized, is likely to serve almost exclusively for local and not for trans-continental traffic, because the sea affords a very much cheaper and, for nearly all purposes, a much better route. A trans-continental line was long ago

undertaken across South America from Buenos Aires to the Chilian coast. The continent here is only about 900 miles wide. A short section remains to be built, but that is over and through the Andes, and will be very costly. (H. G. P.)

Railway Economics and Legislation.

It was at one time an axiom of law and of political economy that prices should be determined by free competition. But in the development of the railway business it soon became evident that no such dependence on free competition was possible, either in practice or in theory. This difficulty is not peculiar to railways; but it was in the history of railway economy and railway control that certain characteristics which are now manifesting themselves in all directions where large investments of fixed capital are involved were first brought prominently to public notice.

For a large number of those who use a railway, competition in its more obvious forms does not and cannot exist. Independent carriers cannot run trains over the same line and underbid one another in offering transportation services. It would be practically impossible for a line thus used by different carriers to be operated either with safety, or with economy, or with the advantage to the public which a centralized management affords. It is equally impossible for the majority of shippers to enjoy the competition of parallel lines. Such duplication of railways involves a waste of capital. If parallel lines compete at all points, they cause ruin to the investors. If they compete at some points and not at others, they produce a discrimination or preference with regard to rates and facilities, which builds up the competitive points at the expense of the non-competitive ones. Such partial competition, with the discrimination it involves, is apt to be worse for the public than no competition at all. It increases the tendency, already too strong, towards concentration of industrial life in large towns. It produces an uncertainty with regard to rates which prevents stability of prices, and is apt to promote the interests of the unscrupulous speculator at the expense of those whose business methods are more conservative. So marked are these evils that such partial competition is avoided by agreements between the competing lines with regard to rates, and by divisions of traffic, or pools, which shall take away the temptation to violate such rate agreements. The common law has been somewhat unfavourable to the enforcement of such agreements, and statutes in the United States, both local and national, have attempted to prohibit them; but the public advantage from their existence has been so great as to render their legal disabilities inoperative. In those parts of the continent of Europe where railways are owned and administered by State authority, the necessity for such agreements is frankly admitted.

But if rates are to be fixed by agreement, and not by competition, what principle can be recognized as a legitimate basis of railway rate-making? The first efforts at railway legislation were governed by the equal mileage principle; that is, the attempt was made to make rates proportionate to the distance. It was, however, soon seen that this was inadmissible. So much of the expense of the handling, both of freight and of passengers, was independent of the length of the journey that a mileage rate sufficiently large for short distances was unnecessarily burdensome for long ones, and was bound to destroy long-distance traffic, if the theory were consistently applied. The system has been retained in large measure in passenger business, but only because of the conflict which inevitably occurs between the authorities and the passengers with regard to the privilege of breaking and resuming a journey when passenger rates are arranged on any other plan. In freight schedules it has been completely abandoned.

A somewhat better theory of rate regulation was then framed, which divided railway expenditures into movement expense, connected with the line in general, and terminal expense, which connected itself with the stations and station service. Under this system each consignment of freight is compelled to pay its share of the terminal expense, independently of distance, *plus* a mileage charge proportionate to the length of the journey or haul. There has been also a further attempt in England to divide terminal charges into station and service terminals, according to the nature of the work for which compensation is sought. But none of these classifications of expense reaches the root of the matter. A system of charges which compels each piece of traffic to pay its share of the charges for track and for stations overlooks the fundamental fact that a very large part of the expenses of a railway—more than half—is not connected either with the cost of moving traffic or of handling traffic at stations, but with the cost of maintaining the property as a whole. Of this character are the expenditures necessary for maintenance of way, for general administration, and for interest on capital borrowed, which are almost independent of the total amount of business done, and quite independent of any individual piece of business. To say that all traffic must bear its share of these interest and maintenance charges is to impose upon the railways a rate which would cut off much of the long-distance traffic, and much of the traffic in cheap articles, which is of great value to the public, and which, from its very magnitude, is a thing that railways could not afford to lose. It is also a fact that with each recurring decade these general expenses (also called indirect, undistributed, or fixed charges) have an increased importance as compared with the particular (direct, distributed, or operating) expense attaching naturally to the particular portions of the traffic. For with increased density of population it becomes profitable to make improvements on the original location, even though this may involve increased charges for interest and for some parts of its maintenance, for the sake of securing that economy of operation, through larger train-loads, which such an improved location makes possible.

Whatever the ostensible form of a railway tariff, the contribution of the different shipments of freight to these general expenses is determined on the principle of charging what the traffic will bear. Under this principle, rates are reduced where the increase of business which follows such reduction makes the change a profitable one. They are kept relatively high in those cases where the expansion of business which follows a reduction is small, and where such a change is therefore unprofitable. This theory of charging what the traffic will bear is an unpopular one, because it has been misapplied by railway managers and made an excuse for charging what the traffic will not bear. Rightly applied, however, it is the only sound economic principle. It means taxation according to ability—that ability being determined by actual experiment.

In the practical carrying out of this principle, railways divide all articles of freight into classes, the highest of which are charged two or three, or even four, times the rates of the lowest. This classification is based partly upon special conditions of service, which make some articles more economical to carry than others (with particular reference to the question whether the goods are offered to the companies in car-loads or in small parcels), but chiefly with regard to the commercial value of the article, and its consequent ability to bear a high charge or a low one. For each of these classes a rate-sheet gives the actual rate-charge per unit of weight between the various

stations covered by the tariff. This rate increases as the distance increases, but not in equal proportion; while the rates from large trade centres to other trade centres at a great distance are not higher than those to intermediate points somewhat less remote; if the law permits, there is a tendency to make them actually a little lower. Besides the system of charges thus prescribed in the classification and rate sheet, each tariff provides for a certain number of special rates or charges made for particular lines of trade in certain localities, independently of their relation to the general system. If these special rates are published in the tariff, and are offered to all persons alike, provided they can fulfil the conditions imposed by the company, they are known as commodity rates, and are apparently a necessity in any scheme of railway charges. If, however, they are not published, and are given to certain persons as individual favours, they become a prolific source of abuse, and are quite indefensible from the standpoint of political economy.

While the superficial appearance of the railway tariff is different for different countries, and sometimes for different parts of the same country, the general principles laid down are followed in rate-making by all well-managed lines, whether State or private. It is a mistake to suppose that the question of public or private ownership will make any considerable difference in the system of rate-making adopted by a good railway. A State system will be compelled, by the exigencies of the public treasury, to arrange its rates to pay interest on its securities; a private company will generally be prevented, by the indirect competition of railways in other parts of the country which it serves, from doing very much more than this. The relative merit of the two systems depends upon the question how we can secure the best efficiency and equity in the application of the principles thus far laid down. There are three different systems of control:—

1. *Private operation, subject only to judicial regulation*, was exemplified most fully in the early railway history of the United States. Until 1870 railway companies were almost free from special Acts of control; and, in general, any company that could raise or borrow the capital was allowed to build a railway wherever it saw fit. In the United Kingdom there was almost as much immunity from legislative interference with charges, but the companies were compelled to secure special charters, and to conform to regulations made by the Board of Trade in the interests of public safety. The advantage of this relatively free system of railway building and management is that it secures efficient and progressive methods. Most of the improvements in operation and in traffic management have had their origin in one of these two countries. The disadvantage attendant upon this system is that the courts are reluctant to exercise the right of regulation, except on old and traditional lines, and that in the face of new business methods the public may be inadequately protected. There is also this further disadvantage, that in the gradual progress of consolidation railway companies take upon themselves the aspect of large monopolies, of whose apparently unrestricted power the public is jealous. As a result of these difficulties there has been, both in the United Kingdom and in the United States, a progressive increase of legislative interference with railways. In the former the Railway and Canal Traffic Act of 1854 specially prohibited preferences, either in facilities or in rates. The Regulation of Railways Act of 1873 provided for a Railway Commission, which should be so constituted as to take cognizance of cases on the investigation of which the courts were reluctant to enter. Finally, the legislation of 1888 put into the hands of a reorganized Railway Commission and of the Board of Trade powers none the less important in principle because their action has been less in its practical effect than the advocates of active control demanded. In the United States the years from 1870 to 1875 witnessed sweeping and generally ill-considered legislation ("Granger" Acts) concerning railway charges throughout the Mississippi valley; while the years from 1884 to 1887 were marked by more conservative, and for that reason more enforceable, Acts, which culminated in the Interstate Commerce Act, prohibiting personal discrimination and gradually restricting discrimination between places, and providing for a National Commission of very considerable power—not to speak of the pooling clause, which was extraneous to the general purpose of the Act, and has tended to defeat rather than strengthen its operation. An increased amount of attention has also been paid, both by the states and the government, to laws in the interests of public safety.

2. *Operation by private companies, under specific provisions of the Government authorities with regard to the method of its exercise*, has been the policy consistently carried out in France, and less systematically and consistently in other countries under the domination of the Latin race. It was believed by its advocates that this system of prescribing the conditions of construction and operation of lines could promote public safety, prevent waste of capital, and secure passengers and shippers against extortionate rates. These expectations have been only partially fulfilled. Well trained as was the civil service of France, the effect of this supervision in deadening activity was sometimes more marked than in its effect in preventing abuse. Moreover, such a system of regulation almost necessarily carries with it a guarantee of monopoly to the various companies concerned, and not infrequently large gifts in the form of subsidies, for without such aid private capital will not submit to the special burdens involved. These rights, whether of monopoly or of subsidy, form a means of abuse in many directions. Where the Government is bad, they are a fruitful source of corruption; even where it is good, they enable the companies to drive hard bargains with the public, and prevent the expected benefits of official control from being realized.

3. *State operation and ownership* is a system which originated in Belgium at the beginning of railway enterprise, and has been consistently carried out by the Scandinavian countries and by Hungary. Since 1860 it has been the policy of Australia. It has generally come to be that of Germany and, so far as the finances of the countries allow, of Austria and Russia; British India also affords not a few examples of the same method. The theory of State ownership is excellent. So large a part of the railway charge is of the nature of a tax, that there seem to be *à priori* reasons for leaving the taxing powers in the hands of the agents of the Government. In practice its operation is far more uncertain. Whether the intelligence and efficiency of the officials charged by the State with the handling of its railway system will be sufficient to make them act in the interest of the public as fully as do the managers of private corporations, is a question whose answer can only be determined by actual experience in each case. If they fail to have these qualities, the complete monopoly which a Government enjoys, and the powers of borrowing which are furnished by the use of the public credit, increase instead of diminishing the danger of arbitrary action, unprogressiveness, and waste of capital. Even in matters like public safety it is by no means certain that Government authorities will do so well as private ones. The question is one which practical railway men have long since ceased to argue on general principles: they recognize that the answer depends upon the respective degree of talent and integrity which characterize the busi-

ness community on the one hand and the Government officials on the other.

Authorities.—On economics of construction and of operation, see Wellington, *The Economic Theory of Railway Location*, 5th edition, New York, 1896. On principles governing railway rates in general, and specifically in England, see Acworth, *The Railways and the Traders*. London, 1891. On comparative railway legislation and the principles governing it, see Hadley, *Railroad Transportation; Its History and Its Laws*, New York, 1885. On the history of railway legislation in England, see Cohn, *Untersuchungen über die Englische Eisenbahnpolitik*, Leipzig, 1874–83. On practice concerning rates in continental Europe, see Ulrich, *Das Eisenbahntarifwesen*, Berlin, 1886. (Since this was published, Continental passenger rates have fallen. The French translation—Paris, 1898—gives Russian tariffs.) (A. T. H.)

British Railway Legislation.

Construction.

The first thing a railway company in Great Britain has to do is to obtain a special or private Act of Parliament authorizing the construction of the line. Not that the mere laying or working of a railway requires parliamentary sanction, so long as the work does not interfere with other people's rights and interests. An example of a railway built without any legislative authority is the little mountain railway from Llanberis to the summit of Snowdon, which was made by the owner of the land through which it passes. Such a railway has no statutory rights and no special obligations, and the owner of it is liable to be sued for creating a nuisance if the working of the line interferes with the comfort of those residing in the neighbourhood. When, however, a company desires to construct a line on a commercial scale, to acquire land compulsorily, to divert rivers and streams, to cross roads either on the level or by means of bridges, to pass near houses, to build tunnels or viaducts, and to execute all the other works incidental to a railway, and to work the line when completed without interference, it is essential that the authority of Parliament should be obtained. The company therefore promotes a Bill, which is considered first by select committees of the two Houses of Parliament, and afterwards by the two Houses themselves, during which period it faces the opposition, if any, of rival concerns, of local authorities, and of hostile landowners. If this is successfully overcome, and the proposals meet with the approval of Parliament, the Bill is passed, and after securing the Royal Assent, becomes an Act of Parliament. The company is then free to proceed with the work of construction, and at once becomes subject to various general Acts, such as the Companies Clauses Act, which affects all joint-stock companies incorporated by any Special Act; the Land Clauses Act, which has reference to all companies having powers to acquire land compulsorily; the Railway Clauses Act, which imposes certain conditions on all railways alike (except light railways); the various Regulation of Railways Acts; the Carriers Protection Act; Acts for the conveyance of mails, parcels, troops; Acts relating to telegraphs to the conveyance of workmen, and to the housing of the labouring classes; and several others which it is unnecessary to specify. From the early days of railways Parliament has also been careful to provide for the safety of the public by inserting in the general or special Acts definite conditions, and by laying upon the Board of Trade the duty of protecting the public using a railway.

Inspection.

The first Act which has reference to the safety of passengers is the Regulation of Railways Act of 1842, which obliges every railway company to give notice to the Board of Trade of its intention to open the railway for passenger traffic, and places upon that public department the duty of inspecting the line before the opening of it takes place. If the officer appointed by the Board of Trade should, after inspection of the railway, report to the department that in his opinion "the opening of the same would be attended with danger to the public using the same, by reason of the incompleteness of the works or permanent way, or the insufficiency of the establishment for working such railway," it is lawful for the department to direct the company to postpone the opening of the line for any period not exceeding one month at a time, the process being repeated from month to month as often as may be necessary. The company is liable to a fine of twenty pounds a day if it should open the line in contravention of such order or direction. The inspections made by the officers of the Board of Trade under this Act are very complete: the permanent way, bridges, viaducts, tunnels, and other works are carefully examined; all iron or steel girders are tested; stations, including platforms, stairways, waiting-rooms, etc., are inspected; and the signalling and "interlocking" are thoroughly overhauled. A code of requirements in regard to the opening of new railways has been drawn up by the department for the guidance of railway companies, and as the special circumstances of each line are considered on their merits, it rarely happens that the department finds it necessary to prohibit the opening of a new railway. The Regulation of Railways Act of 1871 extends the provisions of the above Act to the opening of "any additional line of railway, deviation line, station, junction, or crossing on the level" which forms a portion of or is connected with a passenger railway, and which has been constructed subsequently to the inspection of it. This Act further defines the duties and powers of the inspectors of the Board of Trade, and also authorizes the Board to dispense with the notice which the previous Act requires to be given prior to the opening of any railway or part of it.

It may be remarked that neither of these Acts confers on the Board of Trade any power to inspect a railway after it has once been opened, unless and until some addition or alteration, such as defined in the last-named Act, has been made. When a line has once been inspected and passed, it lies with the company to maintain it in accordance with the standard of efficiency it originally possessed, but no express statutory obligation to do so is imposed upon the company, and whether it does so or not the Board of Trade cannot interfere.

Inquiries into accidents.

The Act of 1871 further renders it obligatory upon every railway company to send notice to the Board of Trade in the case of (1) any accident attended with loss of life or personal injury to any person whatsoever; (2) any collision where one of the trains is a passenger train; (3) any passenger train or part of such train leaving the rails; (4) any other accident likely to have caused loss of life or personal injury, and specified on that ground by any order made from time to time by the Board of Trade. The department is authorized, on receipt of such report, to direct an inquiry to be made into the cause of any accident so reported, and the inspector appointed to make the inquiry is given power to enter any railway premises for the purposes of his inquiry, and to summon any person engaged upon the railway to attend the inquiry as a witness, and to require the production of all books, papers, and documents which he considers important for the purpose. The inspector, after making his investigation, is required to make a report to the Board of Trade as to the causes of the accident and the circumstances attending the same, with any observations on the subject which he deems right, and the Board "shall cause every such report to be made public in such manner as they think expedient." The usual mode of publishing such reports is to forward them to railway companies concerned, as well as to the press, and on application to any one else who is interested. The reports are subsequently included in a Blue-book and presented to Parliament. It should be noted that although the inspecting officer may in his report make any recommendations that he may think fit with a view to guarding against any similar accident occurring in the future, no power is given to the Board of Trade, or to any other authority, to compel any railway company to adopt such recommendations. This omission is sometimes held to be an error, but as a fact it is an advantage. The moral effect of the report, with the criticisms of the company's methods and recommendations appended thereto, is great, and it rarely happens that a company refuses to adopt, or at any rate to test, the recommendations so made. If on the other hand the company is of opinion that the suggestions of the inspecting officer are not likely to prove beneficial, or are for any reason unadvisable, it is at liberty to reject them, the responsibility of doing so resting entirely upon itself. The effect of this latitude is to give the company ample discretion in the matter, and to enable the Act of Parliament to be administered and the object of it to be attained without undue interference.

Working.

In 1889 a very important Act was passed placing upon the Board of Trade the obligation to call upon railway companies throughout the United Kingdom (1) to adopt upon all passenger lines the "block" system of working; (2) to "interlock" their points and signals; (3) to fit all trains carrying passengers with some form of automatic continuous brake. Prior to this some companies had, to a certain extent, done these things, but few, if any, were completely equipped in these respects. A reasonable period was afforded them, according to circumstances, to comply with these requirements, and at the present time the work is practically complete. In this respect the lines of the United Kingdom are far ahead of those of any other country, and a diminution of accidents, particularly of collisions, has resulted therefrom. America is now following the lead thus set, and all the most important lines in the United States have adopted block working and interlocking, but a great deal still remains to be done. In certain respects, on the other hand, America has gone further than the United Kingdom, especially in the matter of automatic signalling, and in the operating of points and signals by electrical power or air-pressure instead of manual labour. In America, also, it is the custom to fit freight trains with an automatic continuous brake, whereas in the United Kingdom this appliance is required by law only in the case of passenger trains, and in fact is not fitted to goods and mineral trains except in one or two isolated instances.

The above-named Acts enable the Board of Trade to take all the necessary steps to ensure that the safety of passenger trains is sufficiently guarded. More recently legislation has been passed to safeguard the lives and interests of railway servants. In 1893 an Act was passed by Parliament giving the Board power to interfere if or when representations are made to them by or on behalf of any servant or class of servants of a railway company that the hours of work are unduly long, or do not provide sufficient intervals of uninterrupted rest between the periods of duty, or sufficient relief in respect of Sunday duty. In such cases the company concerned may, after inquiry, be called upon to submit such a schedule of the hours during which the man or men are employed as will bring those hours within limits which appear to the department reasonable. In the event of the company failing to comply with the demands of the department, the latter is empowered to refer the case to the Railway and Canal Commissioners, who form a special Court constituted by the Railway and Canal Traffic Act of 1888, for deciding, among other things, questions relating to rates and charges, for protecting traders from undue charges and undue preference, for regulating questions of traffic, and for deciding certain disputes between railway companies and the public. The Commissioners are then empowered to deal with the matter, and if "a railway company fail to comply with any order made by the Railway and Canal Commissioners, or to enforce the provisions of any schedule" approved by them, it is liable to a fine of a hundred pounds for every day during which the default continues. This Act has been the means of effecting a considerable reduction in the hours worked by railway men on certain railways, and no case has yet arisen in which a reference to the Commissioners has been necessary. Such modifications of the hours of work have not only been beneficial to the men, but have improved the discipline of the staff and the punctuality and regularity of the train service, particularly in respect of the goods trains.

Hours of labour.

The Notice of Accidents Act of 1884, which obliges employers of labour to report to the Board of Trade, when "there occurs in any employment" as defined by the schedule of the Act, "any accident which causes to any person employed therein, either loss of life or such bodily injury as to prevent him on any one of the three working days next after the occurrence of the accident from being employed for five hours on his ordinary work," affects railways in course of construction, but not, as a rule, otherwise.

Although the administration of the above-mentioned Acts of Parliament has had a beneficial effect upon the safety of the public, and has enabled an enormous volume of traffic to be handled with celerity, punctuality, and absence of risk, it has during recent years come to notice that the number of casualties among railway servants is still unduly great, and in 1899 a Royal Commission was appointed to investigate the causes of the numerous accidents, fatal and non-fatal, to railway men. As a consequence of the report of this Commission the Railway Employment (Prevention of Accidents) Act of 1900 was passed, putting upon the Board of Trade the duty of making "such rules as they think fit with respect to any of the subjects mentioned in the schedule to this Act, with the object of reducing or removing the dangers and risks incidental to railway service." Rules may also be made in respect to other matters besides those mentioned in the schedule, and companies may be called upon to adopt or reject, as the case may be, any appliance, the use or disuse of which may be considered desirable in the interest of the men. Before, however, the rules so made become binding upon the companies, the latter have the right of appealing against them to the Railway Commissioners. Failure to comply with any of the rules renders a company "liable for each offence, on conviction under the Summary Jurisdiction Acts, to a fine not exceeding fifty pounds, or in the case of a continuing offence to a fine not exceeding ten pounds for every day during which the offence continues after conviction." Rules drafted by the Board of Trade under this Act came into force on the 8th of August 1902, the subjects referred to being (1) labelling of waggons; (2) movements of waggons by propping and tow-roping; (3) power-brakes on engines; (4) lighting of stations and sidings; (5) protection of points, rods, &c.; (6) construction and protection of gauge-glasses; (7) arrangement of tool-boxes, &c., on engines; (8) provision of brake-vans for trains upon running lines beyond the limits of stations; (9) protection to permanent-way men when relaying or repairing permanent way. The final settlement of a rule requiring brake-levers to be fitted on both sides of goods-waggons was, however, deferred, owing to objections raised by certain of the railway companies.

Safety of servants.

Other Acts which are of importance in connexion with accidents are the Accidents Compensation Act of 1846; the Employers' Liability Act of 1880, and the Workmen's Compensation Act of 1897.

The public Acts of Parliament referring to British railways are collected in BIGG's *General Railway Acts.* (H. A. Y.)

STATISTICS OF ACCIDENTS.

The railway companies of Great Britain are, as stated above, obliged by the Act of 1871 to give the Board of Trade notice of certain kinds of accidents occurring on their lines. Some of these kinds are explicitly mentioned in the Act, but with regard to requiring notice of others, the Board of Trade has a discretionary power. This it has exercised from time to time, and its general orders now in force specify, as requiring notice, accidents (1) as regards the locomotive power and rolling-stock, such as the bursting of engine-boilers and failures of axles, wheels, tyres, and other parts of locomotive engines, tenders, or vehicles; (2) as regards the permanent way and works, such as the failure of rails, bridges, tunnels, viaducts, &c.; and (3) miscellaneous accidents to rolling-stock and permanent way, such as trains coming into collision with the gates of level-crossings and other obstructions on the lines, &c.

Accidents to trains, such as collisions and derailments, may be divided into two classes, namely, those caused by defective construction or maintenance of the permanent way, works, and rolling-stock, and those caused by mistakes or negligence on the part of the employés of the railway companies; to these must be added a few cases that arise from unavoidable causes, such as obstacles falling on the rails, or the expansion of rails through excessive heat. The improvements in safety appliances on the railways have much reduced the number of serious accidents to trains, and the following summary (Table V.) of the cases into which it was found necessary to order inquiries by the inspecting officers of the Board of Trade, divided into periods of five years, shows to what extent such reduction has taken place since 1871:—

Accidents to trains.

TABLE V.

Number of inquiries held by inspecting officers of the Board of Trade into accidents to trains during successive periods of five years, and total number of miles open for traffic at end of each period of five years.

Period.	Number of Inquiries.	Miles open at End of Period.
1871 to 1875	996	16,658
1876 ,, 1880	621	17,933
1881 ,, 1885	488	19,169
1886 ,, 1890	303	20,073
1891 ,, 1895	266	21,174
1896 ,, 1900	290	21,855

These accidents may be divided into the classes shown in Table VI.:—

TABLE VI.

Class of Accident.	1871–1875.	1876–1880.	1881–1885.	1886–1890.	1891–1895	1896–1900.
A. From engines or vehicles meeting with obstructions, or leaving the rails in consequence of obstructions, or from defects in connexion with the permanent way or works	96	86	78	44	40	27
B. From boiler explosions, failures of axles, wheels, or tyres, or from other defects in the rolling-stock	88	60	40	26	18	9
C. From trains entering stations at too great speed	16	25	40	35	44	30
D. From collisions between engines and trains following one another on the same line of rails, excepting at junctions, stations, or sidings	68	27	23	8	13	18
E. From collisions at junctions	107	67	47	27	26	38
F. From collisions within fixed signals at stations or sidings	394	223	192	112	101	125
G. From collisions between engines or trains meeting in opposite directions	23	9	7	19	4	2
H. From collisions at level-crossings of two railways	5	1	..	..	..	1
I. From engines or trains being wrongly run or turned into sidings or otherwise, through facing-points	124	87	45	20	11	8
J. On inclines (trains)	46	33	10	10	5	11
K. Miscellaneous	29	3	6	2	4	21

The principal improvements which have tended to the reduction of most of the classes of accidents shown in the preceding table

are the adoption of the block system, of interlocking points and signals, and of continuous automatic brakes, all of which the Board of Trade was empowered to order by the Regulation of Railways Act of 1889.

The circumstances which contributed to the accidents inquired into are shown in the following summary (Table VII.); but it must be borne in mind that as a large number of the accidents arose from more than one of the circumstances enumerated, this summary shows an excess over the actual number of accidents :—

TABLE VII.

Circumstances contributing to the Accidents.	1871–1875.	1876–1880.	1881–1885.	1886–1890.	1891–1895.	1896–1900.
Defective rolling-stock or failures of apparatus of rolling-stock . . .	174	232	156	77	39	17
Defective road or works signalling and safety apparatus, &c.	412	276	140	80	53	34
Insufficient or defective accommodation for the requirements of the traffic .	120	51	20	5	6	8
Insufficient establishment, long hours, inexperienced servants, or want of proper supervision	187	125	20	31	69	38
Defective systems for securing intervals between trains	212	89	49	35	25	11
Negligence, want of care, and mistakes of officers and servants	740	459	360	233	220	244
Foggy or stormy weather	82	47	39	31	25	30

In the accidents that occurred to trains, the loss of life and personal injury to passengers was as shown in Table VIII :—

TABLE VIII.

Year.	Number of Passengers Killed and Injured from Accidents to Trains.		Number of Passenger Journeys (exclusive of Journeys by Season-Ticket Holders).	Proportion of Killed and Injured to Number carried.	
	Killed.	Injured.		Killed.	Injured.
1874	86	1613	477,840,411	1 in 5,556,284	1 in 296,243
1875	17	1212	506,975,234	1 „ 29,882,073	1 „ 418,296
1876	38	1279	538,287,295	1 „ 14,165,455	1 „ 420,865
1877	11	664	551,593,654	1 „ 50,144,876	1 „ 830,713
1878	24	1173	565,024,455	1 „ 23,542,685	1 „ 481,692
1879	75	602	562,732,890	1 „ 7,503,105	1 „ 934,772
1880	29	904	603,885,025	1 „ 20,823,586	1 „ 668,013
1881	23	987	622,160,000	1 „ 27,050,435	1 „ 630,354
1882	18	803	654,838,295	1 „ 36,379 905	1 „ 815,489
1883	11	662	683,718,137	1 „ 62,156,194	1 „ 1,032,806
1884	31	864	694,991,860	1 „ 22,419,092	1 „ 804,388
1885	6	436	697,213,031	1 „ 116,202,171	1 „ 1,599,112
1886	8	615	725,584,390	1 „ 90,698,049	1 „ 1,179,812
1887	25	538	733,670,000	1 „ 29,346,800	1 „ 1,363,699
1888	11	594	742,499,164	1 „ 67,530,000	1 „ 1,250,555
1889	88	1016	775,183,073	1 „ 8,808,875	1 „ 762,975
1890	18	496	817,744,046	1 „ 45,430,224	1 „ 1,648,677
1891	5	875	845,463,668	1 „ 169,092,733	1 „ 966,244
1892	21	601	864,435,388	1 „ 41,163,589	1 „ 1,438,328
1893	17	484	873,177,052	1 „ 51,363,356	1 „ 1,804,084
1894	16	347	911,412,926	1 „ 56,963,307	1 „ 2,626,550
1895	5	399	929,770,909	1 „ 185,954,182	1 „ 2,330,253
1896	5	388	980,339,433	1 „ 196,067,887	1 „ 2,526,648
1897	18	324	1,030,420,201	1 „ 57,245,567	1 „ 3,180,309
1898	25	632	1,062,911,116	1 „ 42,516,445	1 „ 1,681,821
1899	14	693	1,106,691,991	1 „ 79,049,428	1 „ 1,596,958
1900	16	863	1,142,276,686	1 „ 71,392,293	1 „ 1,323,611
1901	0	476	1,172,395,900	...	1 „ 2,463,017

From this table it will be seen that no deaths occurred to passengers from collisions, derailments, &c., on the railways of the United Kingdom in the year 1901. The two accidents involving the greatest loss of life in the period covered by the table were (1) the Tay Bridge disaster, which occurred in 1879, when, owing to the failure of the bridge while a train was passing over it during a gale, the train was thrown into the water and 73 passengers lost their lives; and (2) the terrible accident at Armagh in 1889, when the rear portion of a passenger train ran back down an incline and came into collision with a following passenger train, causing the death of 80 passengers and injury to 262 others.

Accidents to passengers.

Accidents to passengers from causes other than accidents to the trains in which they were travelling for the years 1875, 1880, 1885, and 1890–1901 are shown in Table IX :—

TABLE IX.

Year.	From Accidents in connexion with the Movement of Trains, Railway Carriages, &c.		From Accidents on Railway Premises not in connexion with the Movement of Trains, &c.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
1875 . .	...	...	...	...	117	594
1880 . .	114	709	4	204	118	913
1885 . .	96	693	5	223	101	916
1890 . .	100	865	3	359	103	1224
1891 . .	98	737	8	266	106	1003
1892 . .	108	747	12	336	120	1083
1893 . .	89	737	7	312	96	1049
1894 . .	101	821	4	323	105	1141
1895 . .	78	710	4	297	82	1007
1896[1] . .	88	1198[1]	5	515[1]	93	1713[1]
1897 . .	115	1315	2	586	117	1901
1898 . .	128	1238	9	489	137	1727
1899 . .	141	1457	10	617	151	2074
1900 . .	119	1563	7	624	126	2187
1901 . .	135	1669	23	680	158	2349

[1] *Note.*—In the year 1896 an Order of the Board of Trade under the Regulation of Railways Act 1871, laying down more stringent regulations for reporting non-fatal accidents, came into force. By this Order companies are required to report *all* cases of injury to passengers. The principal causes of accidents to passengers in this class are from falling between trains and platforms or on the ballast when entering or alighting from trains in motion, from falling off platforms or out of trains, from being run over when crossing the lines at stations, and from falling when ascending or descending steps at stations.

Total risk to passengers.

Taking the figures for 1901, the total risk to passengers from the time they entered the premises of the railway company until their departure therefrom was—

Fatal accidents . . .	1 in 7,420,227
Non-fatal accidents . . .	1 „ 415,007

This calculation, like those previously given in the above tables, does not take into account the journeys made by holders of season-tickets, of which 1,879,136 were issued in 1901, as the number of journeys made by the holders cannot be estimated. It is obvious that if an accurate estimate of these journeys could be made, a large increase in the number of passenger journeys would be shown, with a corresponding benefit to the passenger when calculating his risk of accident.

Accidents to employés.

Notwithstanding the measures taken by the railway companies for the protection of their servants when on duty, and the efforts of the Government to reduce the risks incurred by the men, the number of accidents of this class continue to be high. The effects of the Rules issued by the Board of Trade under the Railway Employment (Prevention of Accidents) Act of 1900 will, it is hoped, however, tend to the reduction of these accidents. The principal risks incurred by the men are those entailed by shunting operations, and by the work of repairing or inspecting the permanent way while the traffic is in progress. The Rules issued by the Board of Trade are intended to minimize these risks. Table X. shows the number of accidents occurring to servants of the companies in traffic operations, but a large number of slight accidents occur from causes in which the movement of the traffic is not concerned, and these are not included in the two following tables (Tables X. and XI.)

The number of persons employed by the railway companies is known accurately for certain years only, namely, 1874, 1884, 1889, 1895, 1898, and 1901, but for the purposes of these tables it has been estimated for the other years taken (estimated figures being printed in italics).

The apparent sudden rise of the injuries in 1896 is due to the effect of the Board of Trade Order of October 1895, referred to in the note to Table IX. From the commencement of 1896 the companies were required to report non-fatal accidents to their servants whenever they were such as to prevent the servant injured, on any one of the three working days next after the accident, from being employed for five hours on his ordinary work.

TABLE X.

Year.	By Train Accidents.		By Accidents on Railways, exclusive of Train Accidents.		Proportion of Accidents occurring to Servants of Companies by Train and other Accidents to the whole Number employed.		Total Numbers employed by the Railway Companies.
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	
1874 .	46	271	742	2544	1 in 320	1 in 89	250,000
1875 .	21	239	744	3379	1 ,, 334	1 ,, 70	255,000
1876 .	28	236	645	2364	1 ,, 386	1 ,, 100	260,000
1877 .	22	154	620	2009	1 ,, 414	1 ,, 123	265,000
1878 .	15	156	529	1847	1 ,, 500	1 ,, 135	270,000
1879 .	8	118	444	1836	1 ,, 619	1 ,, 143	280,000
1880 .	23	118	523	1962	1 ,, 531	1 ,, 139	290,000
1881 .	19	168	502	2278	1 ,, 576	1 ,, 123	300,000
1882 .	21	153	532	2423	1 ,, 570	1 ,, 122	315,000
1883 .	11	87	543	2373	1 ,, 596	1 ,, 134	330,000
1884 .	23	115	523	2204	1 ,, 634	1 ,, 149	346,426
1885 .	13	81	438	2036	1 ,, 768	1 ,, 163	346,426
1886 .	4	81	421	1929	1 ,, 815	1 ,, 172	346,426
1887 .	8	109	414	1966	1 ,, 821	1 ,, 167	346,426
1888 .	7	93	389	2100	1 ,, 874	1 ,, 157	346,426
1889 .	4	117	431	2652	1 ,, 877	1 ,, 138	381,626
1890 .	12	147	487	2975	1 ,, 705	1 ,, 122	381,626
1891 .	12	154	537	3007	1 ,, 695	1 ,, 121	381,626
1892 .	9	92	525	2823	1 ,, 714	1 ,, 130	381,626
1893 .	10	73	450	2558	1 ,, 829	1 ,, 145	381,626
1894 .	6	62	473	2649	1 ,, 796	1 ,, 140	381,626
1895 .	12	88	430	2566	1 ,, 1052	1 ,, 175	465,112
1896 .	3	153	444	3833	1 ,, 1040	1 ,, 117	465,112
1897 .	9	140	501	3989	1 ,, 912	1 ,, 113	465,112
1898 .	16	110	488	4039	1 ,, 1060	1 ,, 129	534,141
1899 .	19	196	512	4437	1 ,, 1006	1 ,, 115	534,141
1900 .	24	180	559	4405	1 ,, 916	1 ,, 116	534,141
1901 .	8	156	503	4087	1 ,, 1127	1 ,, 135	575,834

Table XI. shows, for the year 1901, the risks incurred in the more important classes of railway service :—

TABLE XI.

Class of Servants.	Number Employed in 1901.	Number of Servants of Railway Companies Killed and Injured during the Year 1901.		Proportion to the Number Employed.	
		Killed.	Injured.	Killed.	Injured.
Stationmasters .	8,103	2	23	1 in 4051	1 in 352
Brakesmen and goods-guards .	15,708	42	845	1 ,, 374	1 ,, 18
Permanent-way men . . .	66,621	121	149	1 ,, 551	1 ,, 447
Gatekeepers . .	3,507	3	6	1 ,, 1169	1 ,, 584
Engine-drivers .	25,556	26	342	1 ,, 983	1 ,, 75
Porters . .	55,276	45	572	1 ,, 1228	1 ,, 97
Shunters . .	10,841	41	650	1 ,, 264	1 ,, 17
Firemen . .	24,083	24	496	1 ,, 1003	1 ,, 49
Inspectors . .	6,772	7	19	1 ,, 967	1 ,, 356
Guards (passenger)	7,291	8	122	1 ,, 911	1 ,, 60
Pointsmen and signalmen .. .	28,496	12	70	1 ,, 2377	1 ,, 407
Labourers . .	53,282	33	153	1 ,, 1615	1 ,, 348
Ticket collectors and examiners .	3,642	1	17	1 ,, 3642	1 ,, 214
Mechanics . .	81,440	18	26	1 ,, 4524	1 ,, 140
Other classes .	185,216	108	724	1 ,, 1715	1 ,, 256
Total . .	575,834	491	4214	1 in 1173	1 in 137

TABLE XII.

Year.	Number of Persons Killed at Level-Crossings.	Number of Persons Injured at Level-Crossings.	Year.	Number of Persons Killed at Level-Crossings.	Number of Persons Injured at Level-Crossings.
1875	66	41	1895	65	33
1880	74	30	1896	51	27
1885	58	21	1897	80	25
1890	83	35	1898	64	27
1891	66	31	1899	60	22
1892	77	21	1900	63	35
1893	55	30	1901	55	26
1894	80	31			

The number of accidents to persons making use of level-crossings over the railways does not show any appreciable diminution in the 25 years from 1875 to 1901, although improvements have been made by the provision of foot-bridges or subways at many busy places where the level-crossings were previously the only means of crossing the line, and in other cases by the provision of signals interlocked with the gates. The numbers of persons killed and injured while passing over level-crossings in certain years are shown in Table XII.

Other accidents.

The remaining classes of accidents on railways are those which occur to trespassers on the railways, of whom 282 were killed and 154 injured in 1901; those which occur to persons transacting business at railway stations and sidings (principally traders' servants engaged in obtaining or delivering goods), 17 of whom were killed and 122 injured in 1901; and those that occur to persons who can neither be described as being on business or trespassing, of whom 24 were killed and 28 injured in 1901. In addition, 144 persons committed suicide by placing themselves in front of trains in 1901, and 17 persons were injured while apparently attempting to commit suicide in the same manner. The number of suicides is slightly in excess of the average number for preceding years.

Accidents in United States.

In the United States of America the figures of accidents are now reported under an Act of Congress, approved on the 3rd March 1901, which requires that "common carriers engaged in interstate commerce make full reports of all accidents to the Interstate Commerce Commission by a monthly report under oath, of all collisions of trains, or where any train or part of a train leaves the track, and of all accidents which may occur to its passengers or employés while in the service of such common carrier and actually on duty." The reports rendered in accordance with this Act are apparently more complete than those hitherto furnished, but the requirements of the Act do not include accidents at level-crossings. For the second six months of 1901 it appears that 108 passengers were killed and 1999 injured in accidents to trains, and 87 were killed and 1510 injured in other accidents. The number of employés killed was 1343, and 17,213 were injured. Compared with the accidents in the United Kingdom for the same period of six months the relative figures are given in Table XIII. :—

TABLE XIII.

	United States of America.		United Kingdom.	
	Killed.	Injured.	Killed.	Injured.
Passengers . .	195	3,509	80	1299
Servants . . .	1343	17,213	286	2178

The latest proportions given for the United States are for the year ending 30th June 1900, as shown in the Report of the Interstate Commerce Commission ; these are compared with the British figures for the year ending 31st December 1900 in Table XIV :—

TABLE XIV.

	United States.		United Kingdom.	
	Killed.	Injured.	Killed.	Injured.
Passengers: Proportion of killed and injured from accidents in connexion with the movement of trains to number of passenger journeys .	1 in 2,316,648	1 in 139,740	1 in 8,461,309	1 in 470,848
Servants: Proportion of killed and injured to numbers employed	1 in 399	1 in 26	1 in 916	1 in 116

The differences between the mileage of the railways, the numbers of passengers carried, and the numbers of employés in the two countries in the year 1900 are shown in Table XV. It will

TABLE XV.

	United States. Year ending 30th June 1900.	United Kingdom. Year ending 31st December 1900.
Mileage of railways . .	193,345	22,078
Number of passengers carried in 12 months . . .	576,865,230	1,142,276,686
Number of employés . .	1,017,653	575,834

be noticed that while the mileage and number of employés is higher in the United States than in the United Kingdom, the number of passengers carried is higher in the United Kingdom.

The number of persons killed and injured at level-crossings (not including those described as employés and trespassers) was 558 killed and 1090 injured in the year ending 30th June 1900, as against 59 killed and 29 injured in the same period in the United Kingdom. (H. A. Y.)

Financial Organization.

Before considering the general method of financial organization of railway companies, it is important to note the attitude taken up by the State toward their construction. In the United States public policy encourages the free building of lines by providing, under general laws, that any body of citizens may become incorporated in order to locate a railway, expropriate the necessary land, and proceed with construction and operation, the sole preliminary being that evidence must be shown of *bona fides* by a most modest subscription of capital. The effect of this legislation has been to make the railway a highly competitive business, subject from the investor's point of view to the extra hazards which must necessarily attend on capital engaged in fierce competition. From the point of view of the public, the policy mentioned has resulted in the multiplication of lines, and consequent cheap rates of service, together with wide development of territory. In the other countries of the world, where Government sanction has to be obtained for each undertaking, after proof not only of the ability of promoters to further the enterprise, but also of its present necessity and probable profitable conduct, the result is to surround capital with greater safeguards, but at some sacrifice of public benefit.

Some economic and *quasi*-political questions of importance may arise as the pressure of continuous high rates threatens to handicap a given region in the commercial race. For instance, in the United States the so-called "Granger" movement by the farmers was an important political force for some years. As the product of the farm depended largely on export values, it followed that the producers in the far interior found the cost of transportation to the sea a heavy burden, and largely disproportionate to the charge upon their competitors nearer to the shore. The progress of competition between rival carriers finally afforded a natural solution of this difficulty, by the reduction brought about in the rates of freight until a point was reached where it bore small proportion to the value of the article transported. But in cases where the same difficulty presents itself with a governmental concession practically precluding competition in rates, the aggrieved citizen naturally turns to the State for redress. This situation is beginning to assert itself in the Argentine Republic, in the British colonies, and to some extent in England itself.

The financial organization of railways began in various countries on substantially identical lines where it was proposed to build under private corporations. The shares of the corporation, after being paid for, carried no further liability, and the capital thus raised by subscription was augmented by borrowing under powers conferred by legislation or charter. Financial developments, however, soon assumed different forms in the different countries. In Great Britain and on the Continent borrowing powers were granted in very limited degree, generally for only one-fourth of the capital, and the debenture, or other obligation representing the authorized debt, became esteemed as a security of the highest character for investment. In the United States, on the other hand, borrowing powers were exercised for the most part under general laws and without limitation, so that often all the actual capital for building a railway was raised by forms of debt, while the share capital was issued solely for contractors' profit, and afforded no guarantee or margin for protection of indebtedness. The latter, therefore, became necessarily a much more precarious form of security for the investor, and large losses ensued to the public, both in the United States and in Europe, by reason of a confused belief that bonds or debentures indicated in each community an identical security, whereas the case was quite otherwise. In the former country, as has been above pointed out, the existing conditions of free competition call for the same examination on the part of an investor into individual conditions and environment as would be needful in respect to any other competitive industry. As rates have fallen, it has come to pass, particularly in the United States, that a complete rehabilitation of the plant has been gradually forced upon all the railways of the country. As the cost of hauling a large train-load is proportionately much less than of hauling a small one, the efforts of managers have been directed to increasing the carrying capacity of their trains. Herein is the explanation of the demands for new capital on a great scale by the older railway companies, which otherwise would presumably have reached the approximate limit of capital requirements. Hence, also, arose the policy now general in the United States of devoting a greater or less proportion of net revenues to payment for permanent improvements, instead of dividing them amongst the shareholders, a policy which has excited much criticism among British holders of American shares, but which American opinion has accepted as being for the best interest of shareholders, inasmuch as it gives assurance of greater stability under the stress of commercial fluctuations.

The tendency to amalgamate connecting systems of railway has had a marked stimulus in late years, by reason of the economies in operation and the advantages in conduct of traffic accruing from the extension of lines under one control. A certain jealousy is exhibited in some public quarters lest a centralized power thus vested over a great number of employés should lead to political abuses in a country where manhood suffrage prevails, but it is to the credit of those controlling such great executive powers that they seem to have been exercised, on the whole, wisely and in the public interest.

The peculiar status of the railway in modern life makes it of equal interest to the investor, the employé, and the political economist. It will be found that the best end is subserved for each of these by all development which tends to secure the maximum of service at the minimum of cost. By such influences will be created that volume and diversity of human industry which affords the best guarantee for the welfare of the individual and of the State. To this end the modern railway has proved itself an instrument of greater efficiency than any other, or perhaps than all others combined, as witness in the United States the growth in tonnage from 72,500,000 tons in 1870 to 975,000,000 tons in 1899, an increase of more than 1300 per cent. (J. GR.)

Railway Construction.

The principles of railway construction described in the ninth edition of this Encyclopædia remain true, and most of the essential facts there told need no modification. The changes are in detail.

Gauge. The tendency of time is to unify the gauge in each country and, generally speaking, in the world, though progress in that direction is not without interruption. In France, for example, at the end of 1898 there were 26,044 miles of railway, and of this amount 2490 miles were of narrow gauge, viz., 1 metre, 0·80 metre, and 0·60 metre, while 870 miles of narrow gauge were in course of construction. In British India about

42 per cent. of the total mileage is built to metre gauge or less, while the standard is 5 feet 6 inches, and the metre gauge lines are added to year by year. In the British colonies generally the gauge of 3 feet 6 inches may be called standard; but throughout the world the gauge of 4 feet 8½ inches is much more used than any other, and is increasing in far greater ratio. In North America 4 feet 8½ inches has become almost universal, except for small industrial railways and some short lines for local traffic, chiefly in mountainous country. The long lines of 3 feet gauge have generally been converted, or a third rail has been laid, permitting interchange of vehicles. The gauges of 5 feet and more have disappeared. A considerable number of lines use 4 feet 9 inches; but cars run freely from this gauge to the lines of 4 feet 8½ inches gauge, and back again. The commercial importance of this free interchange of cars is now the controlling fact in deciding on the gauge of a new railway, unless that railway is isolated by its geographical position. In Great Britain, also, the standard gauge is 4 feet 8½ inches, and there railways are now built to other gauges only under exceptional conditions; the "broad gauge" of 7 feet disappeared when the Great Western main line from London to Penzance was converted to standard gauge throughout its length on 20th–23rd May, 1892. In Ireland, however, the standard gauge is 5 feet 3 inches; and perhaps it would have been better for all the countries of Europe and America had 5 feet 6 inches, or even 6 feet, been made the standard, since the physical limits of the power of locomotives and the ultimate carrying capacity of cars would not have been reached so soon.

On the continent of Europe the standard gauge is generally 4 feet 8½ inches, but in Russia it is 5 feet, and in Spain 5 feet 5¾ inches. In France, as in the United States, there are many miles of track of 4 feet 9 inches gauge; but for traffic purposes this is not a break from the standard of 4 feet 8½ inches. The narrow-gauge railways of France have already been mentioned. In other Continental countries there is also an important mileage of metre gauge, and even narrower, on lines of local or secondary importance. India had, in March 1900, 13,670 miles of railway of 5 feet 6 inches gauge, 9496 miles of metre gauge, and 598 miles of special gauges; hence that country will supply valuable comparative data for the study of the efficiency and cost of working of broad and narrow gauge lines, and for such data the reader may be referred to the elaborate yearly reports of the Government of India. In Australia the disadvantages of a break of gauge are already felt. In New South Wales the standard is 4 feet 8½ inches; but in Victoria, on the south, it is 5 feet 3 inches; and in Queensland, on the north, it is 3 feet 6 inches. Obviously, as commerce between the states increases, the tax of a break of gauge at the frontier will become more serious, and for some years various commissioners of those states have urged the importance of one gauge. In New Zealand, Tasmania, and South Africa the gauge is 3 feet 6 inches. In Lower Egypt the standard is 4 feet 8½ inches, but the line into the Egyptian Sudan is 3 feet 6 inches. The reasons for building the Sudan line to this gauge were weighty and sufficient; but the time will come when a struggling commerce will be taxed with the perpetual costs of a break of gauge. On the other hand, the South African railways are built to 3 feet 6 inches; and if the so-called Cape-to-Cairo railway is ever completed, there will be one gauge from Upper Egypt to Cape Town.

Sleepers.

For sleepers (called cross-ties or ties in the United States) wood is the material still generally used. Metal is employed for the purpose in a few countries where timber is scarce, or liable to destruction by white ants, and, also somewhat experimentally, on a considerable mileage on the continent of Europe; but its use there is not increasing, and in the United States it is exceedingly limited. In England, Germany, and France at least 90 per cent. of the wooden sleepers are treated before they are laid, to preserve them from decay, and the same practice is followed to some extent in other European countries. A great number of preservative processes have been tried (many of them patented), but the one now most largely used is that known as "creosoting." Dead oil of coal tar is forced into the wood under pressure, or sucked in under vacuum, both the timber and the oil being heated. In the United States only a very small percentage of the cross-ties are treated in any way beyond seasoning in the open air, timber being still too cheap in nearly all parts of that country to justify preservative treatment—at least so the officials of the railways think. A few lines, however, which have a long mileage in timberless regions do treat their sleepers. Probably the large majority of railway engineers in nearly all countries believe that timber sleepers, preserved in some way, and protected from direct wear by plates or chairs under the rail, will be standard practice for many years. Steel is the only material that can be substituted for wood in the present stage of invention, and generally it is still too costly for this use.

Rails.

One of the most important events in the whole history of the railway was the substitution of steel for iron rails. That made possible the wheel weights and the speeds of to-day, and diminished the cost of maintenance of track to such a point as made possible the rates of to-day. The continued improvement of the steel rail in stiffness of section and in toughness and hardness of material is an element of progressive economy almost as important as the substitution of steel for iron. The weight of rail has increased, particularly in the United States, and in Great Britain rails weighing 95 and 100 lb per yard are now largely laid on main lines. Harder steel is also employed. The important element in controlling this quality is carbon, and in their notions of desirable carbon contents the rail makers and users of Great Britain differ from those of the United States. Generally speaking the rail steel of the United States is higher in carbon, hence harder, than that made and used in England. In the United States the best and most widely accepted practice is from 0·43 per cent. of carbon as the minimum limit for light rails up to 0·70 per cent. for the top limit for heavy rails. Nevertheless, it is true that even there some rail-makers and railways still specify the minimum carbon as low as 0·35 per cent. In Great Britain the limits of carbon adopted range from 0·25 up to 0·50 per cent., but in the greater number of cases 0·4 is specified as the lower limit. It will be seen, therefore, that there is practical agreement in the two countries as to the minimum of carbon, but a wide difference as to the maximum. The tendency on the Continent is towards harder steel than prevails in England. In recent years there has been a real advance in the art of making rails. This has not consisted so much in the acquisition of new knowledge as in the spread of knowledge from a few men to many. It has come to be widely known that the treatment of the steel from the time of melting to the last passage through the rolls is quite as important as the chemistry of the stock. Especially has it become known to many, as it has long been known to a few, that the last work on steel must be done at a comparatively low temperature if the product is to be fine-grained, homogeneous, and tough. The spread of this knowledge has already affected the outline of the cross-section of the rail, in the United States at least, and it will soon begin to affect rolling-mill practice.

To understand how a more correct knowledge of mill treatment has affected the rail section we must look at the typical sections used. In the United Kingdom the

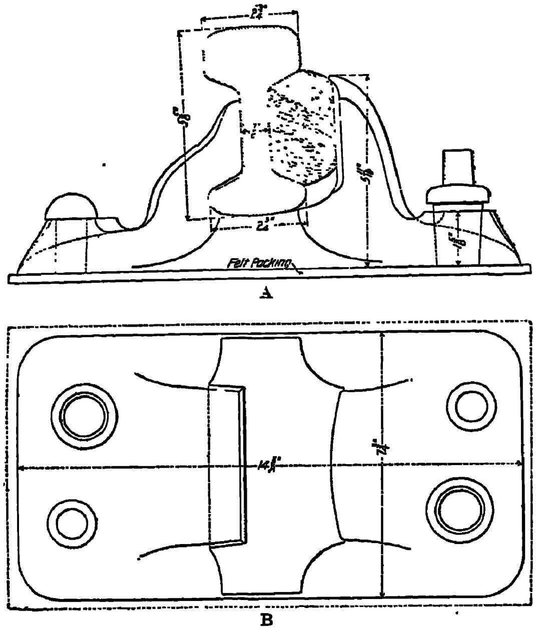


FIG. 1.—A, section of English bull-head rail, 90 lb to the yard, showing also chair and fastenings; B, plan of chair.

standard rail section is the bull-head, which is shown in Figs. 1 and 2. This is used also to a comparatively small extent in France and in India. The rail section much more generally used, always in the United States and nearly always on the continent of Europe, is frequently called the Vignoles section, or in the United States the T rail (Figs. 3 and 4). It is also often spoken of as a flange rail. An inspection of the figures will show that in the bull-head rail the weight of metal in the top and bottom members is not very different, and that the neck (or web) is comparatively thick. Similarly, it will be seen that

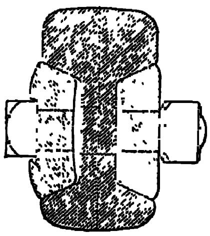


FIG. 2.—English rail and rail joint.

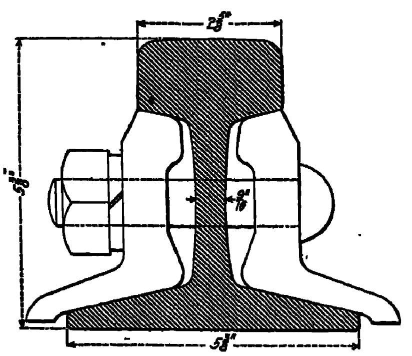


FIG. 3.—American rail, 90 lb to the yard, showing rail joint.

in the Vignoles section the flange or foot is broad and thin, and that there is considerably less metal in the flange than in the head. It will be understood, then, that one part of the bull-head rail cools about as fast as another, but that the flange of the Vignoles rail cools much faster than the head. The result of this is that the finishing passes must be made while the head is at a temperature too high to give good results—otherwise, the flange would be too cool to be rolled. This fact resulted in the development in the United States of what are there called balanced sections—that is, sections in which the metal is divided approximately equally between the head and the flange—and, furthermore, the head is made comparatively broad and thin. The final development of this section was reached in 1893, when the American Society of Civil Engineers recommended a set of standard sections, one

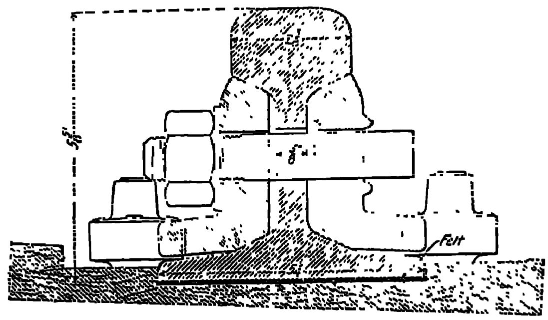


FIG. 4.—French rail, 90½ lb to the yard, showing also rail joint and seat in the sleeper.

of which is seen in Fig. 3. By comparing this with the French rail (Fig. 4) the reader may see the difference in the distribution of the metal. These balanced sections are now standard on many railways, their use is increasing, and, so far as we can now foresee, they are destined to prevail, except that the flange will probably be made thicker. The bull-head section is a better section to roll, but track made with it is more costly, and changes are less convenient; it now seems likely that its use will be continued indefinitely in the British Islands, but that it will not supersede the flange rail elsewhere. The spread of knowledge of the mill treatment of rails is likely to bring about still another change in mill practice, namely, such an arrangement of rolls as will retard the progress of the rails just before they reach the finishing rolls, and permit their temperature to fall, thus making the finishing passes cooler than is now ordinary practice. This will probably be brought about by introducing a table over which the rails will move slowly but continuously, fed up to the finishing rolls at a uniform rate, but having time to cool while on this table. Obviously rail-makers will not permit any change in practice to be made which would diminish the speed and regularity of the output, and it is not for the interest of anybody that such a thing should be done. The plan now developing, as briefly outlined above, will not lessen the speed or quantity of output; it will merely require additional machinery and additional room.

Joints and fastenings.

A few types of rail joints and fastenings are shown in the figures, and little need be added to what the cuts tell. In the United States the joint shown is well-nigh universal. It consists of two symmetrical angle bars, and the variations are in length (from 20 inches to 48 inches), in weight, and in the number of bolts, which may be four or six for each joint. The best length of joint is still much debated. Other joints than the type shown (almost invariably patented) are used, and some of them largely, but far the greater number are of the angle splice type seen in Fig. 3.

Rails in the United States are usually laid directly on the sleepers and spiked with hook-headed spikes driven with a maul. The whole arrangement is simple, and lends itself admirably to fast track-laying, and to repairs and changes of line. Further, it is cheap in first cost, but obviously it is not so durable or so stable as the British and Continental methods. Of late years tie plates have come into considerable use, and their use is increasing. These plates, in the United States, are always made of rolled steel and punched with rectangular holes, through

which the spikes are driven. All the accepted forms now have two or more flanges on the bottom of the plate, running lengthwise of the plate and crosswise of the rail; these are necessary to give the plate proper stiffness, and further, as they are driven into the tie by the weight of passing traffic, they help to fix the plate securely in its place. The plates are laid between the rail and the cross tie and serve two principal purposes: they diminish the wear of the tie under the rail, and they help to support the spike and so to keep the gauge. In Great Britain the simple fish-plate joint, as shown in Fig. 2, is used, often provided with flanges depending vertically below the bottom of the rail, to give additional stiffness to the joint. The rail is laid in a cast-iron chair and held there by a key driven in alongside the rail; this key, which is usually of oak, though sometimes of metal, is now generally placed outside the rails, though the inside position is still to be seen occasionally. The chair is held to the sleeper by screwed spikes and by round drift bolts, which are entered in holes already bored in the sleeper. On some railways, *e.g.*, the Great Western and the Taff Vale, fang bolts are employed. With what has been said of practice in the United States and Great Britain, the figures of Continental joints and fastenings will explain themselves. Wherever the bull-head rail is used, it must be laid in chairs; but the usual Continental practice is to use the Vignoles rail, with plates or strips of felt beneath it, all very carefully fastened to sleepers by screwed spikes. The diagram (Fig. 4) of the French rail and joint shows also the rail seat in the sleeper. The practice of notching the sleeper in this way, and giving the rail a slight cant inwards, is very common on the Continent. The same result is reached in England by canting the rail in its chair. This is never done in the United States, where the rails stand upright; and little pains are taken to prepare seats for them on the ties, on which they soon seat themselves. On the Great Western Railway the practice is to prepare a serrated surface on the sleeper for the chair, which is forced into its seat by hydraulic pressure. On the London and North-Western a strip of felt is interposed between the chair and the sleeper. There is a tendency in Great Britain to increase the weight and bearing-surface of the chairs, also the number of sleepers per mile.

Permanent way.

A section of road-bed typical in the United States is shown in Fig. 5. In Great Britain and the Continent the sleepers are frequently covered with the ballast up to the level of the top of the rail—a practice which adds to stability, but makes inspection and maintenance somewhat more difficult. In general, the reader will be struck by one broad distinction between American and European practice in railway track, namely, the greater expenditure in Europe to get security and permanence. Space does not permit analysis of the causes of this interesting phase of the subject; but underneath it lie the facts that in the United States money and labour were dear, vast and thinly-peopled areas had to be crossed and developed, and the citizen was left to work out his enterprises with the least possible official control. With the gradual equalizing of conditions in the civilized countries of the earth there is a slow but steady movement in the direction of uniformity in railway construction. Various proposals, however, have been brought forward from time to time for constructing railways on principles radically different from those generally followed. In the Lartigue system, for instance, the train is straddled over a single central rail, elevated a suitable distance above the ground. Several small lines have been constructed on this plan, including one, worked by steam, between Ballybunnion and Listowel in Ireland; and in 1901 a Bill was passed by Parliament authorizing a more ambitious railway on the same principle, from designs by Mr F. C. Behr, to connect Liverpool and Manchester. The motive-power is to be electricity, and it is proposed to run frequent trains without a stop between the two places at a speed exceeding 100 miles an hour. In the Langen monorail the car is hung from a single overhead rail; a line on this system is worked between Barmen and Elberfeld, a distance of about 9 miles, the cars for a part of the way being suspended over the river Wupper.

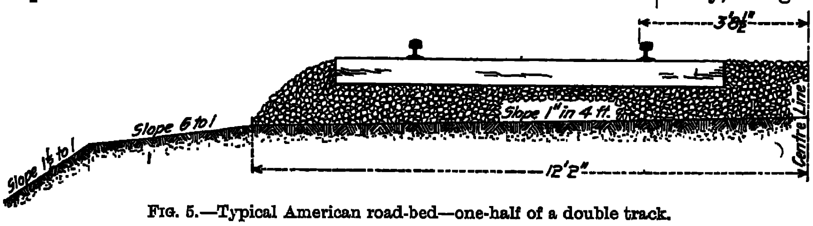


FIG. 5.—Typical American road-bed—one-half of a double track.

The important subjects of tunnels and bridges as related to railway construction are not taken up here, because they are treated in the special articles on those subjects.

(H. G. P.)

SIGNALLING.

In railway phraseology the term "signal" is applied to a variety of hand motions and indications by lamps and other symbols, as well as to fixed signals; but only the last-named class—discs and semaphores, with lights, permanently fixed (on posts) at the side of the track—will be considered here. These may be divided into (1) interlocking signals, used at junctions and yards, and (2) block signals, for maintaining an interval of space between trains following one another. In either class the function of a signal is to inform the engine-driver whether or not he may proceed beyond the signal, or on what conditions he may proceed, and it is essential to give him the information some seconds before it need be acted upon.

Interlocking.

So early as 1846 it became a common practice in England to concentrate the levers for working the points and signals of a station in one or more cabins, and the necessity of interlocking soon became evident to prevent simultaneous signals being given over conflicting routes, or for a route not yet prepared to receive the train. In large terminals concentration and interlocking are essential to rapid movement of trains and economical use of ground. The form of signal now approved practically everywhere is the semaphore (Fig. 7), an arm or blade about 5 feet long extending out horizontally, at right angles to the line of the track, from the top of a post (wood or iron) 15 to 30 feet high, and sometimes higher. This arm, turning on a spindle, is pulled down ("off") to indicate that a train may pass it. The horizontal (or "on") position indicates "stop." A lamp is fixed to the side of the post about on a level with the blade, and by the movement of the blade is made to show at night red for "stop" and green for go-ahead or "all clear." The earlier practice, white for "all clear," still prevails largely in America. The signal is worked from a cabin by rods or wires.

In the early days of railway signalling three positions of the semaphore arm were recognized:—(1) Horizontal, or at right angles to the post, denoting danger; (2) at a downward angle of 45 degrees, denoting caution; (3) hanging vertically downwards or parallel to the post, denoting all right. Corresponding to the position of the arm, three different lights were employed at night —red for danger, green for caution, and white for all right. But of late years, in consequence of the introduction of block-working, British railways make use of only two positions of the arm and two lights—the arm at right angles to the post and a red light,

both signifying danger or stop; and the arm at about 60 degrees and a green light, both meaning all right or proceed. Some companies, while adopting the two positions of the arm or semaphore, still adhere to the use of the three lights—red, green, and white. But the more modern practice of using only red and green lights for signals is far preferable. The reason is obvious. There are many lights and lamps on the platforms, in signal-boxes, and in the streets and houses adjacent to a railway; and if white lights were recognized as signals, a driver might mistake a light of this nature as a signal to proceed: in fact, accidents have been caused in this manner. It is therefore better to abolish the use of white lights for signalling purposes. A white light is not to be regarded as a danger signal, as is sometimes erroneously stated, but rather as no signal at all; and as there is a well-known rule to the effect that "the absence of a signal at a place where a signal is ordinarily shown must be treated as a danger signal," it follows that a white light, when seen at a place where a red or green light ought to be visible, is to be treated as a danger signal, not because a white light *per se* means danger, but because in such a case it denotes the absence of the proper signal. Some companies have adopted a purple light as a "danger" signal for shunting purposes in sidings and yards; but this practice is not to be commended, since red should be the universal danger signal. On the other hand, a few companies have adopted the purple light as an "all-right" signal for shunting purposes, to which there is no objection.

Distant signals are used to make it unnecessary for an engine-driver to slacken his speed in case the stop (*home*) signal is obscured by fog or smoke, or is beyond a curve, or for any reason is not visible sufficiently far away. Encountering the distant signal at a point 400 to 800 yards before reaching the home signal, he is informed by its position that he may expect to find the latter in the same position. The arm of a distant signal usually has a fish-tail end. In America its night colour-indication is made different from that of the home signal. Thus, where white is used to indicate all clear (in both home and distant) the distant arm, when horizontal, shows a green light; where green is the all-clear colour a horizontal distant shows either a yellow light or (on one road) a red and a green light side by side. Two lights for a single arm, giving their indication by position as well as colour, have been used to a limited extent for both home and distant signals. *Dwarf signals* are used for very slow movements, such as those to or from a siding. In cases where room must be economized, signals are usually placed on narrow overhead bridges or "gantries" spanning a number of tracks.

Fig. 6 shows a typical arrangement of interlocked signals, the principle being the same whether a yard has

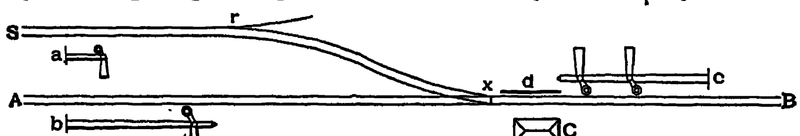


FIG. 6.—Interlocked signals (American practice, signals at right of track, and arms at right of post).

one set of points or a hundred. The signals (at *a*, *b*, and *c*) are of the semaphore pattern (Fig. 7). For the four signals and one pair of points there are, in the second storey of the cabin C, five levers. Each signal arm stands normally in the horizontal position, indicating stop. To permit a train to pass from A to B the signalman moves the arm of signal *b* to an inclined position (60 degrees to 75 degrees downwards); and the interlocking of the levers prevents this movement unless it can safely be made. If *a* has been changed to permit a movement from S to B, or if the points *x* have been set for such a movement, or if either signal on post *c* has been lowered, the lever for *b* is immovable. In like manner, to incline the arm of signal *a* for a movement from S to B it is first necessary to have the points set for track S, and to have the levers of all the other signals in the normal (stop) position. A sixth lever, suitably interlocked, works a lock bar, which engages with the head rod of the points; it is connected to the lock through bar *d* (called in America the detector bar). This bar, about 45 feet long, lying alongside of and close to the rail, must move upwards when the points lock is being moved either to lock or to unlock; and as it is held down by the wheels of any car or engine standing or moving over it, the signalman is prevented from inadvertently changing the points when a train is passing. At *r* is a throw-off or derailing switch ("catch-points"). When *x* is set for the passage of trains on the main line, *r*, connected to the same lever, is open; so that if a car, left on the side track unattended, should be accidentally moved from its position, it could not run foul of the main track. The dwarf signal *a* being for slow movements, has a blade about 1 foot long, and the post is about 4 feet high; the lower arm on post *c* being for slow movements, is also frequently made shorter than the upper one. Where more than two full-sized arms are used on a post, the custom in America is to have the upper arm indicate for the track at the extreme right, and the others in the order in which the tracks lie; in Great Britain the opposite rule prevails, the upper arm indicating for the extreme left.

All the switches and locks are connected with the signal cabin by iron rods (channel-iron or gas-pipe) supported (usually near the ground and often covered by boxing) on small grooved wheels set at suitable distances apart. The foundations of these supports are of wood, cast iron, or concrete. Concrete foundations are comparatively recent, but are cheap and durable. For signals (but not for points) wire connexions are universal in England, and are usual in America, being cheaper than rods. In changing the direction of a line of rodding (pipe) a bell-crank is used, but with a wire a piece of chain is inserted and run round a grooved pulley. Wire connexions are shown at *a* and *b*, Fig. 7, the main or "front" wire being attached at *a*.

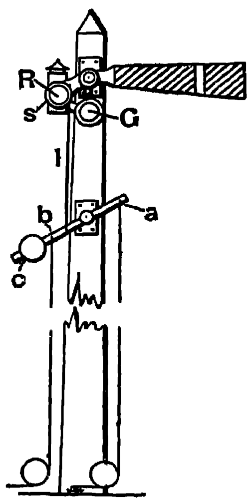


FIG. 7.—Semaphore signal. R, red glass; G, green glass.

By this the signalman moves the arm down to the inclined or go-ahead position, to do which he has to lift the counter-weight *c*. If the wire should break, the counter-weight would restore the arm to the horizontal (stop) position, and thus prevent the unauthorized passage of a train; and in case of failure of the rod l, the iron spectacle *s* would act as a safety counter-weight. The back-wire *b* is added to ensure quick movement of the arm, but is not common in England. Long lines of rigid connexions are "compensated" for expansion and contraction due to changes in temperature by the introduction of bell-cranks or rocker-arms. With wire connexions compensation is difficult, and many plans have been tried. The most satisfactory devices are those in which the connexion, in the cabin, between the wire and the lever is broken when the signal is in the horizontal position. The wire is kept taut by a weight or spring, and at each new movement the lever (if the wire has lengthened or shortened) grips it at a new place.

The function of the interlocking machine is to prevent the simultaneous display of conflicting signals, or the display of a signal over points that are not set accordingly. The most common forms of interlocking have the locking bars arranged in a horizontal plane; but for ease of description we may take one having them arranged vertically,

the principle being the same. The diagram (Fig. 8) shows a section with a side view of one lever. A machine consists of as many levers, placed side by side, as there are points and signals to be moved, though in some cases two pairs of points are moved simultaneously by a single lever, and two or more separate arms on the same post may be so arranged that either one of them will be moved by the same lever, the position of the point connexions being made to govern the selection of the arm to be moved. A switch rod would be connected to this lever at H; the lever K is for use where a signal is connected by two wires, as before described. The lever is held in each of its two positions by the catch rod V, which engages with notches in the segment B. When the signalman, preparatory to lowering a signal, grasps the lever at its upper end, he moves this rod upwards, and in so doing actuates the interlocking, through the tappet N, attached at T. Lifting the tappet locks all levers which need to be locked to make it safe to move this one. In pulling over the lever the rocker R is also pulled; but the slot in it is radial to the centre on which the lever turns, so that during the stroke N remains motionless. On the completion of the stroke and the dropping of V, N is raised still farther, and this unlocks such levers as should be unlocked after this lever is pulled ("cleared" or "reversed"). It will be seen that whenever the tappet N of any lever is locked in the position shown in the figure, it is impossible to raise V, and therefore impossible to move the lever.

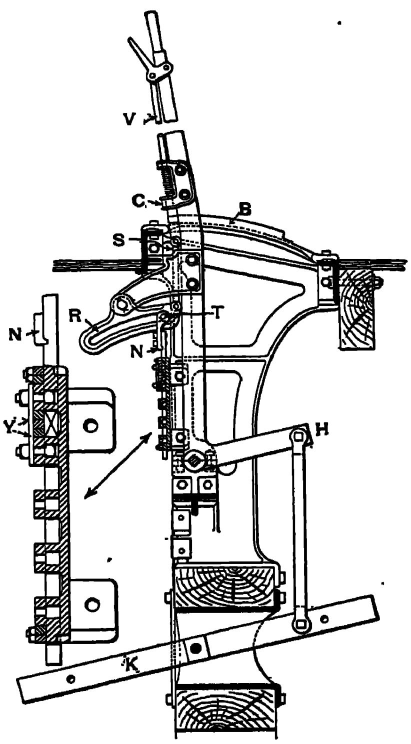


FIG. 8.—Signal lever, with mechanical interlocking.

The action of tappet N may be understood by reference to Fig. 9. A tappet, say 3, slides vertically in a planed recess in the locking plate, being held in place by strips G and K. Transverse grooves N, O, P, carry dogs, such as J. Two dogs may be connected together by bars, R. The dogs are held in place by straps Y (Fig. 8). Locking is effected by sliding the dogs horizontally; for example, dog J has been pushed into the notch in tappet 1, holding it in the normal position. If tappet 2 were raised, its notch would come opposite dog J; and then the lifting of 1 would lock 2 by pushing J to the left. By means of horizontal rod R, the lifting of 1 also locks 4. If 4 were already up, it would be impossible to lift 1.

"*Power interlocking*" is the term used to describe switch and signal machines worked by compressed air, or electric or hydraulic power. The use of power makes it possible to move points at a distance from the cabin. The most widely used apparatus is the electro-pneumatic, which has been installed at over seventy plants in America and to some extent in other countries. One of these, at the South Station, Boston, is probably the most elaborate interlocking plant in the world. In this system points and signals are moved by compressed air at 70 ℔ per square inch, a cylinder with piston being fixed at each signal or switch. From a compressor near the cabin air is conveyed in iron pipes buried in the ground. The valves admitting air to a cylinder are controlled by electromagnets, the wires of which are laid from the cabin underground. Each switch or signal, on completing a movement, sends an electric impulse to the cabin, and the interlocking is controlled by this "return." In the machine the "levers" are very small and light, their essential function being to open and close electric circuits. This is performed through the medium of a long shaft, placed horizontally with its end towards the operator, which is revolved on its axis through 60 degrees of a circle. This shaft actuates the interlocking, which is in principle the same as that already described; and it opens and closes the electric circuits, governing the admission of air to cylinders, by means of simple metal contact strips rubbing on sections of its surface. The high-

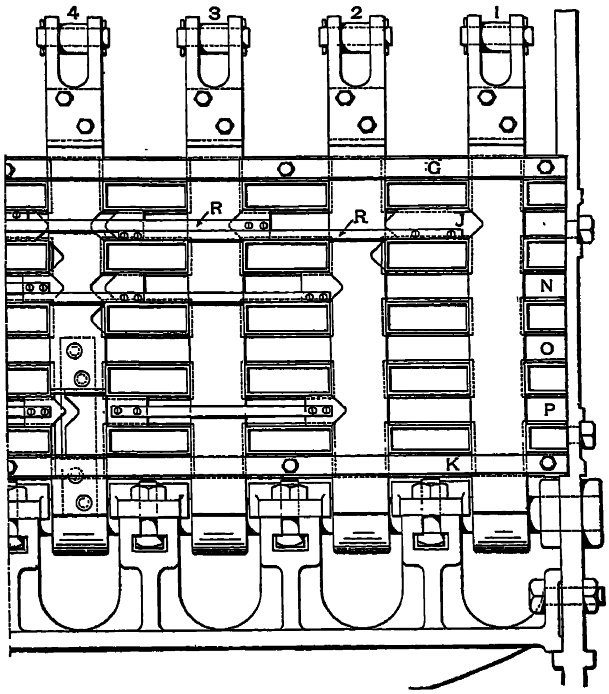


FIG. 9.—Interlocking frame.

pressure machine has been used with hydraulic power instead of pneumatic, and with electrical interlocking instead of mechanical.

Interlocking apparatus worked by compressed air at low pressure (15 ℔ per square inch), and with no electrical features, is in use on some lines in America and has been introduced into England. In place of an electromagnet for admitting compressed air to the cylinders, a rubber diaphragm 8 inches in diameter is used. This is lifted by air at 7 ℔ pressure, this pressure being conveyed from a cabin, 500 feet or more, in one or two seconds. As in the electro-pneumatic machine, the lever of a switch cannot complete its stroke until the switch has actually moved home and conveyed a "return indication" to the cabin. Pneumatic apparatus of other designs is in use to a limited extent.

Pneumatic interlockings are costly to instal, and, depending on an unfailing source of power, have not been much used at isolated places, except on railways where an air-pipe is installed for block signals; but at large yards the pneumatic machines have been made a means of

economy, because one attendant can manage as many levers as can two or three in a manual power machine. Moreover, a single lever will work two or more switches, locks, &c., simultaneously, where desirable. The absence of outdoor connexions above ground is also an advantage.

Since about 1900 electric power has come into use for working both points and signals; although, as mentioned below, motors have been used since about 1897 for isolated automatic signals. At interlocking a motor, with gearing and cranks, is fixed to the sleepers at each pair of points. The power is conveyed from the cabin by underground wires, the locking is of common mechanical types, and, in general, the system is similar to pneumatic systems except in the source of power. By using accumulators, charged by dynamos run by gasoline engines, or by a travelling power-car, the cost of power is reduced to a very low figure, so that power-interlocking becomes economical at small as well as large stations. Electric interlocking is extensively used at Crewe, on the London and North-Western, and at Chicago, Illinois.

Block signalling.

The essence of block signalling is a simple regulation forbidding a train to start from station A until the last preceding train has passed station B. As the introduction of the telegraph was almost or quite contemporaneous with the advent of the railway, the possibility of a block system was early recognized; but its introduction was retarded by the great cost of employing attendants at every block station. But as traffic increased, the time-interval system, dependent, in the case of irregularities, on the efficiency of a flagman, proved inadequate; and in the United Kingdom the block system is now practically universal, while in America it is in use on many thousand miles of line. The Continent is far behind Great Britain.

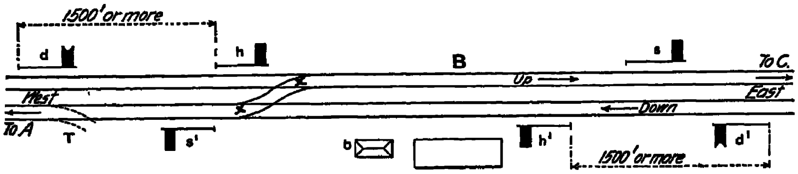


FIG. 10.—Block signals. (English practice, trains run on left-hand track, signals at left of track, arms on left of post.)

The manual "block" system in use at the present day in no way differs from that devised by Cooke in 1842, except so far as the details and designs of the telegraphic instruments are concerned. Cooke used a single-needle instrument giving two indications—the needle to the left signifying "line clear," to the right, "line blocked"; the instrument being also available for speaking purposes. The instruments employed in Great Britain consist of two dials—one for the up line and one for the down—and a bell. They may be divided into two main classes, those requiring one wire, and those requiring three wires for each double line of rails. The dials of the one-wire instruments give only two indications, namely, "line clear" and "train on line" or "line blocked," the latter being the normal indication, even when there is no train in the section. The three-wire instrument has the advantage of giving three indications on the dial, namely, "line clear," "line closed," and "train on line," the normal indication being "line closed." The one-wire instrument differs from the three-wire in that the indicator is moved over to the different positions by a momentary current, and is then held there by induced magnetism, the wire being then free for any succeeding signals. In the three-wire apparatus there is a separate wire, with an instrument at each end for the up line; the same for the down line; and a wire for the bell, which is common to both lines. When no current is flowing, the indicator is vertical, meaning "line blocked or closed." When a current is sent along one of the wires, the deflections to the right or left, according to the polarity of the current, mean "line clear" or "train on line" respectively. Some dial instruments are made with needles, some with small discs, some with miniature semaphores to give the necessary indications, but the effect is the same. The block instruments and bells should not, as a rule, be used for speaking purposes; but on a few subsidiary railways, block working is effected by means of ordinary single-needle telegraphic instruments, or by telephone, the drawback to such an arrangement being that the signalman has no indication before him to remind him of the condition of the line.

Fig. 10 shows the signals at a typical English station, which may be called B. Notice having been received over the block telegraph that a train is coming from A (on the up track), the signalman in the cabin, *b*, lowers the home signal *h*; and (if the block section from B to C is clear of trains) he lowers the starting signal, *s*, also. The function of a distant signal *d* has already been described; it cannot be lowered unless *h* has been lowered. The relation of the signals to the "crossover road" *xx* is the same in principle as is shown in Fig. 6. Dwarf signals are omitted from the sketch. Where the sections are very short, the starting signal of one section is often placed on the same post as the distant signal of the next. Thus, supposing B and C to be very close to each other, B's starting signal would be on the same post as C's distant signal, the latter being below the former, and the two would be so interconnected by "slotting" apparatus that C could not lower his distant signal unless B's starting signal was "off," while B by the act of raising his starting arm would necessarily throw C's distant arm to "danger." In America many block stations have only the home signal, even at stations where there are points and sidings, and on double-track lines the block telegraphing for both is done on a single Morse circuit. In the United Kingdom the practice is to have separate apparatus and separate wires for each track.

Lock-and-block.

In the simple block system it is clearly possible for a signalman, through carelessness, forgetfulness, or other cause, so to lower his signals as to admit a second train into the block section before the first has left it, and that without the driver of either train being aware of the fact. To eliminate as far as possible the chance of such an occurrence, which is directly opposed to the essence of the block system and may obviously lead to a collision, the locking of the mechanical signals with the electrical block instruments was introduced in England by Mr W. R. Sykes about 1876, the apparatus being so arranged that a signalman at one end of a section is physically unable to lower his signals to let a train enter that section until they have been released electrically from the cabin at the other end. The starting signal at a block section A cannot be lowered until the signalman at the next station B, by means of an electric circuit, unlocks the lever in connexion with it. In so doing he breaks the unlocking circuit at his own station, and this break is restored only on the arrival of the train for which the unlocking was performed, the wheels of the train acting through a lever or by a short rail circuit. Valuable improvements have been made in this machine by Patenall, Coleman, and others, and these are in use in America. The passage of a train is also made to set a signal at "stop" automatically, by disconnecting the rod between the signal and its lever. The connexion cannot be restored by the signalman; it must be done by an electromagnet brought into action by the train as it passes the next block station.

"Lock-and-block" has been used to a limited extent on a good many lines in England and a half-dozen in America, but of extensive installations there were in 1901 only four: two in America—the New York, New Haven, and Hartford, 229 miles, and the New York Central and Hudson River, 457 miles, and two in England—the South-Eastern and Chatham and the London and South-Western.

In "permissive blocking," an objectionable practice

which is occasionally resorted to on many lines, especially in America, a second train is permitted to enter a section before the preceding one has cleared it, the engineman being required so to control his speed that if the preceding train be unexpectedly stopped he can himself stop before colliding with it. With this practice "lock-and-block" would be useless.

The block system is used on single as well as on double lines. In the United Kingdom and in Australia the means for preventing collisions between trains running towards each other is the "staff system."

Staff system.

The staff, suitably inscribed, is delivered to the engine-driver at station A, and constitutes his authority to occupy the main track between that station and station B. On reaching B he surrenders the staff, and receives another one which gives him the right to the road between B and C. If there are two or more trains to be moved, all except the last one receive tickets, which belong to that particular staff. The staff system requires no telegraph; but to obviate the inconvenience of sometimes finding the staff at the wrong end of the road, electric staff apparatus has been devised. Staffs (or tablets) in any desired number are kept at each of the two stations, and are locked in a cabinet automatically controlled, through electromagnets, by apparatus in the cabinet at the other station; and a staff (or tablet) being taken out at one station, a second one cannot be taken out at either station until this first one is returned to the magazine at one station or the other. Thus we have a complete block system. By simple "catching apparatus" on the engine, staffs or tablets may be delivered to trains moving at a good speed. The electric staff is used in Great Britain, in Australia, and on half a dozen roads in America.

In America automatic rail-circuit block signals are extensively used, and the Pennsylvania Railroad has substituted them for non-automatic on its main line.

Automatic signals.

They have been introduced in England and France (1901), but only on a very few lines. The apparatus is costly, and so is inspection; but at block stations where there are no points the wages of a signalman are saved. The block sections are made shorter, usually less than a mile long. There are three styles in general use, the Hall (introduced in 1871), the Union clock-work (1880), and the Westinghouse electro-pneumatic (1884). Within the past few years all manufacturers have made signals worked by individual electric motors, and these have been introduced extensively in America. Energy is derived from a non-freezing battery at each post, or from accumulators fed by wires from dynamos situated, say, every 10 miles along the line. Another recent device is the gas-motor signal. A tank of carbonic acid gas, at the foot of the post, furnishes power for several thousand movements. Line-wire circuits have been about abandoned everywhere, and the rail circuit is universal.

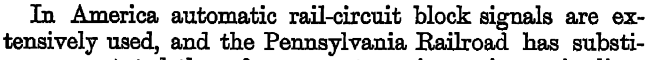


FIG. 11.—Automatic electric block signal, with rail circuit.

Fig. 11 shows the arrangement of a rail circuit. The disc is fixed to a vertical spindle (Fig. 12), and the clock-work revolves the spindle on its axis, one-quarter turn at each operation. The current from the main battery *b* flows through the rails of one side of the track to the signal *s*, through an electromagnet which controls the clock-work, and back to the battery through the other rail. The presence on any part of this block section of a train, or any vehicle with metal wheels connected by metal axles, short-circuits the current from the battery, so that the relay (placed vertically) drops its armature. This releases the clock-work and causes the signal disc to turn so as to indicate "stop." On the restoration of the current the signal makes another quarter turn and then shows only its edge to the approaching train, indicating "all clear." At each rail joint a wire is used to ensure electrical continuity, and at the ends of each block section there are insulating joints. The current for a rail circuit must be of low tension because of the imperfect insulation. As a rule the ballast must not be allowed to touch the rails, and it must be free from iron or other conducting material. Block sections more than about 1 mile long are usually divided into two or more circuits, connected together by relays. At points the rail circuit is run through a circuit breaker, so that the "opening" of the points will set the signal for that section. The circuit is also run through the rails of the side track as far as it fouls the main track. An indicator at each switch gives audible or visual warning of the approach of a train

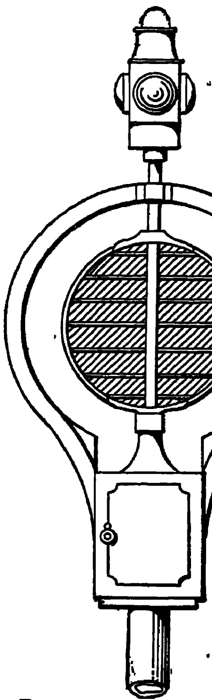


FIG. 12.—Signal moved by clock-work (Union).

The enclosed disc signal, commonly called a "banjo" (Fig. 13), is a circular box about 4 feet in diameter, with a glass-covered opening, behind which a red disc is shown to indicate stop. The disc, very light, made of cloth stretched over a wire, or of aluminium, is supported on a spindle, which is delicately balanced on a pivot so that the closing of an electromagnet lifts the disc away from the window and thus indicates "all clear." On the withdrawal or failure of the current the disc falls by gravity to the "stop" position. A local battery is used, with a relay, the rail circuit not being strong enough to lift the disc.

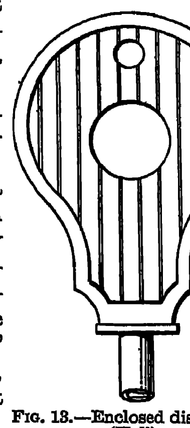


FIG. 13.—Enclosed disc signal (Hall).

In the electro-pneumatic system a full-size semaphore is used. Compressed air, from pumps situated at intervals of 10 to 20 miles, is conveyed along the line in an iron pipe, and is supplied to a cylinder at each signal, exactly as in pneumatic interlocking, before described. The rail circuit, when complete, maintains pressure in a cylinder, holding the signal "off." On the entrance of a train or the failure of the current, the air is liberated and the signal arm is carried by gravity to the "stop" position.

Automatic signals are sometimes made to stand normally (when no train is in the section) in the "stop" position. The local circuit is connected with the rail circuit so that it is closed only when a train is approaching within, say, one mile. With the rail circuit, distant signals are controlled, without a line wire, by means of a polarized relay. Each signal, when cleared, changes the polarity of the rail circuit for the next section in its rear, and this, by the polarized relay, closes the local circuit of the distant signal, without affecting the home signal for that section.

Automatic signals are used in America on a few single lines. The signal at A for the line AB is arranged as before described; and the signal at B, for movements in the opposite direction, is worked by means of a line wire from A, strung on poles. When a section is occupied, signals are set *two* sections away, so as to provide against the simultaneous entry of two trains.

The length of railway in the United States equipped with automatic block signals was in 1902 about 4000 miles.

Fog-signalling. One of the chief causes of anxiety and difficulty in the working of railway traffic is fog, which practically blots out the whole system of visible signals, so that while the block telegraph remains, the means of communicating the necessary instructions to the driver are no longer effective. Delay and confusion immediately arise; and in order to secure safety, speed has to be lessened, trains have to be reduced in number, and a system of "fog-signalling" introduced. In England, especially around London, elaborate arrangements have to be made. "Fog-signalling" consists in the employment of audible signals, or detonators, to convey to drivers the information ordinarily imparted by the visible or semaphore signals. As soon as possible after a fog comes on, a man is stationed at the foot of each distant signal, and generally of each home signal also, who by means of detonators, red and green flags, and a hand-lamp conveys information to the driver of every train as to the position of the semaphore arm. A detonator is a small flat metal case about 2 inches in diameter and ½ inch deep, furnished with two leaden ears or clips which can be easily bent down to grip the head of the rail. The case contains some detonating composition, which readily explodes with a loud report when a wheel passes over it. As soon as a signal arm is raised to "danger," the fogman places upon one of the rails of the track to which the signal applies two detonators, or in the case of a new and improved class of detonator which contains two separate charges in one case, one detonator, and at the same time exhibits a red flag or light to the driver of an approaching train. The engine of a train passing over the detonators explodes them, the noise so made being sufficient to apprise the driver that the signal, though invisible to him, is at danger, and he then should act in the same way as if he had seen the signal. If, however, the signal arm should be lowered to the "all-right" position before a train reaches it, the fogman should immediately remove the detonators and exhibit a green flag or lamp, replacing the detonators as soon as the signal is again raised to danger. As a rule the fogmen are drawn from the ranks of the permanent-way men, who otherwise would be idle. But if, as sometimes happens, a fog continues for several days, great difficulty is experienced in obtaining sufficient men to carry on this important duty without undue prolongation of their hours of work. When this happens, signalmen, shunters, porters, yardsmen, and even clerks may have to be called on to take a turn at "fogging." Some companies have adopted mechanical appliances, whereby a man can place a detonator upon a line of rails or remove it while standing at a distance away from the track, thus enabling him to attend to more than one line without danger to himself. The cost of detonators often amounts to a considerable sum; and an apparatus called an *economizer* has been introduced, whereby the explosion of one detonator removes the second from the rails before the wheels reach it. As it is only necessary for one detonator to explode, the object of placing two on the rails being merely to guard against a miss-fire, considerable saving can thus be effected. Many attempts have been made to design a mechanical apparatus for conveying to a driver the requisite information as to the state of the signals during a fog, and for enabling the fogmen to be dispensed with. Such inventions usually consist of two parts, namely, (1) an inclined plane, or block, or trigger, placed on the permanent way alongside the track or between the rails, and working in connexion with the arm of the signal; and (2) a lever or rod connected with the steam-whistle, or an electric bell or indicator on the foot-plate, and depending from the underside of the engine in such a position as to come in contact with the apparatus on the ground, when the latter is raised above the level of the rails. Most of the proposed systems only give an indication when the signal is at danger, and are silent when the signal is off. This is contrary to good practice, which requires that a driver should receive a positive indication both when the signal is "off" as well as when it is "on." If this is not done, a driver may, if the signal is "off" and if the fog is thick, be unaware that he has passed the signal, and not know what part of the line he has reached. The absence of a signal at a place where a signal is usually exhibited should invariably be taken to mean danger. Fog signals that depend on the explosion of detonators or cartridges have the drawback that they require recharging after a certain number of explosions, varying with the nature and size of the machine. Even when a satisfactory form of appliance has been discovered, the manner of using it is by no means simple. It is clearly no use placing such an apparatus immediately alongside a stop signal, as the driver would receive the intimation too late for him to be able to stop at the required spot. To place devices of this description at or near every stop signal in a large station or busy junction would involve a multiplication of wires or rods which is undesirable. Every such apparatus should certainly be capable of giving an "all-right" signal as well as a "danger" signal. It requires very careful maintenance, and should be in regular daily use to ensure its efficiency.

Development of signalling. The fundamental principles of railway signalling are simple, but the development of the science has called for much study and a large money outlay. On every railway of any consequence the problems of safety, economy, and convenience are involved, one with another, and cannot be perfectly solved. Not for twenty years after block signalling was acknowledged to be desirable did the railways of Great Britain deem themselves able to afford the money to make its use universal. Even so fundamental a duty as that of guarding the safety of life and limb is a relative one, when we have to consider whether a certain expenditure is justifiable for a given safety device. Having good discipline and foregoing the advantages of high speed, many a manager has successfully deferred the introduction of signals; others, having to meet severe competition, or, in Great Britain, under the pressure of the Government, have been forced to adopt the most complete apparatus at great cost. In large city terminal stations, where additions to the space are out of the question, interlocking is necessary for economy of time and labour, as, indeed, it is in a less degree at smaller stations also; as a measure of safety, however, it is desirable at even the smallest, and the wise manager extends its use as fast as he is financially able. At crossings at grade level of one railway with another, and at drawbridges, interlocked signals with derailing switches obviate the necessity of stopping all the trains, as formerly was required by law everywhere in America, and saving a stop saves money. The block system was introduced primarily for safety, but where trains are frequent it becomes also an element of economy. Without it trains must usually be run at least five minutes apart (many managers deem seven or ten minutes the shortest safe interval for general use), but with it the interval may be reduced to three minutes, or less, according to the shortness of the block sections. With automatic signals trains are safely run at high speed only one and a half miles apart. Automatic signals are liable to dangerous failure from sticking of movable parts or from lightning; but records show that a series of signals properly cared for will fail only once in a million times (from all causes); and in view of the lower cost of the automatic, and its perfect adaptability to permissive signalling, makers and users of the system offer the defence that (1) not all failures cause collision; and (2) human attendants also make dangerous mistakes. The signal equipment of the largest railways costs from £100 to £1000 per mile. The electro-pneumatic on a four-track American line has cost \$5000 a mile, not counting interlocking plants. British manufacturers of signals (not railway companies) employ enormous capital. In America automatic signals have been developed at a cost of probably two or three million dollars; and the investment in interlocking represents a still larger sum. On the Continent and in India signalling development has followed that of Great Britain. The German and French lines have many signals, but the equipment of the several lines is far from complete, and the very numerous modifications which have been made in British theories by Continental engineers have not proved improvements, but quite the contrary.

(B. B. A.)

LOCOMOTIVE ENGINES.

Recent changes.

The increase in the weight and capacity of locomotives constitutes the most marked feature in their recent development all over the world. Many factors have contributed to this change. Two of the most important have been the increase of the axle-weight limit and the raising of the boiler above the ground to a sufficient height to allow of almost any desired dimensions of boiler and fire-box, independently of the width between the frames and the diameter of the driving wheels. The improvement in quality of steel boiler plate has permitted an increase in tractive effort with cylinders of a given diameter, and the substitution of cast steel for cast iron in details has reduced useless weight. The general tendency in railway working at the present time is towards higher average speeds with heavier trains, and this circumstance has forced attention to the importance of adequate boiler capacity combined with the highest efficiency of boiler and machinery, especially as the limits of weight and clearance dimensions are being rapidly reached. Clearance dimensions are those heights and widths which must not be exceeded by the engines, carriages, &c., running over a line if they are to avoid coming into contact with fixed structures, such as bridges, tunnels, and platforms. In America, as may be seen from Fig. 14,

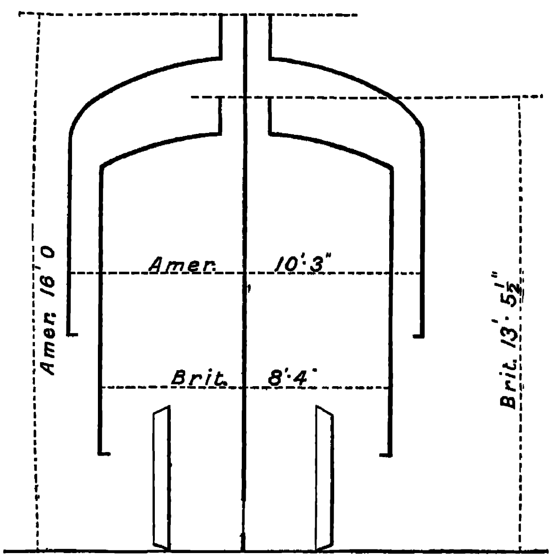


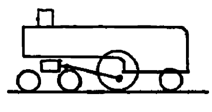
FIG. 14.—British and American clearance gauges.

the maximum permissible measurements are considerably larger than they are in Great Britain, and this fact partially explains the superior size and weight of American engines as compared with British. It is not, however, the whole explanation, for British locomotive designers have not worked nearly up to the extreme dimensions possible until quite recently, and then only in comparatively few cases. Even first-class lines occasionally run some of their fastest and heaviest trains with engines whose designs are thirty years old, and which were suited to a time when the weights to be drawn were much smaller and the average of speed lower. The result is that the wasteful practice of using two engines to one train has frequently to be followed. Even so, there is frequently no reserve of power that will enable a driver to make up lost time; and once late, owing to whatever cause, the train continues so to the end of its journey. It is sometimes argued, however, that even when a driver has an engine capable of "playing with" the load behind it, he has no right to run faster than the speed indicated in his working time-tables, and that if an accident should happen when he was doing so, he might incur a grave legal responsibility. Still, of late years British railway engineers have come to recognize the advantages of ample locomotive power, just as the managers are perceiving the economy of big and full train loads; and recent designs, as may be seen from the examples given below in Table XVI., show increase in boiler capacity, in extent of heating surface, in steam-pressure (which in several cases now reaches 200 ℔ per square inch), in cylinder dimensions, and in adhesive weight. Increased production of steam is the problem that confronts the locomotive engineer, and he has attempted to solve it by the use of larger and longer boilers, and by the employment of various special devices. The employment of liquid fuel is also being tried by several railways in Great Britain, notably the Great Eastern (see PETROLEUM, § *Liquid Fuel*, vol. xxxi.).

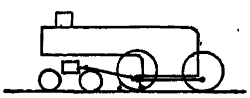
Classification.

Locomotives may be classified, according to the kind of service for which they are employed, into "passenger," "goods" or "freight," and "shunting" or "switching." These broad divisions include many types, which differ with the weight to be hauled, the character of the line, and the speed required, the selection of a type for a given duty being more or less controlled by the custom and tradition of the country. The two main factors governing a design are the required tractive effort and the speed, but locomotive types are best recognized and named according to the number and arrangement of the wheels used for driving. In the following synopsis the small diagrams are intended to indicate the arrangement, relatively to each other, of the boiler, wheels, and cylinders in the principal types into which locomotives may be classified:—

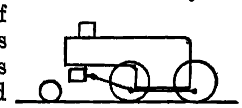
(1) "Single-driver" type. Still used by several railways in Great Britain for express passenger service, but going out of favour; it is also found in France, and less often in Germany, Italy, and elsewhere in Europe. It is frequently designed with three axles only, the driving axle being in the middle. It is adapted for light, high-speed service, and noted for its simplicity, excellent riding qualities, low cost of maintenance, and high mechanical efficiency; but having limited adhesive weight, it is unsuitable for starting and accelerating heavy trains.



(2) "Four-coupled" type, with leading bogie truck. For many years this was practically the only one used in America for all traffic, and it is often spoken of as the "American" type. In America it is still the standard engine for passenger traffic, but for goods service it is now employed only on branch lines. It has been extensively introduced, both in Great Britain and the Continent of Europe, for passenger traffic, and is now the most numerous and popular class. It is a safe, steady-running and trustworthy engine, with excellent distribution of weight, and it is susceptible of a wide range of adaptability in power requirements (see Table XVI., Nos. 1–7, 13, 19, 28, 31, and 34).

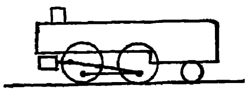


(3) "Four-coupled" three-axle type. Used to some extent in France and Germany and considerably in England for passenger traffic of moderate weight. Engines of this class, with 78-inch driving wheels and the leading axle (which is placed much farther back than is shown in the diagram) fitted with Webb's radial axle-box, for many years have been doing excellent work on the London and North-Western Railway. The famous engine "Charles

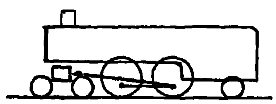


Dickens" was one of this class. Built in 1882, it had, by 12th September 1891, performed the feat of running a million miles in 9 years 219 days, and it completed two million miles on 5th August 1902, having by that date run 5312 trips with express trains between London and Manchester.

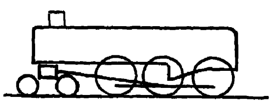
(4) "Four-coupled" three-axle type, with trailing axle. Used on several English lines for fast passenger traffic, and also on many Continental railways. The advantages claimed for it are: short coupling-rods, large and unlimited fire-box carried by a trailing axle, compactness, and great power for a given weight. Its critics, however, accuse it of lack of stability, and assert that the use of large leading wheels as drivers results in rigidity, and produces destructive strains on the machinery and permanent way.



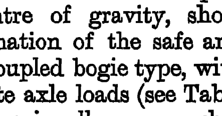
(5) "Four-coupled" type, with a leading bogie truck and a trailing axle. This was, in 1902, the most recent type for powerful express passenger service. It is used to a limited extent both in England and on the Continent, and is rapidly increasing in favour in the United States, where it originated and is known as the "Atlantic" type. It has many advantages for heavy high-speed service, namely, large and well proportioned boiler, practically unlimited grate area, fire-box of favourable proportions for firing, fairly low centre of gravity, short coupling rods, and, finally, a combination of the safe and smooth riding qualities of the four-coupled bogie type, with great steaming capacity and moderate axle loads (see Table XVI., Nos. 9, 10, 20, and 29). Occasionally a somewhat similar type is designed with the bogie under the fire-box and a single leading axle forward under the smoke-box—an arrangement in favour for suburban tank engines. In still rarer cases both a leading and a trailing bogie* have been fitted.



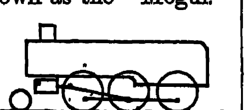
(6) "Six-coupled" with bogie, or "Ten-wheel" type (see Table XVI., Nos. 11, 12, 21, 30, and 35). A powerful engine for heavy passenger and fast goods service. It is used to a limited extent both in Great Britain and on the Continent, but is much more common in America. The design combines ample boiler capacity with large adhesive weight and moderate axle loads, but except on heavy gradients or for unusually large trains requiring engines of great adhesion, passenger traffic can be more efficiently and economically handled by four-coupled locomotives of the eight-wheel or Atlantic types.



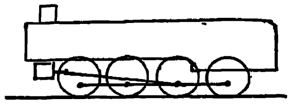
(7) "Six-coupled" total-adhesion type (all the weight carried on the drivers). This is the standard goods engine of Great Britain and the Continent. In America the type is used only for shunting. It is a simple design of moderate boiler power.



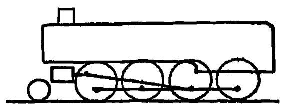
(8) "Six-coupled" type, with a leading axle. This is of American origin, and is there known as the "Mogul." It is used largely in America for goods traffic. On the Continent it is in considerable favour for goods and passenger traffic on heavy gradients. The type is, however, less in favour than either the Ten-wheel or the eight-coupled "Consolidation" for freight traffic (see Table XVI., No. 22).



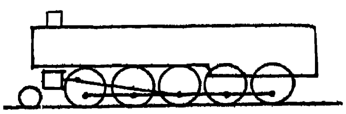
(9) "Eight-coupled" total-adhesion type; now found on a good many English railways and common on the Continent for heavy slow goods traffic. In America it is comparatively infrequent, as total-adhesion types are not in favour (see Table XVI., Nos. 14–17, 32, and 36).



(10) "Eight-coupled" type, with a leading axle. This originated in America, where it is termed the "Consolidation." In the United States it is the standard heavy slow-speed freight engine, and has been built of enormous size and weight. The type has been introduced in Europe, especially in Germany, where the advantages of a partial-adhesion type in increased stability and a larger boiler are becoming appreciated. The wide range in capacity and weight of this type in America is illustrated in Table XVI., Nos. 23–26. No. 25 is an example of a very powerful pusher locomotive for heavy gradients, and shows the application of the Wootten, or wide, shallow fire-box for burning fine anthracite or low-grade bituminous coal. Occasionally the American eight-coupled type has a bogie instead of a single leading axle, and is then termed a "Twelve-wheeler," or "Mastodon."



(11) "Ten-coupled" type, with a leading axle. This originated in America, where it is known as the "Decapod." It is used to a limited extent for mountain-grade goods traffic, and has the advantage over the "Consolidation" or eight-coupled type of lighter axle loads for a given tractive capacity.

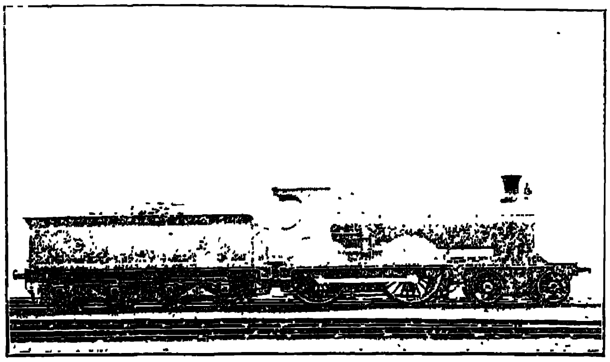


In addition to the foregoing list, various special locomotive types have been developed for suburban service, where high rates of acceleration and frequent stops are required. These are generally tank engines, carrying their fuel and water on the engine proper. Their boilers are of relatively large proportions for the train weight and average speed, and the driving wheels of small diameter, a large proportion of their total weight being "adhesive." Other special types are in limited use for "rack-railways," and operate either by engagement of gearing on the locomotive into a rack between the track rails, or by a combination of this and rail adhesion (see the section below on *Mountain Railways*).

Table XVI., the data for which have been mostly supplied by the various railway companies in Great Britain and the different manufacturers in America, is intended to give some idea of the state of locomotive-building at the beginning of the 20th century, chiefly in Great Britain and America. While, therefore, it contains particulars of some recent engines of which only a few examples—perhaps only one—are in existence, it ignores some types which, although in extensive use, do not seem likely to be perpetuated, or which do not present any novel features. Nos. 1–18 are British engines, Nos. 19–27 American, and Nos. 28–36 Continental.

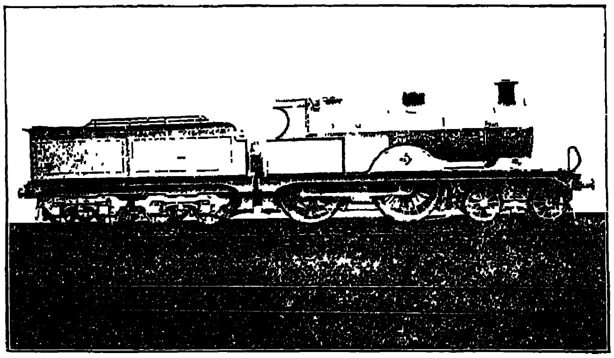
Comparison of locomotive practice.

Locomotives of similar type in the principal countries differ considerably in appearance and constructive detail. A broad distinction may be drawn between European and American practice in the framing and running gear. All American locomotives are built with bar or rectangular-section forged frames, and with a flexible system of levers and springs for equalizing, or distributing, the weight between the various axles. English and Continental locomotives, on the other hand, have side frames of plates braced together as a

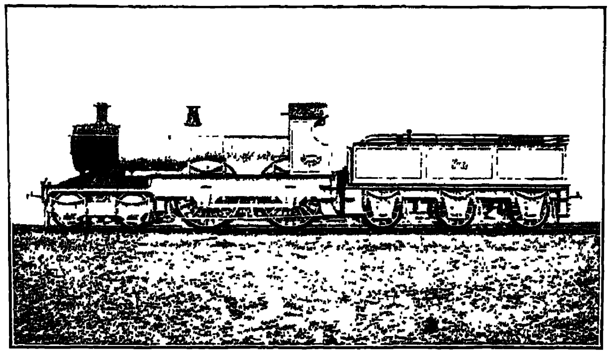


1. Caledonian Railway. "Dunalastair III." class. (St Rollox Works.)

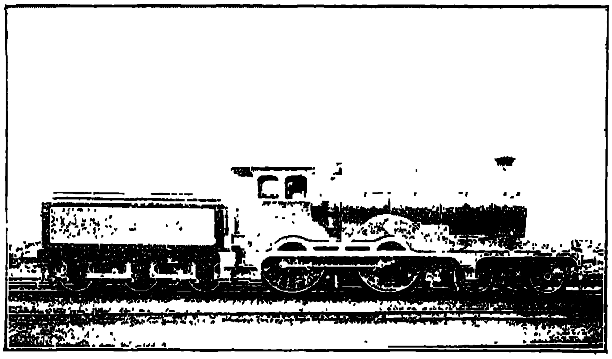
2. London and South-Western Railway.



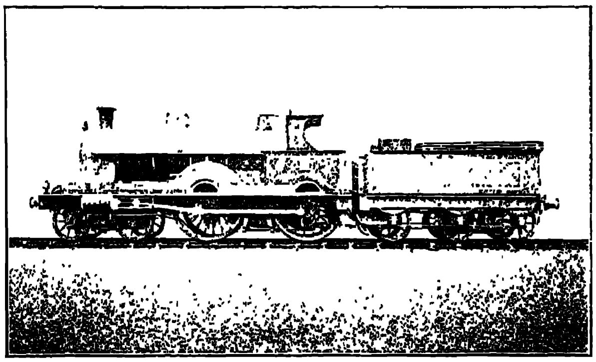
3 Midland Railway. (Derby Works.)



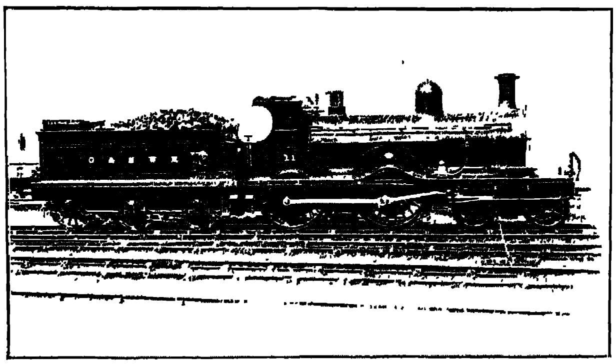
4. Great Western Railway. "Atbara" class. (Swindon Works.)



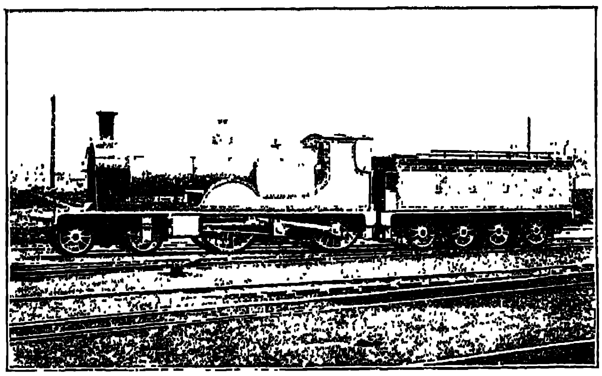
5. Great Eastern Railway. "Lord Claud Hamilton' class. (Stratford Works.)



6. London and North-Western Railway. "King Edward VII." class, four-cylinder compound. (Crewe Works.)

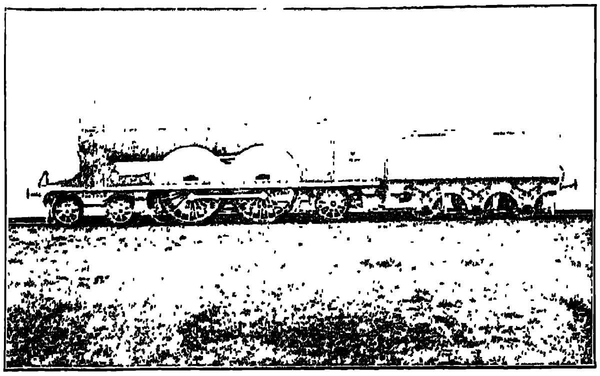


7. Glasgow and South-Western Railway. Four-cylinder non-compound. (Kilmarnock Works.)

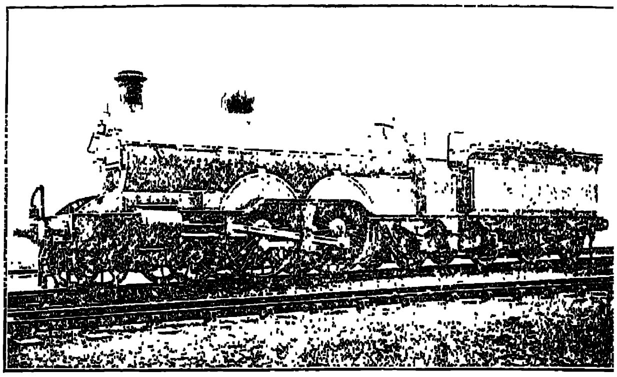


8. London and South-Western Railway. Four-cylinder non-compound.

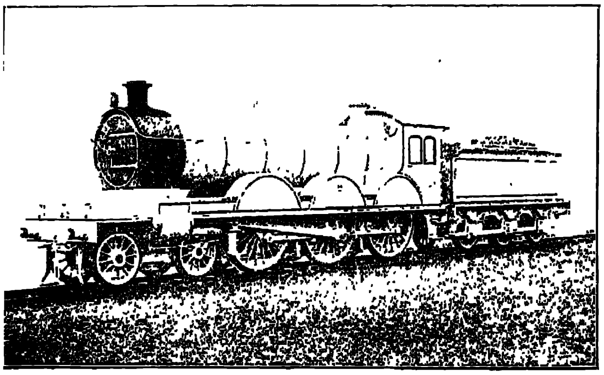
RAILWAYS (BRITISH LOCOMOTIVES).



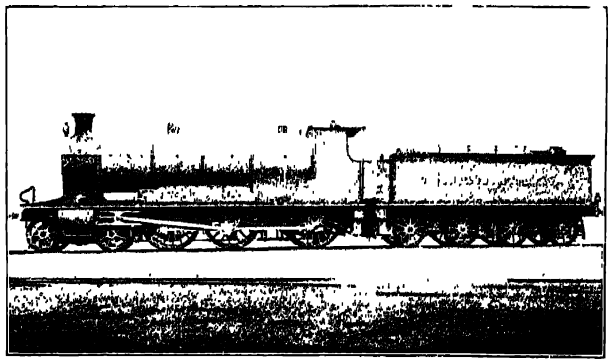
9. Lancashire and Yorkshire Railway. "Atlantic" type. (Horwich Works.)



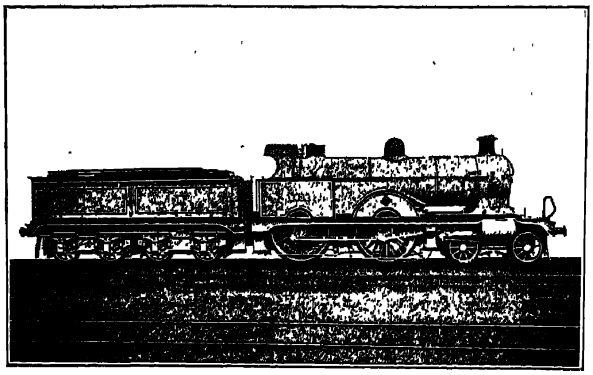
10. Great Northern Railway. "Atlantic" type. (Doncaster Works.)



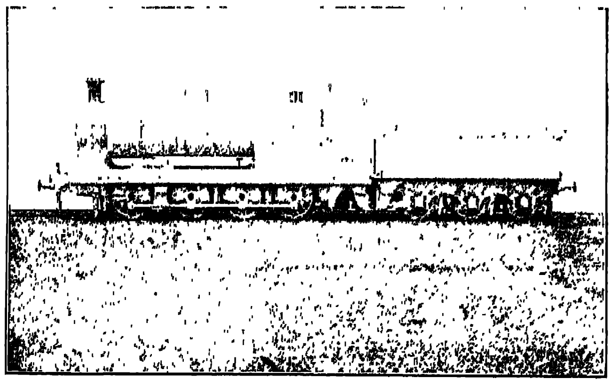
11. North Eastern Railway. (Gateshead Works.)



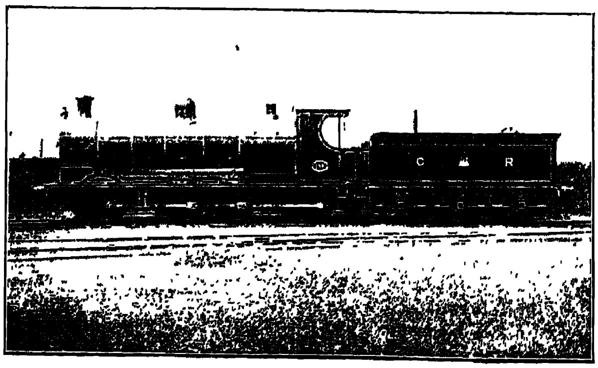
12. Highland Railway. (Dubs and Co., Glasgow.)



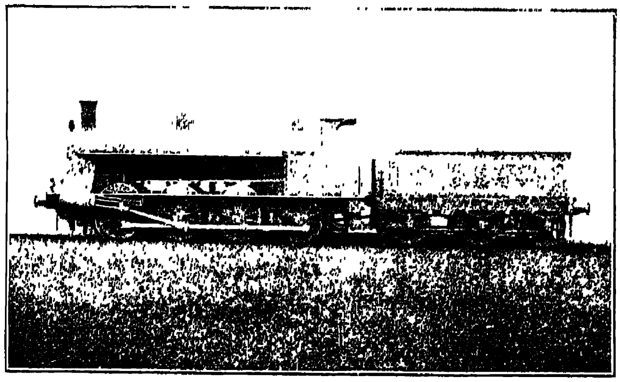
13. Midland Railway. Three-cylinder compound. (Derby Works.)



14. Lancashire and Yorkshire Railway. (Horwich Works.)

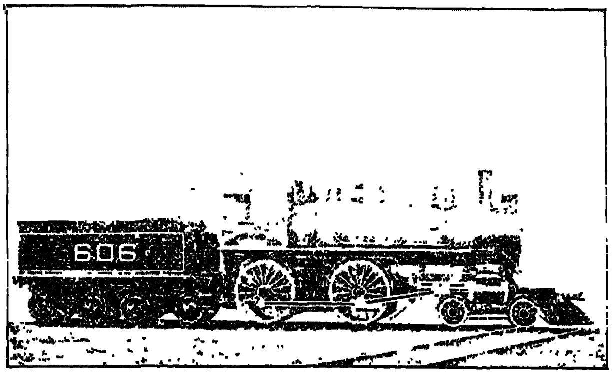


15. Caledonian Railway. (St Rollox Works.)

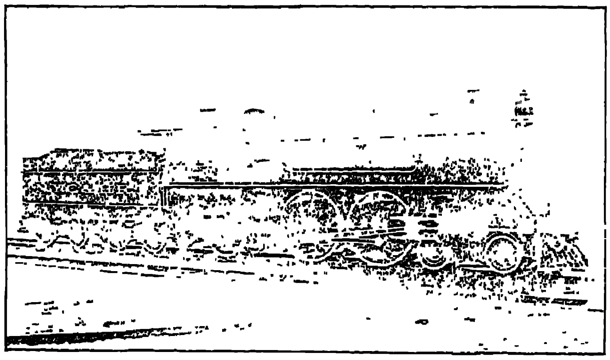


16. London and North-Western Railway. Three-cylinder compound. (Crewe Works.)

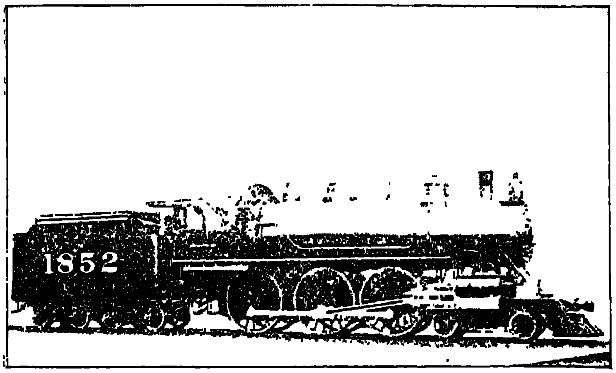
RAILWAYS (BRITISH LOCOMOTIVES).



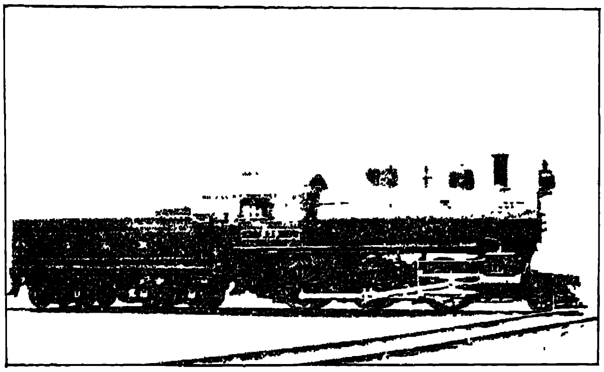
17. "American" type. Seaboard Air Line Railway (Baldwin Loco. Works.)



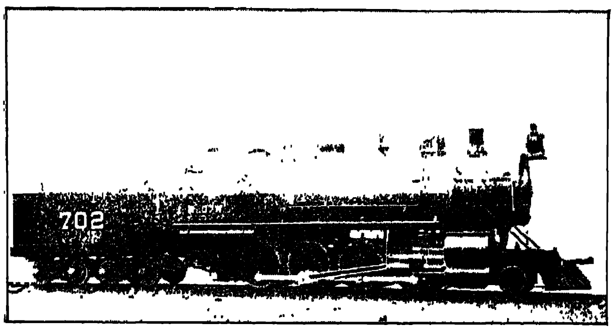
18. "Atlantic" type. New York Central and Hudson River Railway "Empire State" Express engine. (Schenectady Loco. Works.)



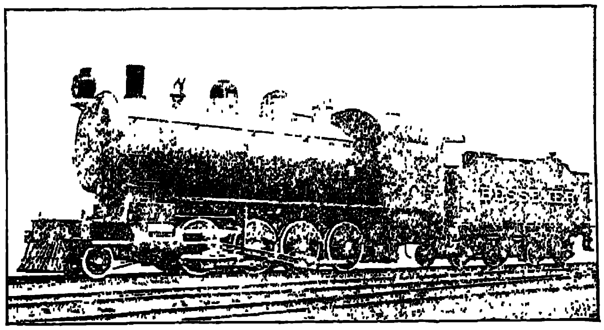
19. Compound 10-wheel type. Union Pacific Railway. (Baldwin Loco. Works.)



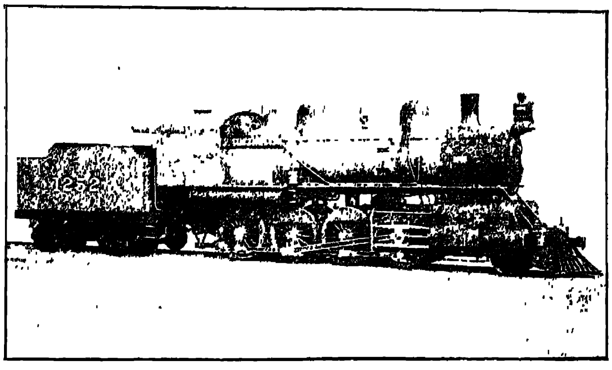
20. "Mogul" type. Pennsylvania Railway. (Baldwin Loco. Works.)



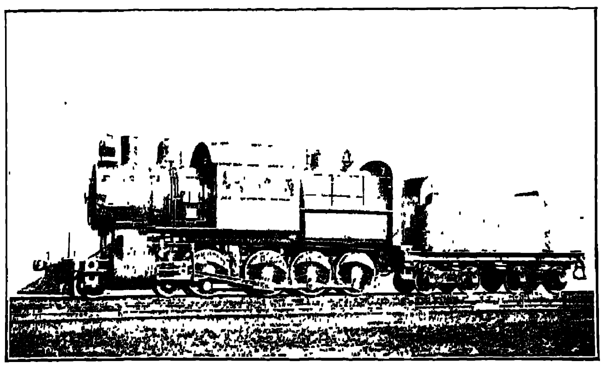
21. Compound, "Consolidation" type. Rio Grande Western Railway. (Baldwin Loco. Works.)



22. "Consolidation" type. Pittsburg, Bessemer, and Lake Erie Railway. (Pittsburg Loco. Works.)



23. Tandem compound, "Consolidation" type. Northern Pacific Railway. (Schenectady Loco. Works.)



24. "Mastodon" type. Chicago and Eastern Illinois Railway. (Pittsburg Loco. Works.)

RAILWAYS (AMERICAN LOCOMOTIVES)

TABLE XVI.—*Comparative Data of Locomotives.*

Number.	Owning Railway.	Type.	Cylinders. Position.	Cylinders. Diameter.	Cylinders. Stroke.	Diameter of Driving Wheels.	Weight (Ton=2240 lb). Total of Engine.	Weight. Total Weight on Coupled Wheels.	Weight. Total with Tender.	Grate Area.	Total Heating Surface.	Remarks.	Number on Plate.
				In.	In.	In.	Tons.	Tons.	Tons.	Sq. ft.	Sq. ft.		
1	Caledonian	2	Inside.	19	26	78	51·70	34·65	96·70	23	1600	"Dunalastair III." (900) class.	1
2	London and South-Western	2	Inside.	18½	26	79	48·85	33·45	93·00	24	1500	Fitted with cross water tubes in fire-box, giving 165 sq. ft. of heating surface.	2
3	Midland	2	Inside.	19½	26	81	51·60	34·09	102·97	25	1519	Belpaire fire-box.	3
4	Great Western	2	Inside.	18	26	80	51·60	33·60	87·85	21·45	†1663·02	...	4
5	Great Eastern	2	Inside.	19	26	84	50·30	33·20	85·35	21·3	1630·5	Fired with liquid fuel on Holden's system.	5
6	London and North-Western	2	2 H.-P. outside. 2 L.-P. inside.	16 20½	24 24	85	57·60	37·00	84·20	20·5	1557·5	The H.-P. valves are worked by means of a simple lever from the L.-P. valve-rods, which are continued through the valve-chests. These engines are like the "Iron Duke" class, but larger.	6
7	Glasgow and South-Western	2	2 outside. 2 inside.	12½ 14½	24 26	81½	48·70	31·70	81·05	18·0	1206	Non-compound; valves of both L.-P. and H.-P. cylinders on each side worked by one set of valve-gear.	7
8	London and South-Western	...	2 outside. 2 inside.	14 14	26 26	79	57·90	40·00	105·00	27·4	1690	Non-compound; axles not coupled; water tubes in fire-box give 190 sq. ft. of heating surface.	8
9	Lancashire and Yorkshire	5	Inside.	19	26	87	58·75	35·00	89·41	26·05	2052·8	Belpaire fire-box.	9
10	Great Northern	5	Outside.	19	24	78	58·00	31·00	99·00	26·75	1442	990 class.	10
11	North-Eastern	6	Outside.	20	26	80	67·10	51·95	107·10	23	1769	Steam-pressure, 200 lb per sq. in.	11
12	Highland	6	Outside.	19½	26	69	58·85	43·85	96·95	26	2050	Steam-pressure, 200 lb per sq. in.	12
13	Midland	2	2 L.-P. outside. 1 H.-P. inside.	21 19	26 26	84	59·5	38·88	112·15	26	1719	2631 class; Serve tubes; steam-pressure, 195 lb per sq. in.	13
14	Lancashire and Yorkshire	9	Inside.	20	26	54	53·78	53·78	84·45	26·05	2038·64	...	14
15	North-Eastern	9	Outside.	20	26	55¼	58·30	58·30	96·90	21·5	1675	...	...
16	Caledonian	9	Inside.	21	26	54	60·60	60·60	102·00	...	2500	Tractive force, 28,665 lb.	15
17	London and North-Western	9	2 H.-P. outside. 1 L.-P. inside.	15 30	24 24	51	49·25	49·25	75·85	20·5	1489	...	16
18	Great Eastern	...	1 H.-P. inside. 2 H.-P. outside.	18½ 18½	24 24	54	71	71	...	42	3010	Ten-coupled, total-adhesion, tank engine; steam-pressure, 200 lb per sq. in.	...
19	Seaboard Air Line	2	Outside.	19	26	72	56·79	34·90	92·41	17·5	1866·3	...	17
20	New York Central	5	Outside.	21	26	79	78·57	42·41	127·75	50·32	3505·17	Steam-pressure, 200 lb per sq. in.	18
21	Union Pacific	6	2 H.-P. outside. 2 L.-P. outside.	15½ 28	28 28	78	81·69	63·08	133·93	32	3011	...	19
22	Pennsylvania	8	Outside.	20	28	62	71·43	62·09	125·00	30·25	2431·3	...	20
23	Rio Grande Western	10	2 H.-P. outside. 2 L.-P. outside.	17 28	30 30	57	88·68	79·09	138·39	35	3330·2	...	21
24	Pittsburgh, Bessemer, and Lake Erie	10	Outside.	24	32	54	112·60	100·45	174·55	36·8	3805	...	22
25	Lehigh Valley	10	Outside.	22	30	55	100·45	90·17	154·51	90·0	4100	Wootten fire-box.	23
26	Northern Pacific	10	2 H.-P. outside. 2 L.-P. outside.	15 28	34 34	63	88·39	78·12	138·75	52·29	2997·10	...	...
27	Chicago and Eastern Illinois		H.-P. L.-P.	21½ 33	30 30	54	89·28	71·43	133·04	72	2447	...	24
28	Est	2	2 H.-P. outside. 2 L.-P. inside.	13¾ 21⅝	25⅛ 26 1/16	81½	58·29	33·24	...	27·12	1988·12	Steam-pressure, 213 lb per sq. in.	...
29	Nord	5	2 H.-P. outside. 2 L.-P. inside.	13⅜ 22	25⅛ 25⅛	80 5/16	62·99	32·48	108	29·5	2274·5	Nos. 2641, 2642; steam-pressure, 228 lb per sq. in.	...
30	Ouest	6	2 H.-P. outside. 2 L.-P. inside.	13¾ 25⅛	21⅝ 25⅛	67 11/16	57·48	40·84	...	26·37	2088·25	...	...
31	Est	2	Outside.	18½	26 1/16	82 5/16	55·87	32·87	...	23·12	1811·5	Flaman boiler.	...
32	Nord	9		20⅞	25⅝	51	45·80	45·80	70·54	22·7	1340	...	...
33	Paris–Orleans	5	Outside.	16½	25 9/16	70 13/16	47·14	31·49	...	22·63	1869	Durant and Lencauchez valve-gear; steam-pressure, 213 lb per sq. in.	...
34	Prussia State	2	H.-P. L.-P.	18 26¾	23⅜ 23⅜	78	48·21	29·93	84·37	24·6	1280	...	...
35	Kaiser Ferdinand	6	H.-P. L.-P.	20⅞ 31⅞	28⅜ 28⅜	71⅜	69·20	42·86	102·67	33·3	2240	...	...
36	St Gothard	9	...	20½	24	46	50·89	50·89	75·00	23·1	1700	...	...

rigid whole, and the weight is transmitted to the axles by independent spring supports, though equalizing levers are not entirely unknown. American locomotives of standard gauge invariably have the frames inside of the wheels, and outside cylinders, with solid integral saddles to carry the forward end of the boiler. British and Continental locomotives have the frames either inside or out, or both; and the cylinders are often inside, especially in Great Britain, the use of a cranked driving axle being a necessary incident of this practice. In American engines the height of the boiler from the ground and its larger diameter are noticeable features. The fire-box, too, is larger, and often placed above, instead of between, the frames; it is made of steel, not of copper as in Great Britain. An extended smoke-box is another characteristic of American practice, but one which is also to be found in Great Britain and the Continent. In proportions, American engines have much larger ratios of grate area and heating surface to cylinder volume than are found elsewhere, the difference being especially marked in contrast with British practice, and their actual dimensions and weight exceed those usual in other countries. High finish and absence of external pipes and visible mechanism are striking features of British engines, and to a less extent of those of the Continent. The aim of American designers is to have all moving and wearing parts accessible for quick inspection and repair, and appearance and finish are regarded as of secondary importance.

Elements of design.

(1) *Train Resistance* is a matter involved in much obscurity. It depends upon many variable conditions, such as the weather, track, kind and condition of equipment, as well as composition and weight of train. The formulæ given below presuppose that the trains are of average weight, and that the bearings are well lubricated and warmed by running; they also apply only after speeds of 12 miles an hour have been reached, since in starting a train from rest the frictional resistance is momentarily higher. On level straight track it should be taken at not less than 20 lb per ton of 2000 lb; this falls rapidly to the normal amount at a speed of say 2 miles an hour, but up to 12 miles an hour resistance should never be assumed at less than 5 lb per ton of 2000 lb. Train resistance may be expressed by the summation of the following factors:—

At a given speed	$Y_1 = \frac{S}{6} + 3$	(a)
Additional for gradients	$Y_2 = 0{\cdot}38\ M$	(b)
Additional for curves	$\left\{ Y_3 \begin{array}{l} = 0{\cdot}7\ C \text{ (for cars)} \\ = 1{\cdot}4\ C \text{ (for locomotive)} \end{array} \right\}$	(c)
Additional for acceleration	$Y_4 = 0{\cdot}0132V$	(d)
Or, for an increase in speed from a velocity V_1 to V_2	$Y_4 = 0{\cdot}0132(V_2^2 - V_1^2)$	(e)

In the above the resistances are in pounds per ton of 2000 lb of train weight, including the locomotive: S = speed in miles per hour; M = gradient in feet per mile; C = curvature in degrees; and V = velocity attained in one mile, starting from zero and expressed in miles per hour. Equations (d) and (e) include an allowance for energy stored in the rotating wheels.

A large number of the formulæ which have been suggested by various observers for the calculation of train resistances are collected in a paper on "Train Resistance," read before the Institution of Civil Engineers (London), on 26th November 1901, by Mr J. A. F. Aspinall, general manager of the Lancashire and Yorkshire Railway. This paper contains an account of numerous experiments carried out by the author with trains of various lengths, composed of the standard four-wheel-bogie passenger stock of that railway, and the general formula which he gives as expressing the results he obtained is

$$R = 2{\cdot}5 + \frac{V^{\frac{5}{3}}}{50{\cdot}8 + 0{\cdot}0278L},$$

where R = resistance in pounds per ton (2240 lb) drawn, V = velocity of train in miles per hour, and L = length of train in feet over the coach-bodies.

(2) *Tractive Effort.*—Theoretical tractive effort is represented by

$$T.\ E. = \frac{Pd^2S}{D}, \text{ in pounds} \quad . \quad . \quad . \quad . \quad . \quad . \quad (f)$$

where P = mean effective pressure in cylinders, in pounds per square inch; d = diameter of cylinder, in inches; S = stroke of piston, in inches; and D = diameter of driving wheels, in inches. For any given train, therefore, the following equation is true:—

$$\frac{Pd^2S}{D} = 1{\cdot}1(Y_1 + Y_2 + Y_3 + Y_4)T \quad . \quad . \quad . \quad . \quad . \quad (g)$$

where T = weight of train, including locomotive and tender, in tons of 2000 lb, 10 per cent. being allowed for internal friction of the engine. The tractive effort of a locomotive is greatest in starting, or at slow speeds; it is dependent upon the mean effective pressure in the cylinders, which is greatest at long cut-off when starting, and is generally assumed at 85 per cent. of boiler pressure for a maximum.

(3) *Steaming Capacity* is a variable factor, depending upon the type of boiler, combustion rate, character of fuel, &c. In good practice on heavy work the following are maximum results:—In express passenger service, with simple expansion cylinders, one-horse power for each two square feet of heating surface. In fast freight service, with simple expansion cylinders, one-horse power for each three square feet of heating surface. In heavy freight service, with simple expansion cylinders, one-horse power for each four square feet of heating surface. In express passenger service, with compound cylinders, one-horse power for each half square foot of heating surface. In the heaviest goods and passenger service a new limit for performance has been approached in the capacity of the stoker to shovel coal into the fire-box; 100 to 120 lb per minute appears to be the maximum practicable quantity.

Compound locomotives.

The era of compounding, as applied to locomotives, was inaugurated by Mr A. Mallet in 1876 in France, followed by Mr A. von Borries in Germany, Mr T. W. Worsdell and Mr F. W. Webb in England, and Mr S. M. Vauclain in America, all about the year 1889. Since the latter date the growth in use of the compound has been rapid, especially in America and France, in both of which countries it has passed the experimental stage. The same may be said of England so far as concerns the London and North-Western Railway, where many compounds on the Webb system are at work with satisfactory results; but on other lines, such as the North-Eastern, they are as yet scarcely more than experiments, though there are signs that such experiments will be widely tried in the near future.

The types proposed are many, and are known under the names of their designers. They may be classified (a) by the number of cylinders, two, three, or four; (b) by the number of main crank connexions, two or four; (c) by the peculiarities in starting mechanism, which may be either automatic or non-automatic; (d) by the use or not of a receiver between the cylinders.

The main types are represented by the "two-cylinder" (Mallet in France, von Borries in Germany, Worsdell in England); the "three-cylinder" (Webb and Johnson in England); and the "four-cylinder" (Mallet and de Glehn in France, Vauclain in America, Russia, &c., Webb in England). The four-cylinder designs are by far the most used, and appear to give the best results.

Important advantages are claimed for compounding, especially for modern powerful locomotives. The principal ones are:—

(a) Possibility of greater heat utilization by increasing the range of steam expansion, which is accomplished by successive expansion in two cylinders, instead of in one.

(b) Saving of steam by reduction of cylinder condensation, due to the lower range of temperatures resulting from less expansion in each cylinder.

(c) Better steam distribution by working at long cut-offs, thus avoiding the mechanical difficulties with valve motions at short cut-offs.

(d) Other mechanical advantages in certain types of multiple-cylinder compounds, such as the use of cylinders of smaller diameter, which with high pressure steam give a more uniform turning movement at the drivers than is possible in the two-cylinder simple engine.

(e) An important operating advantage obtained as the obvious result of the saving in fuel secured, namely, an

increase in the reserve capacity of the boiler for a given amount of work done by the engine.

The obtainable economy in fuel varies with service conditions, but the following may be expected as reasonable average results for compound as compared with simple locomotives having the same characteristics and used in the same kind of service:—

Passenger	10 to 15 per cent.
Goods	15 to 20 „ „
Heavy continuous grade goods .	25 to 40 „ „

It is very difficult to compare the cost of locomotives in various countries, because the specifications and material and weights vary. On the Continent of Europe it is customary to sell locomotives by weight, while in Great Britain and the United States they are sold at so much each. The cost of material causes fluctuations, apart from those which result from demand. We may, however, take as typical a British six-coupled goods engine and tender, with cylinders 18 by 24 inches. Such engines were sold in Great Britain in 1899 for about £3000. In the United States we may take as typical an eight-wheel or American-type locomotive and tender, with cylinders 17 by 24 inches. Such engines were sold in 1870 for about $12,750, in 1880 for $9000, in 1890 for $7000, and in 1900 for $8500. In the earlier years such an engine was unusually large and few were built. Now it is smaller than is ordinarily used in the United States. Further, even with the same size of cylinders these engines have increased in size and weight during the thirty years. In 1876 an eight-wheel American engine with cylinders 17 by 24 inches weighed about 72,000 lb; now it would weigh about 90,000 lb. Then the boiler was about 48 inches in diameter, now it is about 54. Steam-pressure has risen from 130 lb to 180 lb and more. In the United States the prices in the last quarter of 1900 were about $11,500 for a 60-ton Consolidation locomotive, $15,500 for a 90-ton Consolidation, and from $12,500 to $15,000 for a 75-ton Mogul or 10-wheel engine.

Cost of locomotives.

AUTHORITIES.—The following books will serve to give the reader an insight into the principles, the details of construction, and the present state of the art of building locomotives:—W. F. PETTIGREW. *Manual of Locomotive Engineering.* London, 1899. —E. SAUVAGE. *La Machine Locomotive.* Paris, 1894.—M. DEMOULIN. *Traité Pratique de la Machine Locomotive.* Paris, 1898.—M. N. FORNEY. *Catechism of the Locomotive.* New York, 1890.—A. T. WOODS and DAVID L. BARNES. *Compound Locomotives.* Chicago, 1893.—*Proceedings of the American Railway Master Mechanics' Association,* published annually by the Association, Chicago. (J. GH.)

ROLLING STOCK.

Passenger Trains.—The passenger carriage of Great Britain and the Continent and the passenger car of the United States are unlike in many particulars. The carriage has, in general, transverse compartments, with side doors, and without a longitudinal passageway or end doors, although the recent introduction of corridor cars, having end doors and platforms, with communication through the car or train, suggests the probability of a general though gradual change of practice in that respect. The American passenger car has end doors only, with a central longitudinal passageway or aisle. In general the whole interior space is open; but just as the use of cars with end doors and through aisles is increasing in Great Britain and on the Continent, so the use of sleeping-cars divided into private compartments is increasing in the United States. Even in those cars, however, the end doors and through aisles are retained, and the number in use is not yet great enough to indicate a general change to the compartment plan, even for sleeping-cars. The relative merits of these two broad types of passenger-car design have been much discussed, but the question is too complicated to be considered here. It is enough to say that it is affected by the temperament, or at least by the rooted habits, of the peoples, by the methods of dealing with baggage, and by the division of passengers into classes.

The three classes, which originally were universal in Great Britain, have now been reduced to two on several important lines, by the abolition of the second class. Where this alteration has been effected, third-class passengers are carried by all trains, even the fastest, at a maximum rate of one penny a mile, and the practice of restricting certain expresses to first- or first- and second-class passengers only lingers on two lines in the South of England and in Ireland. On the Continent third-class passengers are still excluded from many of the faster trains, though there is a tendency towards increased liberality in this respect. The ordinary fares, however, are there appreciably lower than in Great Britain. In Hungary, Austria, and Russia a zone-tariff system is in operation, whereby the country is mapped out into zones, and the traveller pays according to the number of these he passes through, and not simply according to the number of miles he is conveyed. For example, on Russian railways, for any distance up to 6 versts (=4 miles), there is a minimum fare of 23 kopecks first class, 14 kopecks second class, and 9 kopecks third class. For distances between 6 and 300 versts, the charge progressively increases verst by verst, though at a gradually diminishing rate, so that, for instance, the first-class fare for 300 versts (8 roubles 90 kopecks) is less than twice that for 150 (5 roubles 40 kopecks). For distances greater than 300 versts, the fares increase by zones; these vary in length, but the increment of price is the same for each, whatever its length, namely, 50 kopecks first class, 30 kopecks second class, and 20 kopecks third class. The zones are 25 versts long between 301–500 versts, 30 between 501–710 versts, 35 between 701–900 versts, 40 between 901–1510 versts, and 50 for greater distances. By a change which came into effect in May 1902, the 50-verst zones extend only from the 1511th to the 3010th verst, and for greater distances the zones contain 70 versts. The charges on these are increased to 100 kopecks first class, 60 kopecks second class, and 40 kopecks third class. In America there is nominally one class, the average fare being about 1⅛d. per mile, but the extra charges levied for parlour, sleeping, and other cars practically constitute a differentiation of class, besides making the real cost of travelling higher than that just given. Immigrants are carried in special trains at much lower rates.

In America and other countries where long distances have to be travelled and passengers have to spend several days continuously in a train, sleeping-cars, restaurant-cars, smoking-cars, &c., become almost a necessity, and accordingly are to be found as a matter of course on most of the best through trains. On the continent of Europe they are largely in the hands of the International Sleeping-Car Company, and the charges for such accommodation *de luxe* frequently constitute a very heavy addition to the ordinary distance rates levied by the railways. In England, where the distances are comparatively small, sleeping and restaurant cars must rather be regarded as luxuries; still, even so, they are very frequently to be met with. The Midland Railway was the first to run sleeping-cars on its trains, the innovation being due to Sir James Allport about 1875. The earliest were Pullman cars imported from America; but when other lines began to adopt them, they were made in England with such differences as commended themselves to the various designers. In the most recent type a side corridor runs the whole length of the vehicle, and terminates in a vestibule platform at either end, so that communication

Dining and sleeping cars.

may be had with the adjacent coaches. Off this corridor open small compartments or berths, made for one or two persons only, each being fitted with a folding lavatory similar to that found in a ship's cabin. Sleeping-cars are run on most of the important night trains between London and Scotland, Manchester, Liverpool, Holyhead, &c., and are available for passengers holding first-class tickets on payment of a uniform fee of five shillings. Such cars for third-class passengers have frequently been talked about, but have yet to make their appearance on any British railway. The number of restaurant-cars increased greatly about the end of the 19th century; and whereas at first they were attached only to two or three expresses, mostly running between London and Scotland, they are now frequent on trains covering much shorter distances, *e.g.*, between London and Lancashire, Birmingham, Cromer, &c. The introduction of corridor trains has greatly extended their usefulness, and, without extra charge beyond the amount payable for food, they are provided for all classes, except on the Great Western Railway, which, although early in the field as regards corridor trains, for long excluded all but first-class passengers from its dining-cars, which, moreover, were very limited in number. However, the introduction in 1901 of corridor trains and dining-cars for all classes by its great rival, the London and South-Western Railway, compelled a change in its policy, and in 1902 orders were given for dining-stock for second- and third-class passengers.

Construction of carriages.

European carriages were at first mounted on two, and later on three, axles, which were free to rise and fall through a limited range, but not to turn with respect to the carriage. Thus the length of the body was limited, for to increase it involved an increase in the length of the rigid wheel-base, impossible with due regard to safety. Hence bogies or swivel trucks, which allow of longer car bodies, are fast coming into use; indeed, the standard coaching stock of Great Britain is now carried on bogies. The American passenger car has invariably been mounted on swivel trucks, having four wheels each for ordinary cars and six wheels each for sleeping, postal, and other heavy cars.

A noteworthy feature in British practice has been the large increase in the weight of passenger vehicles, both absolutely and still more in relation to the number of persons they can accommodate. The result, which is attributable in great part to the lavatories now general, and to the introduction of corridor carriages, is reflected in the heavier trains run, and in the larger and more powerful locomotives that must be provided to haul them. Some idea of the extent to which rolling stock has increased in weight and decreased in capacity may be gained from the official figures, as given in Table XVII., of the standard stock in use on the Midland Railway in 1901, if they are compared with those in the similar table to be found in the article RAILWAYS in the ninth edition of this Encyclopædia (vol. xx. p. 248). Thus a standard bogie third-class passenger coach in 1885 weighed 17¾ tons and held 70 persons; in 1901 the weight had risen to almost 25 tons and the capacity fallen to 36 persons.

Heating and lighting.

As a result of early practice in bridge, station, and tunnel construction, British and Continental carriages cannot be made as large as American passenger cars; though the restriction is less on the Continent than in Great Britain (see Fig. 14 for clearance gauges). One consequence is that larger cubic capacity per passenger is possible in the United States—a fortunate circumstance, since the greater range of temperature there makes proper heating and ventilation relatively more important and at the same time more difficult. In the United Kingdom the ancient system of hot-water cans[1] is still largely employed for heating, but in the United States much the most common method is by steam taken from the boiler of the locomotive and circulated through the train by a line of piping connected by flexible couplings between the cars—a method which is also finding increased favour in Europe. As to lighting, the feeble glimmer of the oil lamp is still to be seen in some English railway carriages, but it has mostly been displaced by gas and electricity. The former is a rich oil gas, compressed and stored in steel reservoirs under the carriages. The latter is obtained from dynamos driven from the axles of the coaches. In block-trains, where the component coaches are permanently coupled together, one dynamo sometimes lights all the carriages; but usually each has its own dynamo, and so becomes an independent unit. In the system most commonly employed in England the dynamo is connected to the axle in such a way that its speed, and consequently the current it yields, is approximately constant, whatever the speed of the train. In another system, which is of American origin, the required constancy of current is provided for by means of an automatic switch, which adds to or takes away resistance from the field-coils of the dynamo according as the speed of the train rises or falls. In both systems accumulators are used to maintain the light when the train is at rest or travelling too slowly to admit of current being generated. Gas and electric lighting are also extensively resorted to in American and Continental trains; but up to 1902 compressed oil-gas was very much more common than electric lighting, and in the United States kerosene-oil lamps were still extensively employed.

TABLE XVII.—*Details of Midland Railway Stock.*

Carriage.	Length of Body.	Compartments.						Number of Passengers.		Weight.	
	Feet.	First.	Third.	Lavatories.	Luggage.	Kitchen.	Pantry.	First.	Third.	Tons.	Cwt.
6-wheeled-bogie 1st class dining .	60	2 saloons	..	2	..	1	1	24	..	33	9
6-wheeled-bogie 3rd class dining .	60	..	2 saloons	2	2	..	..	..	42	32	7
4-wheeled-bogie 1st class corridor .	50	4	..	2	1	..	1	16	..	24	4
4-wheeled-bogie 3rd class corridor .	50	..	6	2	..	..	..	..	36	24	19
4-wheeled-bogie composite . .	50	2	3	2	1	..	..	8	18	26	16
6-wheeled-bogie sleeping . .	60	5 saloons	..	2	..	..	..	11	..	34	9

Communication with guard.

In Great Britain the railway companies are by the Regulation of Railways Act, 1868, required to fit trains which run more than 20 miles without a stop with some means of communication between the passengers and the officials in charge. With the system of separate carriages this is not an easy matter to accomplish satisfactorily. On some lines electrical devices have been in use for many years, but the most common method has been a continuous cord running along the whole length of the train outside and above the carriage windows, which, when pulled down, was supposed to give an alarm signal to the guards and engine-driver. The arrangement had many disadvantages, not the least being that it frequently failed to act. Recently a number of the railway companies have decided

[1] These cans in many cases do not contain water, but fused acetate of soda. When cold, the contents are solid; but when they are heated by being immersed in hot water, they liquefy, and in the process absorb heat, which is given out again on the change of state back to solid. Hence the cans remain warm for a very long time.

to adopt a modification whereby the cord, which runs along the cornice inside the compartments, is continuous through each carriage but not through the train, and is connected to the air-brake apparatus, so that, when pulled down, it puts the brakes on sufficiently to attract the attention of the driver. In the corridor trains, attendants can pass freely from one end to the other, and a system of electric bells enables the passenger to summon them at will.

There is a broad difference in practice in making up passenger vehicles into trains, which has come about partly because of the different mode of handling luggage. In the United States the passenger claims his luggage at the luggage-room of the station, or more often gives his receipt ("check") to a third party, and only sees his luggage at his hotel or house. Hence the luggage going by any one train is concentrated in one or more special vehicles ("baggage cars"), placed at or near the head of the train; this is also true of Continental practice. Here also will often be found in the United States the "express car," which carries such packages as in other countries are carried by parcel post or by fast goods trains at special rates. Here will often be found also a huge post-office car. Then follow, in order as mentioned, a smoking-car, ordinary day-cars (often called coaches), parlour-cars, sleeping-cars, and, finally, a dining-car. Dining, sleeping, and postal cars have no place in trains making short runs. In the United Kingdom passenger trains often contain vehicles which are never seen in the United States and seldom on the Continent, namely, horse-boxes and carriage-trucks. These are a part of the thorough organization for comfort and convenience in railway travelling which is probably more complete in the British Islands than anywhere else in world.

Weight. A comparison of the weights of passengers trains in Europe and the United States is difficult to make. In all countries trains of different weights are used according to the different services they are required to perform, and it would obviously be improper to compare a long-distance fast train, with sleeping or dining cars, with a slow short-distance train, carrying nothing but passengers. Moreover, the weight of a train timed to leave a given station at a particular time may vary from season to season, and even from day to day, according to the number

TABLE XVIII.—*Weight and Speed of Trains.*

Train.	Journey.	Distance.	Approximate Weight, exclusive of Engine and Tender (ton=2240 lb).	Speed, inclusive of Stops.	Remarks.
		Miles.			
10 a.m. ex Euston	London to Edinburgh	399½	265–340	48½	
10 a.m. ex King's Cross	,, ,,	393¼	230–280	47⅔	
2 p.m. ex Euston	London to Carlisle	299¼	290–330	48	
,, ,,	London to Crewe	158	330	48	
,, ,,	Crewe to Carlisle	141¼	290–330	49¾	
11.50 p.m. ex Euston	London to Crewe	158	290	52⅓	
,, ,,	Crewe to Carlisle	141¼	290	52	
,, ,,	Carlisle to Edinburgh	100¼	...	48¼	
11.30 p.m. ex King's Cross	London to Grantham	105½	200–300	52¾	
,, ,,	Grantham to York	82¾	200–300	54½	
,, ,,	York to Newcastle	80½	200–300	53⅔	
,, ,,	Newcastle to Edinburgh	124½	200–300	50½	
5.30 p.m. ex Euston	London to Crewe	158	330	54	
5 p.m. ex Birmingham (L. & N.-W. Railway)	Birmingham to London	113	120	56½	
2 p.m. ex Leeds	Leeds to King's Cross, London	185¾	90–170	51¾	
,, ,,	Grantham to King's Cross	105½	90–170	55½	
1.30 p.m. ex King's Cross	London to Leeds	185¾	165–190	50¼	
...	London to Peterborough	76½	165–190	55	
10.35 a.m. ex Paddington (Cornish express)	London to Penzance	325¼	...	41½	
,, ,,	London to Exeter	193⅝	220	53½	
,, ,,	Exeter to Plymouth (North Road)	52⅜	230	41⅔	
1.40 p.m. ex Paddington	London to Worcester	120½	176	53	
9.30 a.m. ex St Pancras	London to Edinburgh	406	190	47⅓	
,, ,,	London to Leeds	196¼	190	50½	
,, ,,	Leeds to Carlisle	112½	...	49	
12 p.m. ex St Pancras	London to Glasgow	423	155	47	
3.44 p.m. ex Jersey City (Pennsylvania RR.)	New York to Washington	226½	312	47½	Congressional Limited.
10.14 p.m. ex Jersey City (Pennsylvania RR.)	New York to Chicago	911	336	38½	Pennsylvania Limited.
12 noon ex Chicago (Pennsylvania RR.)	Chicago to New York (Jersey City)	911	215	46½	Pennsylvania Special.
8.30 a.m. ex Grand Central Station (New York Central)	New York to Buffalo	439½	225	53¼	Empire State Express.
,, ,,	New York to Albany	142¾	225	53½	
,, ,,	Albany to Buffalo	296¾	225	53½	
,, ,,	Syracuse to Rochester	80⅓	225	57½	
12.30 p.m. ex Chicago (New York Central)	Chicago to New York	979½	312	49	20th Century Limited.
5.30 p.m. ex Grand Central Station (New York Central)	New York to Chicago	979½	460	40¾	Lake Shore Limited.
12.14 p.m. ex Jersey City (Lehigh Valley RR.)	New York to Buffalo	446½	230	45·6	Black Diamond Express.
3.51 p.m. ex Jersey City (Philadelphia and Reading Railway and Baltimore and Ohio RR.)	New York to Washington	227¼	300	47¼	Royal Limited.

of coaches required to accommodate the traffic. For short and middle distances probably the usual weight of trains varies between about the same limits in all countries; for long distances the necessity of providing sustained arrangements for living on the journey tends to increase of weight, and therefore in extensive countries like the United States heavier trains may be found than in small ones like Great Britain. At the same time, there are some long-distance trains in Great Britain quite as heavy, if not heavier than some in the United States, even though the average weight of rolling stock is distinctly greater in the latter country. General conclusions, except of the vaguest character, are therefore almost impossible, and the best that can be done is to consider specific instances. A number of these have been collected in Table XVIII., which gives some of the best and heaviest trains run in the two countries. In using it, the reader must remember that the weight of a particular train may vary not only initially from day to day, owing to variation of traffic, but also on any one journey from station to station, owing to carriages being added or taken away.

Speed. A comparison of average speeds is scarcely less difficult than of average weights. In 1888 a careful study was made of express train mileage in the United Kingdom, on the Continent, and in the United States. For the United Kingdom and the United States 40 miles an hour, including stops, was taken as express train speed, *i.e.*, an average rate of 40 miles an hour from the beginning of the journey to the end. But on the Continent so few trains reached this rate of travelling that the arbitrary speed of 29 miles was taken there for express speed. It was found that in the United Kingdom trains ran 62,900 miles every day at and over 40 miles an hour, and in the United States 13,956 miles, while on the Continent of Europe trains ran 118,000 miles at and over 29 miles an hour, but at and over 40 miles an hour there was something less than 9000 miles a day on the entire Continent. Since that date an important change has taken place in Great Britain, the United States, France, and Germany. In all these countries faster trains are run, and the average express speed has been raised. The fastest trains are no longer run in Great Britain, but in America, by the Philadelphia and Reading Railway between Philadelphia and Atlantic City, in competition with the Pennsylvania Railroad. Passengers are conveyed from Philadelphia by ferry-boat across the river Delaware to Camden, whence the distance to Atlantic City by the Philadelphia and Reading Company's lines is 55½ miles. This is covered by some trains in 50 minutes; the booked speed thus is 66·6 miles an hour, and on some occasions an average speed of over 71 miles an hour has been maintained from start to stop. By the Pennsylvania Railroad Company's system the distance between Camden and Atlantic City is 58 miles, and trains weighing about 160 tons, exclusive of engine, are booked to perform the journey at the rate of 64·4 miles an hour. In Great Britain, on the Caledonian Railway from Forfar to Perth, one train covers 32½ miles in 33 minutes (59·09 miles an hour), and on the North-Eastern Railway a train runs from Darlington to York (43¾ miles) in 43 minutes (61·04 miles an hour). In France, also, instances may be found of trains timed over 60 miles an hour, *e.g.*, Paris to Arras 120 miles in 117 minutes. Of course still higher speeds, up to 75 and even 80 miles an hour, are reached and sustained for shorter or longer distances every day by express trains, the average speed of which between any two stopping-places is very much less. But isolated examples of high speeds afford little information as to the train service at the command of the traveller in different countries, for it is obvious that his convenience will be better served by a large number of trains, all maintaining a good average of speed, than by a service consisting mostly of poor trains, with only one or two exceptionally fast ones. From this point of view Great Britain remains ahead of all other countries. To give exact numerical expression to this superiority is impossible, but Table XIX. will supply a general idea of the volume and speed of express traffic in different countries. No train has been included which does not run daily (except Sundays) and travel at least 40 miles an hour on the average, inclusive of stops. This limitation excludes many trains which are called "fast" and "express," both in the United States and on the Continent, but even if the speed necessary to gain admission to the table were reduced by a good many miles an hour, Great Britain would still hold the first place if the number of high-speed trains is taken into account as well as the average of speed attained:—

TABLE XIX.—*Speed and Number of Express Trains.*

Trains (Summer, 1902) in both Directions between	Distance.	Number of Trains.	Totals.	Speed in Miles per Hour.						
				40 Miles but under 42 Miles.	42 Miles but under 44 Miles.	44 Miles but under 46 Miles.	46 Miles but under 48 Miles.	48 Miles but under 50 Miles.	50 Miles and over.	Fastest.
London and Rugby—			92*							
By L. & N.-W. Railway	82½	75		6	2	11	16	13	27	56·5
By G. C. Railway	83¼	17		3	3	4	3	0	4	50·5
London and Manchester—			48							
By L. & N.-W. Rly. *viâ* Stoke	183½	5		0	3	1	1	0	0	47·8
By L. & N.-W. Rly. *viâ* Crewe	188¾	12		3	0	3	2	0	4	50·3
By Midland Railway—	180½	16		1	4	5	0	6	0	49·4
By G. N. Rly. (*viâ* Retford)	209½	3		1	0	2	0	0	0	45·1
By G. C. Rly.	206	12		5	3	2	2	0	0	46·6
London and Leeds—			41							
By G. N. Railway	185¾	15		2	3	1	5	1	3	52·5
By Midland Railway	196¼	26		3	5	3	4	6	5	51·2
London and Exeter—			27							
By G. W. Railway	193½	15		2	4	1	0	2	6	53·5
By L. & S.-W. Railway	171½	12		5	1	4	0	2	0	49·0
London and Edinburgh—			39							
By East Coast Route	393¾	16		0	2	0	10	0	4	50·7
By West Coast Route	399½	12		2	2	1	4	3	0	49·9
By Midland Route	406	11		1	1	3	6	0	0	47·3
London and Edin. (Winter, 1901–02)—			20							
By East Coast Route	393¾	10		0	1	1	6	0	2	50·7
By West Coast Route	399½	11		3	2	1	2	3	0	49·9
By Midland Route	406	8		1	2	2	3	0	0	47·3
London and Aberdeen—			19							
By East Coast Route	523¾	6		0	3	2	1	0	0	47·2
By West Coast Route	540	7		1	2	3	0	1	0	48·0
By Midland Route	530½	6		2	3	1	0	0	0	44·4
New York (Jersey City) and Philadelphia—			83							
Pennsylvania RR.	89½	44		14	5	8	7	7	3	50·1
P. and R. Railway	90¼	39		16	6	0	2	9	6	50·8
New York and Albany—			21							
N. Y. C. and H. R. RR.	143	21		4	3	7	3	1	3	53·6
New York and Boston—			4							
N.Y., N.H., & H. RR. *viâ* Shore Line	233	4		0	0	0	4	0	0	46·6
N.Y., N.H., & H. RR. *viâ* Air Line	214	0		0	0	0	0	0	0	..
New York and Buffalo—			17							
N. Y. C. & H. R. RR.	439½	13		7	1	1	0	3	1	53·2
Lehigh Valley (from Jersey City)	446½	2		0	0	2	0	0	0	45·7
Del. Lack. and West. RR. (from Hoboken)	410	2		1	0	1	0	0	0	45·5
Paris and Calais (Nord)	185	8	8	1	2	0	2	0	3	55·5
Paris and Marseilles (P. L. M. Railway)	536	4	4	2	2	0	0	0	0	43·1
Berlin and Hamburg (Prussian State Rlys.)	177	8	8	0	1	1	1	3	2	51·3
Berlin and Halle (Prussian State Rlys.)	100¼	17	17	4	1	4	4	2	2	50·0
Berlin and Hanover (Prussian State Rlys.)	160	13	13	7	2	3	1	0	0	46·0

* Including trains that pass through Rugby without stopping.

Goods Trains.—The vehicles for the transportation of goods are known as goods waggons or trucks in Great Britain and on the Continent, and as freight cars in America. The principal British and Continental types are open trucks or waggons (the lading often covered with sheets), mineral trucks, and covered or box waggons fo

cotton, grain, &c. The American freight cars of the principal types are known as box cars, gondola cars, coal cars, stock cars, tank cars, and refrigerator cars. Most of these terms explain themselves. The gondola car corresponds to the European open waggon, and is used to carry goods not subject to injury by the weather; but in the United States the practice of covering the load with tarpaulin sheets is unknown, and therefore the proportion of box cars is much greater than in Europe. Indeed, the long hauls in the United States make it even more important there than in other countries to load cars in both directions, and so it has come about that for the return journey coal, coke, ore, lumber, and other coarse articles are loaded into box cars that have carried grain or merchandise one way. It is common to put small end doors in American box cars, through which lumber and rails may be loaded. The fundamental difference between American freight cars and the goods waggons of Europe and all other lands is in carrying capacity. This difference is interesting as an example of development under the influence of surrounding conditions. Indeed, the American freight car is so unlike those of other countries that comparisons are difficult. In the United Kingdom the average carrying capacity of goods waggons must be under 10 tons, perhaps about 8 tons, and the capacity of heavy mineral trucks is 11 tons. On the Continent the average carrying capacity is a little over 10 tons; there are many cars still in service of less than 10 tons' capacity, but much the greater number are rated at 10 tons, while large numbers of 15-ton cars have been built within a few years, and the tendency is to raise the capacity. These are all short cars with four wheels. Freight cars in the United States have long bodies on two swinging trucks of four wheels each, and their average capacity is quite three times as great as that of European waggons. For years the standard freight car has been of 30 tons' capacity (short tons, 2000 lb); in recent years many 40-ton cars have been put in service; and still more recently several thousand cars have been built of 50 and even 55 tons' capacity. This great carrying capacity of the freight cars in the United States has worked in several ways to make possible those very low freight rates mentioned in the introduction to this article. It has diminished the ratio of non-paying to paying load; it has diminished the interest on first cost and cost of maintenance relatively to the work done; it has diminished in some degree, probably small, the amount of track and yard room required to do a unit of work; it has diminished journal and rolling friction relatively to tons hauled, for these elements of train resistance grow relatively less as the load per wheel rises; finally, and most important of all, the wages element has fallen as train loads have grown greater, since no more men are required to handle a heavy train than a light one.

Size and construction of trucks.

It is often said that if these things are true for one country they must be true for another, and that in Great Britain, for example, the use of more capacious cars would bring down the cost of goods carriage. This is not the place to debate a controverted question, but it may be pointed out that social and geographical conditions are different in the United States and the United Kingdom, and in each country the methods of conveying goods and passengers have been developed according to the requirements of those conditions. In one country the population is dense, large towns are numerous and near each other, the greatest distances to be traversed are short, and relatively a large part of the freight to be carried is merchandise and manufactured material. In the other country precisely the opposite conditions exist. Under the first set of conditions quickness and flexibility of service are relatively more important than under the second set; therefore goods are collected and despatched promptly, in numerous cars, often only partly loaded. But where the great volume of freight is raw material and crude foodstuffs, and the distances are great, a low charge per unit of transportation is more important than any other consideration; therefore freight is massed into full car loads and enormous trains, and sent perhaps 1000 miles to a distributing-point, or to a seaport. At the same time it must be noted that several British railway companies are experimenting with trucks of large capacity, similar to those used in America, but appear to find some trouble in getting full loads for them.

Weight and speed.

The differences in the carrying capacity of freight cars in Europe and the United States have brought about the differences in the make-up of freight trains. Here, as with passenger trains, averages mean little, but typical special cases give useful comparisons. In Great Britain we find, on six of the great railways, mineral trains (*i.e.*, trains carrying coal, coke, and ore) which weigh (trucks and load, but not the engine) from 525 to 765 tons. These weights, however, are in some cases greatly exceeded. Several British railways have engines capable of hauling loads of 1000 tons; and on the North-Eastern one (No. 15 in Table XVI.) has taken a train of 81 loaded trucks and one van, weighing $1326\frac{1}{4}$ tons and nearly a third of a mile in length, up a bank of 1 in 108 at the worst point, where also there was a curve of 20 chains' radius. The speed of such mineral trains, like the weight, varies with the gradients and other conditions, and they may be timed from 10 to 30 miles an hour, not counting time spent on sidings. The fast goods trains carry lighter loads and run faster; on the same lines these vary from 214 to 460 tons and make 25 to 30 miles an hour, the speeds rising so high as 37 miles an hour for short distances, and falling so low as 13. In Prussia an example of good practice for the various classes of goods trains gives weights from 900 to 1100 tons, and speeds (terminus to terminus) of 11 to 21 miles an hour, according to load and gradient. In the United States mineral and grain trains weigh from 1500 to 3800 tons (2240 lb), and 2000 tons would be only fairly good practice for this class of traffic. These trains are necessarily and properly very slow, being timed at 10 or 12 miles an hour. The merchandise trains of the United States are lighter and faster than those carrying coal, ore, salt, &c.; and this is true also of the important classes of trains which carry live stock, fruit, and dairy products, and dressed meat in refrigerator cars. It is obvious that the weight and speed of these trains must vary with topographical conditions. In the great continental basin are long lines with easy gradients and curves; in the Allegheny and Rocky Mountains gradients are heavy and curves are numerous and of short radius. We find, therefore, that the trains of which we are now speaking weigh from 600 to 1800, and even 2000 tons, and the journey speeds, from terminus to terminus, including stops, vary from 15 to 30 miles an hour. It is not uncommon for these trains to maintain, for considerable distances, 40 miles an hour; and managers of some of the most important prairie lines estimate that their freight trains often run over a mile a minute for many miles at a time. Such speeds for freight trains of 1000 tons or more demand great engine-power, the best couplings, and high-power continuous brakes. (See BRAKES.)

Couplings.—The means generally employed for connecting freight cars or goods waggons, one to the other, are not automatic; that is, men must go between the vehicles to couple or uncouple them, or at best can only avoid doing so by the use of a stick to guide the coupling link to its

place. As a result, many men have been killed or maimed in the performance of their duties in railway yards, and a great body of public opinion has grown up which calls for automatic couplers, and has found expression in agitation, invention, and legislation. In the United States an automatic freight car coupler is used on possibly 90 per cent. of freight stock. To effect this took more than twenty-five years of discussion and experiment. The Master Car Builders' Association, which is a great body of mechanical officers organized especially to bring about improvement and uniformity in details of construction and operation, expressed itself in 1874 as understanding the importance of a "self-coupler," but none had then been invented which could be considered as useful. At that time a member of the Association spoke of the disappearance of automatic couplers which had been introduced thirty or forty years before. This body pursued the subject with more or less diligence, and in 1884 laid down the principle that the automatic coupler should be one acting in a vertical plane; that is, the engaging faces should be free to move up and down within a considerable range, in order to provide for differences in the height of cars brought together. This principle having been fixed, the task of the inventor was considerably simplified. In 1887 a committee reported that the coupler question was "the knottiest mechanical problem that had ever been presented to the railroad," and over 4000 attempted solutions were on record in the United States Patent Office. The committee had not found one which did not have grave disadvantages. In 1887, however, the Association recommended the adoption of a coupler of the Janney type, and this coupler as it has developed is shown in Fig. 15.

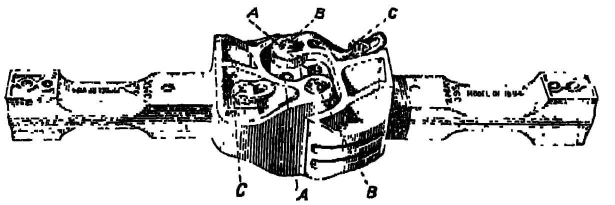


FIG. 15.—Automatic coupling for freight cars (U.S.A.).

The committee concluded that "the principle of contact of the surfaces of vertical cylinders embodied in the Janney coupler affords the best connexion for cars on curves and tangents." The method of constructing the working faces of the Janney coupler is shown in Fig. 16, which illustrates

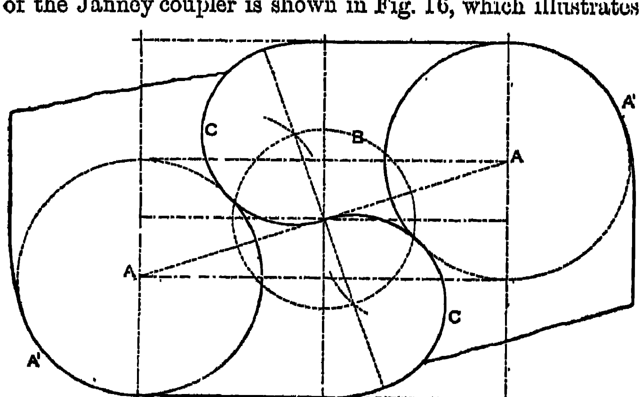


FIG. 16.—Development of the working faces of the Janney coupler. The sides of the square are 6 inches, and the centres AA are taken at 2 inches from the top and bottom of the square. The circles A'A', which are struck with 2-inch radius, define the first portion of the knuckle. The inner circle B has a radius of 1½ inches. From its intersection with A'A' arcs are struck cutting B in two points. These intersections determine the centres of the semicircles CC which form the ends of the respective knuckles. These semicircles and the circles A'A' are joined by tangents and short arcs struck from the centre of the figure.

the principle of contact of vertical cylinders. This principle was patented, but the company owning the patent undertook to permit its free use by railway companies which were members of the Master Car Builders' Association, and thus threw open the underlying principle of this coupler to competition. From that time the numerous patents have been merely on details. There are fifteen different couplers of the Janney type, patented and made by as many different concerns, each of which is used on at least 10,000 cars, and, in addition, many other forms are in less extensive use. The movement towards the use of an automatic coupler was stimulated in some degree by laws enacted by the various states and by the United States; and in 1893 Congress passed an Act, one clause of which required railway companies to have their freight cars equipped with automatic couplers by January 1898. The Interstate Commerce Commission, which has discretion in the matter, extended the limit to 1st August 1900.

The coupler in general use outside of the United States is a chain and hook, with spring buffers, which, however, are no part of the coupler itself. In the United States the universal coupler, which has now almost disappeared, was the "link-and-pin" coupler, in which a draw-bar is spring-connected to the frame of the car. The out-board end of this draw-bar is a socket, into which one end of a solid link is inserted, and the pull is exerted on a pin dropped through this link. The first strain of compression, when the cars close together, is also taken on this draw-bar and transmitted back through the springs to the frame of the car. Thus there is a fundamental difference between American and European practice in that in the United States the coupler is also a buffer.

The essential change from the link-and-pin to the automatic coupler is in the out-board end or head of the draw-bar. The socket to receive the link is replaced by a hook, shown at A, Fig. 15, which is usually called the knuckle. This hook swings on the pivot B. It has an arm which extends backwards, practically at right angles with the working face of the hook, in a cavity in the head, and engages with the locking-pin C. This locking-pin is lifted by a suitable lever, which extends to one side or to both sides of the car. Lifting the locking-pin releases the knuckle, which is free to swing open, disconnecting the two cars. The knuckle stands open until the coupling is pushed against another coupling, when the two hooks turn on their pivots to the position shown in Fig. 15, and the locking-pin drops into place and the couplers are made fast. This coupler is only partly automatic. It often happens that when two cars are brought together to couple, the knuckles are closed and must be opened by hand. There are various contrivances by which this may be done by a man standing clear of the cars, but in most cases he must go between the cars to reach the knuckle. This defect will no doubt be corrected by comparatively simple means. This form of automatic coupler is the only one used to any extent in the United States, where it is now practically universal, and no reason now appears why any other should be used there. It has been adapted to British and Continental rolling stock in a few instances for experiment, but whether or not it will be found acceptable cannot be foretold. The tendency in Great Britain is perhaps rather towards some non-automatic form of coupling which can be safely coupled and uncoupled without the necessity of men going in between the waggons.

Another question which is attracting the attention of inventors and railway companies in England is the problem of fitting waggons with hand-brakes which can be applied and released from either side of the waggon indifferently. The old form of brake is worked by a lever which is fitted at one side only, and thus the men, in order to work the brake, often have to incur the danger of passing

under the waggons. The Board of Trade has power, under the Prevention of Accidents Act of 1900, to insist on all waggons being fitted with "either-side" brakes. (See above, p. 137.)

Vestibules for Passenger Cars.—End platforms and end doors have always been characteristic of American passenger equipment, and are extending to British and Continental carriages. Their use secures a continuous passageway through the train, but is attended with some discomfort and some risk when the train is in motion. The opening of the end doors may make a draught through the car, disagreeable in cold weather, and passengers occasionally fall from the open platform, or are blown from it, while the train is moving. The first object of the vestibule is to enclose the platform with a housing so arranged as to be continuous when cars are made up into trains, and fitted with side doors for ingress and egress when trains are standing. A second effect of the vestibule has developed in use. It appears that the lateral swaying of the cars is diminished by the friction between the vestibule frames. The fundamental American vestibule patent, issued to Mr H. H. Sessions, of Chicago, in November 1887, covered a housing in combination with a vertical metallic plate frame of the general contour of the central passageway, projecting slightly beyond the coupling line, and held out by horizontal springs top and bottom; the plate frame being connected with the platform housing by flexible connexions at the top and sides,

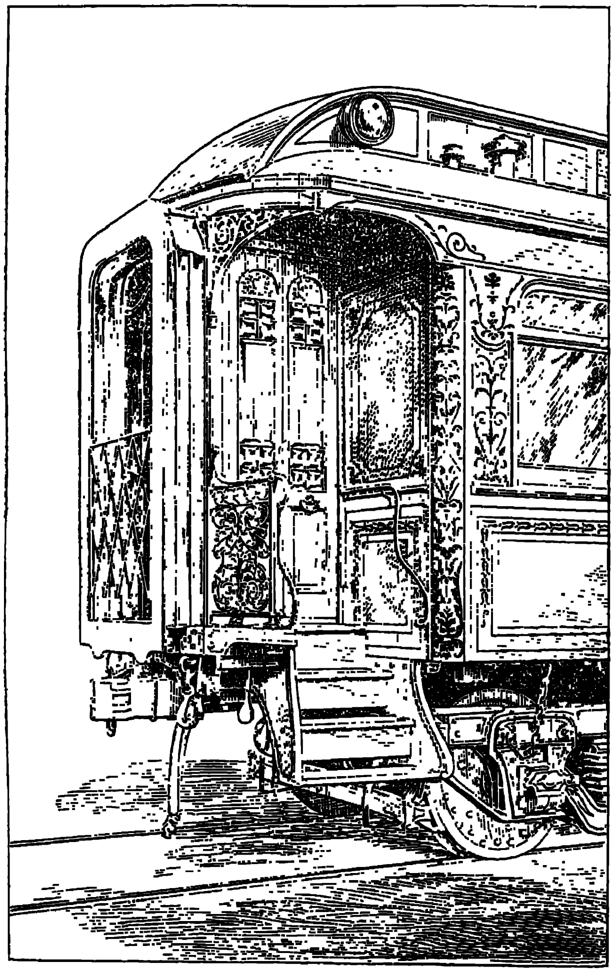


FIG. 17.—A "Vestibule"; the "lazytongs" gate is folded away when two cars are coupled together, giving free passage from end to end of the train.

and by sliding plates below. A common form of this vestibule is shown in Fig. 17. Subsequent improvements on the Sessions patent have resulted in a modified form of vestibule in which the housing is made the full width of the platform, although the contact plate and springs, and the flexible connexions, remain the same as before. On long journeys the vestibule is a convenience and a comfort; but its application is practically limited to the cars which are run in such trains, as it is an obstruction to the free ingress and egress of passengers on local trains which make frequent stops.

Of American cars intended to carry passengers, the proportion equipped with vestibules in September 1900 was about as follows: cars owned by railway companies, 15 per cent.; cars owned by the Pullman Company, 75 per cent. It appears probable that the application of vestibules will continue until the following maxima are reached: railway companies, 25 per cent.; Pullman Company, 100 per cent. (H. G. P.; R. H. So.)

INTRA-URBAN RAILWAYS.

Development. The great concentration of population in cities during the 19th century brought into existence a class of railways to which the name of intra-urban may be applied. Such lines are primarily intended to supply quick means of passenger communication within the limits of cities, and are to be distinguished on the one hand from surface tramways, and on the other from those portions of trunk or other lines which lie within city boundaries, although the latter may incidentally do a local or intra-urban business. Intra-urban railways, as compared with ordinary railways, are characterized by shortness of length, great cost per mile, and by a traffic almost exclusively passenger, the burden of which is enormously heavy. For the purpose of connecting the greatest possible number of points of concentrated travel, the first railways were laid round the boundaries of areas approximately circular, the theory being that the short walk from the circumference of the circle to any point within it would be no serious detention. It has been found, however, in the case of such circular or belt railways, that the time lost in traversing the circle and in walking from the circumference to the centre is so great that the gain in journey speed over a direct surface tramway or omnibus is entirely lost. Later intra-urban railways in nearly every case have been built, so far as possible, on straight lines, radiating from the business centre or point of maximum congestion of travel to the outer limits of the city; and, while not attempting to serve all the population through the agency of the line, make an effort to serve a portion in the best possible manner, that is, with direct transit.

The actual beginning of the construction of intra-urban railways was in 1853, when powers were obtained to build a line, $2\frac{1}{4}$ miles long, from Edgware Road to King's Cross, in London, from which beginning the Metropolitan and Metropolitan District railways developed. These railways, which in part are operated jointly, were given a circular location, but the shortcomings of this plan soon became apparent. It was found that there was not sufficient traffic to support them as purely intra-urban lines, and they have since been extended into the outskirts of London to reach the suburban traffic.

The Metropolitan and Metropolitan District railways followed the art of railway building as it existed at the time they were laid out. Wherever possible the lines were constructed in open cutting, to ensure adequate ventilation; and where this was not possible, they were built by a method suggestively named "cut and cover." A trench was first excavated to the proper depth, then the side walls and arched roof of brick were put in place, earth was filled in behind and over the arch, and the surface of the

ground restored, either by paving where streets were followed, or by actually being built over with houses where the lines passed under private property. Where the depth to rail-level was too great for cut-and-cover methods, ordinary tunnelling processes were used; and where the

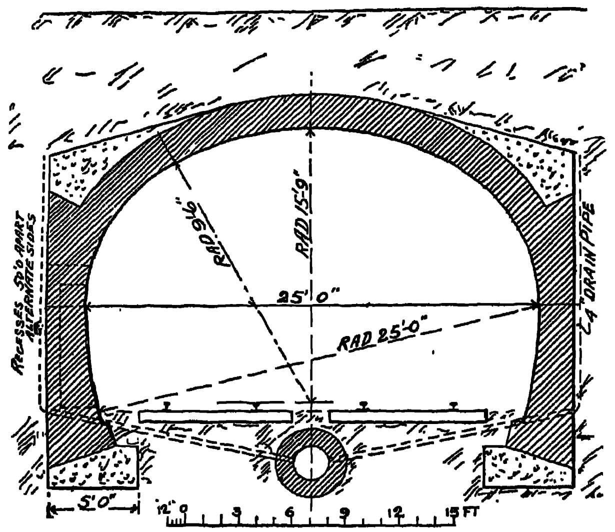


FIG. 18.—Type-section of arched covered way, Metropolitan District Railway, London.

trench was too shallow for the arched roof, heavy girders, sometimes of cast iron, bridged it between the side walls, longitudinal arches being turned between them (Fig. 18).

The next development in intra-urban railways was an elevated line in the City of New York. Probably the first suggestion for an elevated railway was made by Colonel Stevens, of Hoboken, New Jersey, as early as 1831, when the whole art of railway construction was in its infancy. He proposed to build an elevated railway on a single line of posts, placed along the curb line of the street, a suggestion which not only embodies the general plan of an elevated structure, but the most striking feature of it as subsequently built, namely, a railway supported by a single row of columns. The first actual work, however, was not begun till 1870, when the construction of an iron structure on a single row of columns was undertaken. The superiority, so far as the convenience of passengers is concerned, of an elevated over an underground railway, when both are worked by steam locomotives, and the great economy and rapidity of construction, led to the quick development and extension of this general design. By the year 1878 there were four parallel lines in the City of New York, and constructions of the same character had already been projected in Brooklyn and Chicago and, with certain modifications of details, in Berlin. In the year 1894 an elevated railway was built in Liverpool, and in 1900 a similar railway was constructed in Boston, U.S.A., and the construction of a new one undertaken in New York.

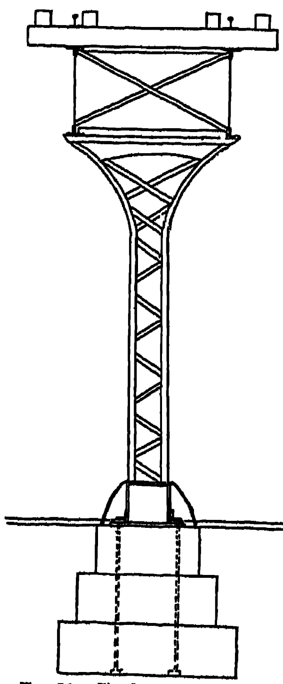


FIG. 19.—Single-column elevated structure.

These elevated railways as a rule follow the lines of streets, and are of two general types. One (Fig. 19), the earliest form, consisted of a single row of columns supporting two lines of longitudinal girders carrying the rails, the lateral stability of the structure being obtained by anchoring the feet of the columns to their foundations. The other type (Fig. 20) has two rows of columns connected at the top by transverse girders, which in turn carry the longitudinal girders that support the railway. In Berlin, on the Stadtbahn, which for a part of its length traverses private property, masonry arches, or an earthen embankment between retaining walls, were substituted wherever possible for the metallic structure.

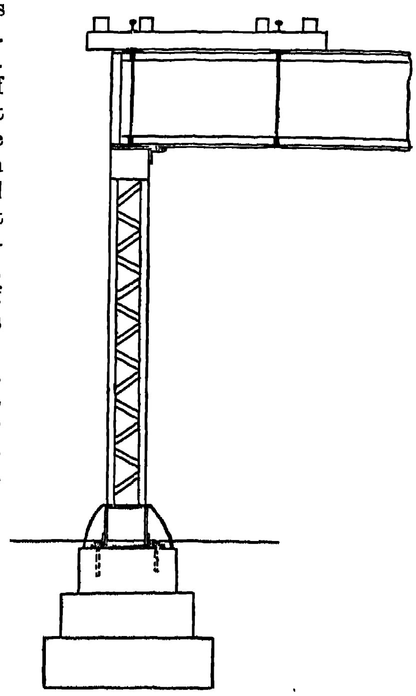


FIG. 20.—Double-column elevated structure (half-section).

The next great development, marking the third step in the progress of intra-urban railway construction, took place in 1886 when Greathead (*q.v.*) began the City and South London Railway, extending under the Thames from the Monument to Stockwell, a distance of 3½ miles. Its promoters recognized the unsuitability of ordinary steam locomotives for underground railways, and intended to work it by means of a moving cable; but before it was completed, electric traction had developed so far as to be available for use on such lines. Electricity, therefore, and not the cable, was installed (Fig. 21). In the details of construction the shield was the novelty. In principle it had been invented by Brunel for the construction of the original

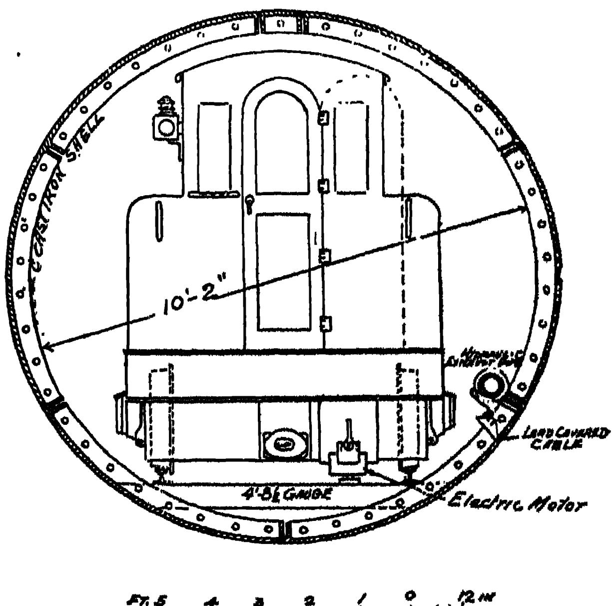


FIG. 21.—Section of tunnel and electric locomotive, City and South London Railway.

Thames tunnel, and it was afterwards improved by Beach, of New York, and finally developed by Greathead. (For the details of the shield and method of its operation, see TUNNELLING.) By means of the shield Greathead cut a circular hole at a depth ranging from 40 to 80 feet below the surface, with an external diameter of 10 feet 9 inches; this he lined with cast-iron segments bolted together, giving a clear diameter of 10 feet 2 inches. Except at the shafts, which were sunk on proposed station sites, there was no interference with the surface of the streets or with street traffic during construction. Two tunnels were built approximately parallel, each taking a single track. The cross-section of the cars was made to conform approximately to the section of the tunnel, the idea being that each train would act like a piston in a cylinder, expelling in front of it a column of air, to be forced up the station shaft next ahead of the train, and sucking down a similar column through the station shaft just behind. This arrangement was expected to ensure a sufficient change in air to keep such railways properly ventilated, but experience has proved it to be ineffective for the purpose. This method of construction has been used for building other railways in Glasgow and London, and in the latter city alone projects for "tube railways" of this character were brought before Parliament in 1902, which involved a capital of about 100 millions. One of the largest of these was for a line running from the terminus of the London United Tramways at Hammersmith, through the heart of the City, to the north-east suburbs. The later examples of these tube railways have a diameter ranging from 13 to 15 feet.

The fourth step in the development of intra-urban railways was to go to the other extreme from the deep tunnel which Greathead introduced. In 1893 the construction was completed in Budapest of an underground railway with a thin, flat roof, consisting of steel beams set close together, with small longitudinal jack arches between

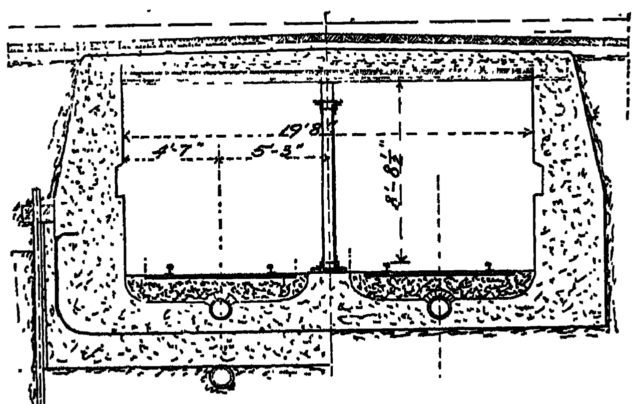


FIG. 22.—Electric underground railway, Budapest.

them, the street pavement resting directly on the roof thus formed (Fig. 22). The object was to bring the level of the station platforms as close to the surface of the street as the height of the car itself would permit; in the case of Budapest the distance is about 9 feet. This principle of construction has since been followed in the construction of the Boston subway, of the Chemin de Fer Métropolitain in Paris, and of the New York underground railway. The Paris line is built with the standard gauge of 4 feet $8\frac{1}{2}$ inches, but its tunnels are designedly made of such a small cross-section that ordinary main line stock cannot pass through them. The system, so far as authorized in 1902, has a total mileage of 38·86 miles, of which seven-tenths are to be in tunnel and the remainder in open cutting or on viaduct. The lines complete and in operation in September 1902 had a mileage of 8·67 miles, and ran between the Porte de Vincennes and the Porte Maillot, between the Place de l'Étoile and the Porte Dauphine, and between the Place de l'Étoile and the Trocadéro. Each of these sections is self-contained and is worked independently, thus abolishing junctions, with their inevitable signal delays; even the northern loop, under construction in 1902, which will form a complete circle with the existing Porte de Vincennes–Porte Maillot line, is not to be worked as a closed circuit, but on the "shuttle" system as an independent line. The stations are very numerous—for example, there are eighteen on the Porte de Vincennes–Porte Maillot line, which is 6·6 miles long—and the average speed is about 13 miles an hour. The terminal stations are constructed as loops, thus enabling trains to pass from the up to the down line without shunting delays, and exchange stations are provided wherever the lines touch each other or other railways. On the main line a three-minute service is maintained by day (5.30 A.M. to

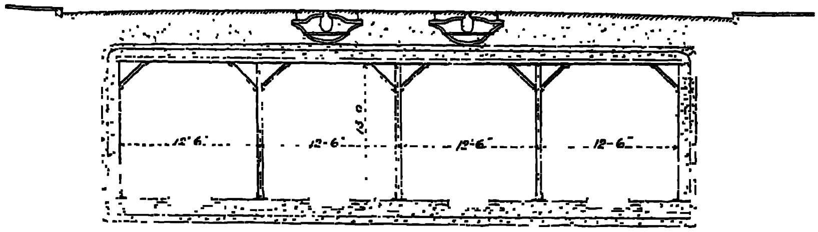


FIG. 23.—New York Rapid Transit Railway, showing also the tracks and conduits of the electric surface tramway.

8.30 P.M.) and a six-minute one by night (8.30 P.M. to 1 A.M.). The motive power is electricity, continuous current at 500 volts being employed. The New York underground railway (Fig. 23), when completed, will mark a still further step in advance, in that there are practically two different railways in the same structure. One pair of tracks is to be used for a local service with stations about one-quarter of a mile apart, following the general plan of operation in vogue on all other intra-urban railways. The other, or central, pair of tracks is for trains making stops at longer distances. Thus there is a differentiation between the long-distance traveller who desires to be carried from one extreme of the city to the other, and the short-distance traveller who is going between points at a much less distance.

To sum up, there are of intra-urban railways two distinct classes: the elevated and the underground. The elevated is used where the traffic is so light as not to warrant the expensive underground construction, or where the construction of an elevated line is of no serious detriment to the adjoining property. The underground is used where the congestion of traffic is so great as to demand a railway almost regardless of cost, and where the conditions of surface traffic or of adjoining property are such as to require that the railway shall not obstruct or occupy any ground above the surface.

Underground railways are of three general types: The one of extreme depth, built by tunnelling methods, usually with the shield and without regard to the surface topography, where the stations are put at such depth as to require lifts to carry the passengers from the station platform to the street level. This type has the advantage of economy in first construction, there being the minimum amount of material to be excavated, and no interference during construction with street traffic or subsurface structures; it has, however, the disadvantage of the cost of operation

of lifts at the stations. The other extreme type is the shallow construction, where the railway is brought to the minimum distance below the street level. This system has the advantage of the greatest convenience in operation, no lifts being required, since the distance from the street surface to the station platform is about 12 to 15 feet; it has the disadvantages, however, of necessitating the tearing up of the street surface during construction, and the readjustment of sewer, water, gas, and electric mains and other subsurface structures, and of having the gradients partially dependent on the surface topography. The third type is the intermediate one between those two, followed by the Metropolitan and Metropolitan District railways, in London, where the railway has an arched roof, built usually at a sufficient distance below the surface of the street to permit the other subsurface structures to lie in the ground above the crown of the arch, and where the station platforms are from 20 to 30 feet beneath the surface of the street—a depth not sufficient to warrant the introduction of lifts, but enough to be inconvenient.

Operation.

In the operation of intra-urban railways, steam locomotives, cables, and electricity have severally been tried, the first being used in the earlier examples of underground lines and in the various elevated systems in the United States. The fouling of the air that results from the steam-engine, owing to the production of carbonic acid gas and of sulphurous fumes and aqueous vapour, is well known, and its use is now practically abandoned for underground working. The cable is slow; and unless development along new lines of compressed air or some sort of chemical engine takes place, electricity will monopolize the field. Electricity is applied through a separate locomotive attached to the head of the train, or through motor carriages attached either at one end or at both ends of the train, or by putting a motor on every axle and so utilizing the whole weight of the train for traction, all the motors being under a single control at the head of the train, or at any point of the train for emergency. The distance between stations on intra-urban railways is governed by the density of local traffic and the speed desired to be maintained. As a general rule the interval varies from one-quarter to one-half mile, except on the express lines of the New York underground railway, where the inter-station interval averages about one and one-half miles. On the steam-worked lines the speed of trains is about 11 to 15 miles per hour, according to the distance between stations. Later practice takes advantage of the great increase in power that can be temporarily developed by electric motors during the period of acceleration; this, in proportion to the weight of the train to be hauled, gives results much in advance of those obtained on ordinary steam railways. Since high average speed on a line with frequent stops depends largely on rapidity of acceleration, the tendency in modern equipment is to secure as great an output of power as possible during the accelerating period, with corresponding increase in weight available for adhesion. With a steam locomotive all the power is concentrated in one machine, and therefore the weight on the drivers available for adhesion is limited. With electricity, power can be applied to as many axles in the train as desired, and so the whole weight of the train, with its load, may be utilized if necessary. On the Central London Railway the acceleration of gravity is also utilized; the different stations stand, as it were, on the top of a hill, so that outgoing trains are aided at the start by having a slope to run down, while incoming ones are checked by the rising gradient they encounter.

The following table (No. XX.) gives the statistics of the most recent English and American electric practice, the effort of the machines being actual output as measured by mechanical horse-power:—

TABLE XX.—*English and American Practice.*

	Central London.	Boston Elevated.	Manhattan Elevated. Electricity.	Manhattan Elevated. Steam.
Weight of train—tons (=2240 lb)	160¾	131	128½	110¾
,, ,, motor—,, ,,	42	27	34	21½
Weight of motor on drivers—tons	42	16	34	14
Number of motors . . .	1	5	2	1
,, ,, cars	8	5	6	5
Average distance between stops—feet	2550	2587	1775	1775
Schedule speed—miles per hour .	14·8	17·2	13·6	11·5
Maximum horse-power during acceleration	650	1600	950	250
Horse-power at full speed . .	220	200	160	150

On the Central London each train is worked by a single electric locomotive, though, owing to complaints of vibration from householders above the line, a modification of this arrangement is to be adopted; the Manhattan Elevated contemplates two motor cars, one at each end of the train, all the axles of each being equipped with motors; while the Boston Elevated, in order to overcome heavy gradients (8 per cent.), has one truck of every car supplied with power.

Cost.

The cost of intra-urban railways depends not only on the type of construction, but more especially upon local conditions, such as the nature of the soil, the presence of subsurface structures, like sewers, water and gas mains, electric conduits, &c.; the necessity of permanent underpinning or temporary supporting of house foundations, the cost of acquiring land passed under or over when street lines are not followed, and, in the case of elevated railways, the cost of acquiring easements of light, air, and access, which the courts have held are vested in the abutting property. The cost of building an ordinary two track elevated railway according to American practice varies from $300,000 to $400,000 per mile, exclusive of equipment, terminals, or land damages. The cost of constructing the deep tubular tunnel in London, whose diameter is about 15 feet, exclusive, in like manner, of equipment, terminals, or land damages, is about £170,000 to £200,000 per mile. The cost of the Metropolitan and Metropolitan District railways of London varied greatly on account of the variations in construction. The most difficult section, namely, that under Cannon Street, where the abutting buildings had to be underpinned, and a very dense traffic maintained during construction, while a network of sewers and mains was readjusted, cost at the rate of about £1,000,000 per mile. The contract price of the New York underground railway, exclusive of the incidentals above mentioned, was $35,000,000 for 21 miles, of which 16 miles are underground and 5 are elevated. The most difficult portion of the road, 4½ miles of four-track line, cost $15,000,000.

The burden of traffic on intra-urban railways assumes proportions not met on any trunk-line railways. During a year the Metropolitan and Metropolitan District railways of London, on a combined trackage of something more than 100 miles, handled upwards of 150,000,000 passengers; but a portion of the mileage of both these lines cannot be strictly reckoned as intra-urban. The elevated system in New York, with 40 miles of double track, has carried in a year over 221,000,000 passengers, and in a single day more than 1,000,000 passengers. The Central London Railway,

with a total of 5¾ miles of double track, has carried as many as 228,961 passengers in one day (29th October 1900, the date of the return of the City Imperial Volunteers from South Africa), and its total for the year 1901 was 41,188,389. (W. B. P.)

TRAMWAYS.

The commercial development of tramways, or as they are called in the United States of America, street railways, has become wholly a matter of mechanical traction. Since the introduction of the cable and electric methods, with notable economies and advantages, very few stage-coach or horse-tramway lines have been established; and the abandonment of the cable itself for electricity on all ordinary levels was in progress at the end of last century. After a long period of experimentation, neither storage batteries nor compressed-air systems can be said to have demonstrated their commercial advantages sufficiently to ensure their wide use. Few storage battery cars were to be found in operation in 1900; and in Berlin the municipality had so far acknowledged their comparative failure as to grant larger privileges to the trolley in the streets of that city, from which it had previously been barred. In Paris and New York compressed-air cars were operated on a few routes, but not in increasing numbers or with any apparent economy. The beginning of the 20th century saw electricity everywhere the dominating motive power in urban traction: for underground lines, with a third rail; for elevated lines, with a third rail; on streets and roads, whether city or surburban, with either the overhead trolley or the conduit system. Where the objection has still remained in cities to laying tracks through fine residential streets, a revival of earlier omnibus services has been attempted in the use of automobiles, propelled chiefly by electric motors and storage batteries. These cannot compete commercially with tramways, though they may be thought by some to be a desirable addition. Several cities in Europe and America have such lines in operation, and that in the city of Mexico may be mentioned as typical.

It is to the United States, with its new centres of busy population undergoing rapid development, that we must look for the most impressive figures of the tramway industry. The large areas covered, the great width of the streets, and the rectangular disposition of all the main thoroughfares have been favourable factors in stimulating a growth of remarkable proportions. In 1899 the number of cable cars declined from 4701 to 4250, and of horse cars from 3106 to 1489; but the number of electric cars increased from 46,549 to 50,658, and the track increased from 15,942 miles to 17,969. All told, there were 871 tramways of various types with a total of 19,213 miles of track and 58,736 cars. These represented a capital stock of $1,023,819,987 and a funded debt of $777,862,571, making a total of 1,801,682,558, or an increase of nearly $200,000,000 over the preceding year. The capitalization is at the rate of about $94,000 per mile of single track. There are no available statistics as to the return to capital from investment in tramways in America, but a study of the situation in 1897 went to show that they were then earning gross $150,000,000. In 1898 some 220 lines earned $130,000,000, these being large systems. The gain in gross earnings in 1898 over 1897 would doubtless reach $25,000,000, making $175,000,000 in 1898, when the total capitalization was about $1,622,000,000. If the net receipts be taken at 40 per cent., there remained applicable to bonds and stock from $60,000,000 to $70,000,000, or from 4 to 5 per cent. upon the entire capitalization as it stood, without regard to the proportion that may have been issued as a stock bonus with the bonds, or the newer construction not yet on an earning basis.

The economies wrought by the introduction of mechanical traction on tramways are noteworthy. They are best evidenced by the analysis of some one system, and that which is available in the fullest detail is furnished by the Metropolitan Street Railway Company of New York, which has the largest composite system in the world, and is operating with animal, cable, electric, and other powers. This company ran 45,390,318 car miles in the year ending 30th June 1900. The cost of operating with the cable per car mile was 17·76 cents; with electricity, 13·16 cents; and with horses, 18·98 cents. The total passenger receipts were $14,335,406. Had the horse mileage been operated electrically, there would have been an economy of $540,000 in the change. Had the whole system been operated by horses, the cost would have been $8,615,082 instead of the actual $7,034,033, showing that on this one system mechanical traction had already effected an annual saving with its present traffic of over $1,500,000. The item of the 13·16 cents cost of operation per electrical car mile of the system is made up as follows: maintenance of way, 0·81; maintenance of equipment, 1·41; power, 1·99; transportation, 7·29; general expenses, 1·66. The percentage of operating expenses to gross receipts was as follows: cable, 51; electricity, 40·5; horses, 73·6. It is to be borne in mind that the Metropolitan electric system is regarded as the costliest of its class, namely, the underground trolley making contact with the feeding conductors by means of a "plough" lowered into a slotted conduit.

Mr J. Clifton Robinson, managing director and engineer of the London United Tramways, supplies the following particulars for the lines in West London owned by that company, which in 1901 were converted from horse to electric traction (overhead trolley), the mileage at the same time being doubled:—The cost of operation per car mile was, with horses, 9·00d.; with electricity it is 5·40d., made up of maintenance of way 0·75d., maintenance of equipment 1·02d., power 0·46d., and other expenses 3·17d. The average number of passengers carried per car mile was, with the horse cars, 8·14; with electric cars it is 11·00; and in addition to this increase in the number of passengers per car mile the mileage has increased over 300 per cent. With horse traction, 8 miles of route carried 9,000,000 of passengers per annum; with electric traction, 16 miles carried 32,000,000. The percentage of operating expenses to gross receipts was 82·00 per cent. with horses; with electricity it fell to 52·00 per cent., and it is expected that this figure will be improved upon when the plant in the power station is employed to the full capacity for which it is designed. In 1902 over 60 miles of line were authorized and in course of construction, and a total of not less than 100 miles is projected in West London and the Thames Valley.

The statistics as to the street railway earnings in America are based upon the universal practice there of charging a "flat" 5 cent fare for the whole trip, which may be 15 or 20 miles long, and often includes one or two free transfers. The extent of this "transfer" practice, which is not at all a familiar condition in Europe, may be inferred from the fact that in Kansas City, Mo., there are no fewer than 85 points of intersection on the leading tramway system, at each of which transfers are given out, so that any part of the city can be reached from any other part on one fare. The population of the urban district is only 215,000, but no fewer than 70,000 such transfers are issued daily. In Europe the measured tariff system prevails, so that while the short-distance rider for less than a mile pays one-fifth the American fare, the long-distance rider may pay two or three times as much. Curiously enough, the gross receipts per mile in Europe are quite as high as in America, indicating that European tramways lie in areas of dense population, while in the United States long cheap rides to reach homes in the suburbs are common. In fact, the rapid building up of suburbs round the American cities has been one of the most obvious results of tramway development; but it has not as yet become so pronounced in Europe as to excite comment. The general effect on American suburban real estate of the discrimination in favour of the citizen seeking a suburban home may be fairly judged from the experience of Brookline, Mass. From 1855 to 1885 the value of real estate had risen about $350,000 a year, reaching $17,000,000. In 1890, consequent on the introduction of the electric tramway and the rush of home-seekers to get out of Boston, the valuation jumped to $30,000,000, although property in the old centre was not injured.

A feature of commercial economy which does not appear at first sight in a study of the American figures is the ability to handle more passengers with fewer cars and fewer men. In the United States in 1890 there were 32,505 cars and 70,764 employés to 8783 miles of road. The electrical transformation was then getting into full swing, and 16-foot cars were in general use, the speed rarely exceeding 6 to 8 miles an hour. The average speed of the electric cars may now be put at 10 miles per hour, and the length of the car at 24 feet. The number of horse and electric cars has been reversed in the ten years. The total number of passengers carried in 1890 by all methods of power was 2,023,010,202, while for the year closing in 1900 the traffic for the electric cars alone is estimated at 4,000,000,000. On the latter basis, and estimating the daily car miles at 3,000,000, the daily saving to the tramways is $180,000. With the same mileage of track as in 1899, the New York Metropolitan showed a gain in 1900 of $1,562,920 in the gross and $695,896 in the net. On one line in New York with horse cars in 1897, the round trip occupied three hours, and 200 cars carried 17,000,000 passengers. With electric cars in 1900, the round trip required only two hours, and

300 cars carried 50,000,000 passengers. The value of the daily saving in time by the trolley to the American working population alone is over $20,000 per day.

The following table (No. XXI.) gives some idea of the relative growth of the development of electric tramways in the leading countries of Europe:—

TABLE XXI.—*Electric Railways and Tramways in Europe.*

Name of Country.	1894.			1895.			1896.			1897.			1898.			1899.		
	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.	Miles of Track.	Capacity in Kilo-watts of Power Station.	Number of Motor Cars.
Great Britain	70	3000	120	...	...	...	...	...	...	440	20,000	800	560	28,000	1500	900	40,000	2000
Germany	164	2934	...	585	5264	632	648	7194	857	1000	19,000	2000	1800	26,000	3100	2300	54,000	5400
Austria-Hungary	42	1115	...	72	1639	129	114	1949	157	134	2,389	194	169	3,404	243	180	3,600	291
Belgium	5	90	...	35	1130	48	40	1130	48	56	1,220	73	110	2,415	107	120	3,000	200
Spain	12	210	...	12	210	12	47	600	26	74	600	40	98	930	50	167	2,450	141
France	68	1796	...	154	3610	152	211	4490	225	448	8,736	432	626	15,158	664	800	25,000	1000
Italy	11	720	...	28	870	33	62	1890	84	168	5,070	289	212	6,750	311	235	6,600	318
Switzerland	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	250	7,500	330
																4052	142,150	9683

If to these figures there be added those of Norway and Sweden, Russia, Holland, Portugal, Rumania, Servia, and Bosnia, it would appear that for the last year under report there were in Europe 5092 miles of track, 147,760 kilowatt capacity of power plant, and 10,030 motor cars. The growth indicated by these figures did not slacken during 1900, when such cities as Paris and Geneva enjoyed the addition of extensive electric tramway systems; the former city, like London, also seeing a large underground electric railway system put in operation. It has been estimated that the entire Continental tramway enterprise represents an investment of probably £200,000,000. In Great Britain, according to Garcke's *Manual of Electrical Undertakings*, in 1901–1902 a total capital of nearly 40 millions sterling (ordinary, preference, and loan and debenture) was divided among 125 electric traction undertakings, and 47 municipalities had expended on electric traction an amount of 10½ millions. On 1st January 1900 British companies had been organized to build and operate foreign tramways with an authorized capital of £18,543,517, and towards this there had been paid in £9,854,372 for shares and £2,793,777 debentures, a total of roughly two-thirds the amount. To this, again, must be added £4,000,000 of British capital in Continental tramways; £2,000,000 in tramways in the colonies, but not of British corporate domicile; and £6,700,000 invested in American and Canadian tramway work. It should be added, however, that Continental capital, notably German, has of late been very active in the exploitation of tramway enterprises outside the respective territorial limits of the banking groups interested; while a more recent feature of such international financing has been the endeavour to purchase London underground electric railway franchises and companies by American capital. While much of this work may be due to a desire to create markets for apparatus, as well as to bring new securities into existence, it seems to be a fact that no city in the world has yet transportation facilities adequate to the demands of its own resident and suburban population, and this is specially the case in London.

For some of the British systems a large quantity of American apparatus has been imported; but British machinery and detail parts of excellent construction and durability are now freely obtainable, large factories for its production having sprung up in different parts of the country. The figures for 1898–99 of the British tramway system show the following results:—

Total number of cars	6,323
,, ,, locomotives (including motor cars)	584
,, ,, horses	44,171
,, ,, passengers carried	924,820,247
,, ,, car miles run	96,078,503
Gross receipts	£4,879,602
,, per car mile	1s. 0·192d.
Operating expenses	£3,675,559
,, ,, per car mile	9·12d.
Net receipts	£1,204,043
,, per car mile	3·072d.

Since these official figures were compiled, however, the advance of electric traction has been so rapid as to change many of them appreciably. For example, Dublin reported a cost per car mile of only 5·24d., and Leeds reported 5·97d. per car mile with a percentage of 47·3 for operating expenses, although its electric system was far from complete. According to Garcke's *Manual* for 1901–1902, of electrical tramways and light railways in the United Kingdom, the track mileage constructed was 1252 miles, under construction 846 miles, and authorized and about to be constructed 1348 miles, a grand total of 3446 miles. The number of electrical cars constructed was 3834, and under construction 777.

The sociological side of the electric tramway has many interesting aspects, some of which have important commercial or industrial features. In many cities the conversion of the old horse-car stables into electric centres has enhanced the value of adjoining real estate materially; while medical officers have noted a diminution of diseases that might be attributed to horses. The creation of new suburbs has been mentioned already. Another striking fact has been the deliberate effort manifested by tramway managers to reach parks and places of rural pleasure resort; in the United States over 100 tramways have reported as to their ownership of parks, and some of them have gone so far as to organize vaudeville entertainments, the performers during the summer travelling from place to place, and thus providing a constantly new programme. In Geneva, Switzerland, electric tramways have been developed with special reference to the parks on the outskirts; and one of the electric lines runs several thousand feet up Mont Salève, from the plateau of which an unsurpassed view is obtained of the Lake of Geneva on the left and the whole Mont Blanc range on the right.

(T. C. M.)

LIGHT RAILWAYS.

Great Britain.

The term light railways is somewhat vague and indefinite, and therefore to give a precise definition of its significance is not an easy matter. No adequate definition is to be found even in the British statute-book; for although Parliament has on different occasions passed Acts dealing with such railways both in Great Britain and Ireland, it has not inserted in any of them a clear and sufficient statement of what it intends shall be understood by the term, as distinguished from an ordinary railway. Since the passing of the Light Railways Act of 1896, it is possible to give a formal definition by saying that a light railway is one constructed under the provisions of that Act; but it must be noted that the Commissioners appointed under that Act have authorized many lines which in their physical characteristics are indistinguishable from street tramways constructed under the Tramways Act, and to these the term light railways would certainly not be applied in ordinary parlance. Still they do differ from ordinary tramways in the important fact that the procedure by which they have been authorized is simpler and cheaper than the methods by which special private Acts of Parliament have to be obtained for tramway projects. Economy in capital outlay and cheapness in construction is indeed the characteristic generally associated with light railways by the public, and implicitly attached to them by Parliament in the Act of 1896, and any simplifications of the engineering or mechanical features they may exhibit compared with the standard railways of the country are mainly, if not entirely, due to the desire to keep down their expenses.

The saving of cost is effected in two ways: (1) Instead of having to incur the expenses of a protracted inquiry before Parliament, the promoters of a light railway under the Act of 1896 make an application to the Light Railway Commissioners, who then hold a local inquiry, to obtain evidence of the usefulness of the proposed railway, and to hear objections to it, and, if they are satisfied, settle the draft order and hand it over to the Board of Trade for confirmation. The Board may reject the order if it thinks the scheme to be of such magnitude or importance that it ought to come under the direct consideration of Parliament, or it may modify it in certain respects, or it may remit it to the Commissioners for further inquiry. But once the order is confirmed by the Board, with or without modifications, it has effect as if it had been enacted by Parliament, and it cannot afterwards be upset on the ground of any alleged irregularity in the proceedings. (2) The second source of economy is to be sought in the reduced cost of actually making the line and of working it when made. Thus the gauge may be narrow, the line single, the rails lighter than those used in standard practice, while deep cuttings and high embankments may be avoided by permitting the curves to be sharper and the gradients steeper: such points conduce to cheapness of construction. Again, low speeds, light stock, less stringent requirements as to continuous brakes, signals, block-working and interlocking, road-crossings, stations, &c., tend to cheapness in working. On the lines actually authorized by the Board of Trade under the 1896 Act the maximum speed permitted has in no case exceeded 25 miles an hour, and that only on the level and in the straight. For such lines the normal minimum radius of the curves has been fixed at about 600 feet; when a still smaller radius has been necessary, the speed has been reduced to 10 miles an hour and a guard-rail insisted on inside the curve. Again, the speed has been restricted to 20 miles an hour on long inclines with gradients steeper than 1 in 50, and also on a line which had scarcely any straight portions and in which there were many curves of 600 feet radius and gradients of 1 in 50. In the case of a line of 2½ feet gauge, with a ruling gradient of 1 in 40, a maximum speed of 15 miles an hour and a minimum radius of curve of 300 feet have been prescribed. Curves of still smaller radius have entailed a maximum speed of 10 miles an hour. It must be understood that a railway described as "light" is not necessarily built of narrower gauge than the standard. Many lines, indeed, have been designed on the normal 4 feet 8½ inches gauge, and laid with rails weighing from 50 to 70 ℔ per yard; a flat-footed 60 ℔ rail, with the axle load limited to 14 tons, has the advantage for such lines that it permits the employment of a proportion of the locomotives used on main lines. The orders actually granted have allowed 50 ℔, 56 ℔, 60 ℔, and 70 ℔ rails, with corresponding axle loads of 10, 12, 14, and 16 tons. On a line of 2 feet gauge, rails of 40 ℔ have been sanctioned. In regard to fencing and precautions at level-crossings, less rigid requirements may be enforced than with standard railways; and in some cases where trains are likely to be few, it has been provided that the normal position of the gates at crossings shall be across the line. Again, if the speed is low and the trains infrequent, the signalling arrangements may be of a very simple and inexpensive kind, or even dispensed with altogether.

Table XXII. gives particulars of the applications which had been made up to the end of 1901 to the Commissioners since the passing of the Act in 1896. It should be mentioned that the Act, which in 1902 was re-enacted for a further term, provided that the Treasury might advance a portion of the money required for a line in cases where the council of any county, borough, or district had

TABLE XXII.—*Applications for Light Railway Orders.*

Date.	Number.	Mileage.	Gauge. 5′ 9″		4′ 8½″		4′ 0″		3′ 6″		3′ 0″		2′ 6″		2′ 0″		1′ 11½″		Motive Power Proposed. Steam.		Electric.		Mechanical, etc.	
			No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.	No.	Mileage.
December 1896	28	307¾	...	...	19	208¾	1	14	6	48	1	26	1	11	...	...	...	...	...	...	...	...	...	...
May 1897	28[1]	273¾	...	...	20	205¾	1	12	6	36¼	...	...	2	19¾	...	...	...	...	...	...	...	...	...	...
November 1897	30	292½	1	½	16	186	1	4	8	65½	1	2	1	6½	1	16½	1	11½	13	166½	16	125½	1	½
May 1898	35[2]	430¼	...	...	23	260¼	...	...	9	135	...	...	...	...	1	21	1	14	17	302½	17	127¾	...	...
November 1898	54	499½	...	...	38	395¼	...	...	15	99¾	...	...	...	...	...	...	1	4½	22	256	32	243½	...	...
May 1899	40[2]	412	...	...	25	322¾	1	18	12	67¼	...	...	1	4	...	...	...	...	18	242¾	19	148¼	2	21
November 1899	43	441½	...	...	28	294¼	1	18	14	129¼	...	...	...	...	...	...	...	...	12[8]	181	30	242½	1	18
May 1900	24	206½	...	...	15	157¼	1	14¼	6	21¼	1	6½	1	7¼	...	...	...	...	7	99½	17	107	...	...
November 1900	27[3]	142½	...	...	11	80½	1	5¾	5	42¾	1	13½	...	...	...	...	...	...	2	17½	16	125	...	...
May 1901	26[4]	269	...	...	20	253	...	...	1	16	...	...	...	...	...	...	...	...	5	39	16	230	...	...
November 1901	44[5]	384⅝	...	...	29[6]	292⅞	1	4¼	12[6]	87½	...	...	...	...	...	...	...	...	4	19¾	37	364⅞	...	...
Totals	379[7]	3659⅞	1	½	244	2656⅝	8	90¼	94	748½	4	48	6	48½	2	37½	3	30	...	...	...	...	...	...

[1] One scheme (Leek) applied for 10 miles of 4′ 8½″ and 7¼ miles of 3′ 6″. [2] One amending order, no new mileage involved. [3] Nine amending orders.
[4] Five amending orders. [5] Three amending orders. [6] One scheme (Derby and Nottingham) applied for 14 miles of 4′ 8½″ and 5¼ of 3′ 6″.
[7] Nineteen amending orders. [8] Including one of 39¾ miles steam or electric.

agreed to do the same, and might also make a special advance in aid of a light railway which was certified by the Board of Agriculture to be beneficial to agriculture in any cultivated district, or by the Board of Trade to furnish a means of communication between a fishing-harbour and a market in a district where it would not be constructed without special assistance from the State.

As a general classification (Table XXIII.), the Commissioners have divided the schemes that have come before them into three classes: (A) those which like ordinary railways take their own line across country; (B) those in connexion with which it is proposed to use the public roads conjointly with the ordinary road traffic; and (Neutral) which includes inclined railways worked with a rope, and lines which possess the conditions of A and B in about equal proportions.

The so-called light railways in the United States and the British colonies have been made under the conditions peculiar to new countries. Their primary object being the development and peopling of the land, they have naturally been made as cheaply as possible; and as in such cases the cost of the land is inconsiderable, economy has been sought

TABLE XXIII.—*Classification of Light Railway Applications.*

	Number of Lines applied for up to 31st December 1901.	Mileage.	Total Construction Estimate excluding Rolling Stock.	Number of Lines approved by the Commissioners and sent to the Board of Trade.	Mileage.	Total of Construction Estimate approved.
			£			£
Class A .	144	1836$\frac{1}{4}$	11,117,213	86	923$\frac{1}{2}$	5,375,420
,, B .	211	1686$\frac{5}{8}$	15,309,536	82	418	3,447,990
Neutral .	5	137	893,848	1	$\frac{1}{2}$	17,953
Amending orders .	19	...	39,398	12	...	39,398

by the use of lighter and rougher permanent way, plant, rolling stock, &c. Such railways are not "light" in the technical sense of having been made under enactments intended to secure permanent lowness of cost as compared with standard lines. On the Continent of Europe many countries have encouraged railways which are light in that sense. France began to move in this direction in 1865, and has formulated elaborate provisions for their construction and regulation. Italy did the same in its laws of 1873, 1879, 1881, 1887, and 1889; and Germany fostered enterprise of this kind by the Imperial edicts of 1875, 1878, and 1892. Holland, Hungary, and Switzerland were all early in the field; and Belgium has succeeded, through the instrumentality of the semi-official Société Nationale de Chemins de Fer Vicinaux, started in 1885, in developing one of the most complete systems of rural railway transport in the world. An account of the regulations prescribed by several of these countries is given below.

France. In France the lines which best correspond to British light railways are called "*Chemins de fer d'interêt local.*" These are regulated by a decree No. 11,264 of 6th August 1881, which the Ministry of Public Works is charged to carry out. Construction can be commenced after the *Conseil General* of the department has approved the project, and the Prefect the details; only if the scheme interferes with rivers or great public lines of communication does the Ministry of Public Works interfere. The model "form of regulation" lays down the scales of the drawings and the information to be shown thereon. For the first installation a single line is prescribed, but the "concessionaire" must provide space and be prepared to double when required. The gauge may be either 1·44 metres (4′ 8·7″), or 1 metre (3′ 3·37″), or ·75 centimetres (2′ 5·5″). The radius of curves for the 1·44 gauge must not be less than 250 metres, 100 metres for the 1 m. gauge, and 50 metres for the ·75 m. gauge. A straight length of not less than 60 metres for the largest gauge, and 40 metres for the smallest, must be made between two curves having opposite directions. Except in special cases, gradients must not exceed 8 in 100; and between gradients in the opposite sense there must be not less than 60 metres of level for 1·44, and 40 metres for 1 m. and ·75 m. gauges. The position of stations and stopping-places is regulated by the Council of the Department. The undertaking, once approved, is regarded as a work of public utility, and the undertakers are invested with all the rights that a public department would have in the case of the carrying out of public works, and are subject to the same responsibilities and conditions. Within the areas that come under the "Defence Acts" the works are subject to all the military necessities and laws which are prescribed for works in such areas, both retrospectively and prospectively.

The Prefecture is responsible for preventing and limiting all interference by the undertakers with public and private rights, and for regulating the precautions for public safety. The contracts for the work are made either under public competition, on the published price list approved and in use in the department, or by sealed tenders from a selected list of contractors. The working of the lines is under detailed regulations, to which the approval of the Prefect of the department must be obtained; and the penalty for non-observance of these is practically confiscation, if defalcation, or neglect, is carried far enough. The Prefect may step in and work the line at the expense of the "concessionaires." The matters as regards which the Prefect must be consulted and satisfied are: numbers of staff in respect to safe working; efficiency, design, and construction of the locomotives and of the rolling stock; classification and interior arrangements of the passenger and goods carriages: separation of sexes; size and composition of trains; number of trains; policing; general bye-laws; maximum and minimum speed; and time-tables. At the end of the period of the concession the "département" comes into possession of the road and all its fixed appurtenances, and in the last five years of the period the "département" has the right to enter into possession of the line, and apply the revenue to putting it into a thorough state of repair, if it has been allowed to deteriorate. It has also the right to select and buy, at a price to be adjudged by experts, any part or all of the rolling stock and movables, and the owners can only oblige it to take the fuel and stock of necessary working and maintenance materials at a valuation. It has also the right to purchase the undertaking at the end of the first fifteen years, the net profits of the preceding seven years to govern the calculation of the purchase price. The maximum 1st, 2nd, and 3rd class passenger fares are, per kilometre, ·067 f. (·6d.), ·050 f. (·455d.), and ·037 f. (·34d.) respectively, when the trains are run at "*grande vitesse,*" the fares including 30 kilogrammes weight of personal baggage. All goods trains are at *petite vitesse* fares, except those for oysters, fish, and perishable goods. Any reduction of rates must be subject to the approval of the Prefect and of the Minister of Public Works. All preference rates, except on behalf of the public service, are interdicted. All the details of tickets, way bills, invoices, and papers in connexion with traffic, delivery, and storage are specified, and the working hours prescribed by the Prefect.

Belgium. In Belgium a public company under Government control does all that in France forms the responsibility of the Ministry of the Interior and of the Prefect of the department. Over an average of years it appears that 27 per cent. of the capital cost was found by the State, 28 per cent. by the province, 40·9 per cent. by the communes, and 4·1 per cent. by private individuals. As far as possible, these railways are laid beside roads, in preference to independent formation; the permanent way costs £977 per mile in the former as against £793 in the latter. If laid in paving, the price varies between £1108 and £2266 per mile. The total length in Belgium, either worked by the company or leased by it, is 726$\frac{1}{2}$ miles. To work this mileage, 253 locomotives, between 18 and 30 tons in weight, 716 passenger vehicles, 400 covered vans, 1367 open waggons, and 10 special vehicles are in constant use. In the case of a Belgian light railway intended primarily to serve an agricultural district, about 12$\frac{1}{4}$ miles in length, and mainly dependent upon its goods traffic, the line is constructed on the road, excepting where steep gradients, &c., make slight diversions desirable. Usually a line of way is formed at one side of the road, raised slightly by ballast, &c., and separated from the remainder of the road by kerbstones; it resembles a footpath alongside a country road. In this way the railway is not available for ordinary carriage traffic, nor is it used by pedestrians. Through villages, and where roads have to be crossed, the line is of the usual tramway type. The line is of 1 metre gauge, with steel rails weighing 21$\frac{1}{2}$ kilos (42 lb) per yard. In the towns a deeper rail is used, weighing about 60 lb per yard. In three lines of the Vicinaux system, in the aggregate 45 miles in length, the sharpest curves are 30 metres, 35 metres, and 40 metres respectively. There are gradients of 1 in 20 and 1 in 25. The speed is limited, by regulation, to 30 kilometres (about 18 miles) in the country and 8 miles per hour in towns and through villages; the time allowed in the time-table for the journey, for instance, from Andenne to Eghozee, 12$\frac{1}{4}$ miles, averages one hour twenty-five minutes, but one train in the day each way only takes about one hour five minutes. The engine, 18 tons weight, has six wheels coupled, each of 3 feet diameter; all moving parts are cased, and it is driven from either end (the driver, of course, always being in front).

A train, for example, at starting, is composed of one goods waggon, one passenger carriage, and one fourgon or luggage van. For suburban passenger traffic there is usually no van, but the Société has a certain number of vehicles forming a second-class compartment and a small van. Vans have a post office letter-box, in which letters can be posted at the various halting-places.

A room in an inn generally forms a waiting-room for passengers, and a place where parcels can be left, either until called for or to be picked up by the train. No tickets are, however, issued, or ordinary station business transacted; and it is not usual to make any payment to the proprietor of the inn, who gladly affords these slight facilities in return for the custom brought to the house. In addition to the stations as above, there are also fixed points (with a notice-board only) where the train stops if there is any one to pick up or set down, such as at important cross-roads, &c.

In Italy many railways which otherwise fulfil the conditions of a light railway are constructed with a gauge of 4′ 8$\frac{1}{2}$″. The weights are governed by what the railway has to carry and the speed. Light locomotives, light rails, and light rolling stock are employed.

There are no bridges, except where watercourses occur. Cuttings are reduced to a minimum; and where the roads are sufficiently wide, the rails are laid on the margins. The advantage of uniformity of gauge is in the use of trucks for goods which belong to the rolling stock of the main lines.

Italy. In Italy these railways are called "Economic Railways," and are divided into five types. Types I., II., and III., are of 4′ 8½″ gauge, type IV. of 0·95 m., and type V. of 0·70 m.; but as there is no example of type V., the classification is practically one of 1·445 m. (4′ 8½″) and one of 0·95 (3′ 0·5″). The chief difference between the first three types lies in the weight of rails and rolling stock and in the radius of the curves. The real light railway of Italy is that of type IV.: gauge, 0·95 m. (3′ 0·5″); weight of rails, 12 (26·45 ℔) to 20 (44 ℔) kilos.; mean load per axle, 6 tons; minimum curve, 70 m. (229′ 2·6″) radius; width of formation, 3·50 m. (11′ 5·5″); top width of ballast, 2·10 m. (6′ 10·7″); depth of ballast under sleepers, 0·10 m. (3′ 9·5″); maximum gradients, 1 in 50; length of sleepers, 1·70 m. (5′ 6·92″); width between parapets and width of tunnels, 1 m. over width of carriage; height of tunnels, 5 m. (16′ 4·85″); locomotives, maximum weight per axle 6 tons, rigid wheel base 1·80 m. (5′ 10·86″), diameter of driving wheels 1 m. (3′ 3·37″).

Germany. In Germany the use of light railways (*Klein-bahnen*) has made great strides. The gauges in use vary considerably between 4′ 8½″, the standard national gauge, and 1′ 11¾″, which appears to be the smallest in use. They are under the control of the Post and Telegraph Department, the State issuing loans to encourage the undertakings; the authorities in the provinces and communes also give support in various ways, and under various conditions, to public bodies or private persons who desire to promote or embark in the industry. These conditions, as well as the degree of control over the construction and working of the lines, are left to the regulation of the provincial governments. Similarly, the same authorities decide for themselves the conditions under which the public roads may be used, and the precautions for public safety, all subject to the confirmation of the Imperial Government. For instance, at speeds of less than 27 miles an hour, a buffer compartment (instead of a buffer vehicle) may be sufficient between the passenger carriages and the engine; the conductor may have sole charge of the train, sell tickets at stopping-places where no ticket-office is maintained, and look after payments for luggage; the driver and stoker may be charged with the care of the carriages and the greasing of the wheels; women may be employed as gate-keepers; fencing need not be continuous; gates at level-crossings need not always be insisted on; telegraph and bell signals may be dispensed with; trains may occasionally stop at points intermediate to the usual stopping-places; trains of limited size (50 axles) may be pushed at low speeds; brakes per axle on the carriages—actually applied—may be reduced in proportion to the gradients. The freedom which the legislature in Germany has given to provincial and communal authorities to regulate these railways by rules growing out of experience and common sense, in contradistinction to the empirical State regulation which exists in other countries, has resulted in a very large and rapid adoption of their use to the development of rural industries of all kinds.

Portable railways. What are known as "portable railways" should be included in the same category as light railways. With a 24″ gauge, lines of a portable kind can be made very handily, and the cost is very much less than that of a permanently constructed light railway. The simplicity is great; they can be quickly mounted and dismounted; the correct gauge can be perfectly maintained; the sections of rails and sleepers (which are of iron) are very portable, and skilled labour is not required to lay or to take them up; the making of a "turn-out" is easy, by taking out a 15 foot section of the way and substituting a section with points and crossings. The safe load per wheel varies between 12 cwt. on a 10 inch 16 ℔ wheel, and 40 cwt. on an 18 inch 56 ℔ wheel. The rolling stock is constructed either for farm produce or heavy minerals, the latter holding 10 to 27 cubic feet. For timber, 4 or 5 feet bogies can be used. A useful waggon for agricultural transport on a 24-inch gauge line is 16 feet long by 5 feet wide; it weighs 72 cwt. and costs £30. A portable line of this kind will have 20 ℔ steel rails and 2112 steel sleepers—4′ 6″ long—to a mile, laid 2′ 6″ apart centre to centre. The total cost per mile of such a line, including all bolts, nuts, fish-plates, and fastenings, ready for laying, delivered in the United Kingdom, is under £500 a mile.

See EVANS AUSTIN. *The Light Railways Act*, 1896, which contains the rules of the Board of Trade.—W. H. COLE. *Light Railways at Home and Abroad.*—Lieut.-Col. ADDISON. Report to the Board of Trade (1894) on Light Railways in Belgium.

(C. E. W.)

MOUNTAIN RAILWAYS.

Railways having gradients above a certain limit, which may be taken as about 30 in 1000, are regarded as mountain railways. They are of three kinds: adhesion lines; rack railways, either pure rack or rack and adhesion combined; and cable railways.

Adhesion lines (Table XXIV.) may be either of normal or of narrow gauge. The maximum gradient is dependent on

TABLE XXIV.—*Adhesion Lines.*

	Ceylon Government Railway. Kaduganawa Incline.	St Gothard Railway. Mountain Incline.	Darjiling Railway. Himalaya.	La Guaira–Caracas Railway. Venezuela.	Mexican Railway. Mexico.	Callao–Oroya Railway. Peru.	Südost Railway. Switzerland.	Landquart–Davos Railway. Switzerland.	Yverdon–St Croix. Switzerland.	Tiadaghton Fahnastalk. Pennsylvania, U.S.A.	Cantagallo Railway. Brazil.
Gauge	5 ft. 6 in.	4 ft. 8½ in.	2 ft.	3 ft.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	1 metre	1 metre	4 ft. 8½ in.	1·10 metre
Cost of construction per mile	...	£68,873, exclusive of summit tunnel	£4575	£25,000	...	£31,960	£10,400	£11,520	...	...	£20,000
Radius of sharpest curve, metres	201	280	21·3	42·7	100	120	180	100	100	58	40
Radius of sharpest curve, feet	660	918	70	140	328	394	590	328	328	191	131
Steepest gradient	1:45	1:37	1:28	1:27	1:25	1:25	1:20	1:22	1:22	1:16·6	1:12
Length of incline	12 miles	18 and 21 miles	40 miles	23 miles	14 miles	100 miles	7 miles	13·7 miles	5·2 miles	One of 2·7 miles, and various others	6¼ miles
Diameter of cylinder	17 in.	15¾ and 22¾ in.	11 in.	15½ in.	16 in.	18 in.	15 in.	19·3 and 13 in.	11 and 16¾ in.	12 in.	18 in.
Stroke	26 ,,	25¼ in.	14 ,,	20 ,,	22 ,,	24 ,,	21 ,,	21·7 in.	19¾ in.	10 ,,	20 ,,
Axles, number	3 all coupled	6 coupled in threes	2 coupled	3 coupled and 1 bogie	6 coupled in threes	...	3 coupled	2 pairs of 2 coupled	4 coupled	4 coupled	3 coupled
Rigid wheel-base	9 ft. 6 in.	8 ft. 10 in.	5 ft. 6 in.	6 ft. 10 in.	8 ft. 3 in.	14 ft. 9 in.	8 ft. 2 in.	5 ft. 3 in.	4 ft. 7 in.	4 ft. 2 in.	8 ft. 3 in.
Diameter of wheels	3 ,, 6 ,,	4 ft.	2 ,, 2 ,,	3 ft.	3 ,, 6 ,,	4 ,, 1 ,,	2 ,, 11 ,,	3 ,, 3 ,,	3 ,, 3½ ,,	...	3 ,, 3 ,,
Heating surface	1342 sq. ft.	1660 sq. ft.	355 sq. ft.	872 sq. ft.	1712 sq. ft.	1066 sq. ft.	1022 sq. ft.	863 sq. ft.	731 sq. ft.	...	...
Engine-weight loaded	32·5 tons	84 tons	13·8 tons	33·8 tons	92·2 tons	45 tons	36 tons	40 tons	34 tons	35 tons	40 tons
Net train-weight hauled up the incline	147 ,,	200 ,,	35 ,,	68 ,,	175 ,,	75 ,,	85 ,,	70 ,,	60 ,,	75 ,,	40 ,,
Load drawn per ton of locomotive weight	2·85 ,,	2·38 ,,	2·5 ,,	2·02 ,,	1·9 ,,	1·15 ,,	2·36 ,,	1·75 ,,	1·72 ,,	2·14 ,,	1 ,,

climatic conditions, a dry climate being the most favourable. The theoretical limit is about 60 in 1000; between 50 and 60 in 1000 an adhesional engine is able to haul only its own weight. The gradient should not in practice exceed 45 in 1000; and even that is too heavy, for theoretical conditions cannot always be realized. A wet rail will prevent the use of the theoretical adhesion of the driving wheels, and the gradients must be such that a locomotive can haul some paying load in all states of the weather. On the Albula or Engadine railway in Grisons, Switzerland, the first intention was to lay out the line on a gradient of 45 in 1000; but after consultation with the leading engineers in Switzerland, a gradient of 35 in 1000 was chosen, on the ground of working economy.

Locomotives are of very varied types; but the tendency is towards those which have as much of their weight as possible on the driving wheels, so as to be available for adhesion, and which possess great lateral flexibility for passing round sharp curves. In vehicles, reduction of dead weight and lateral flexibility are usually aimed at. The best have long carriages on bogies; these, however, are more used in America than in Europe. The brakes are like those used on ordinary railways. On the mountain sections of the St Gothard the maximum speed is 45 km. an hour on a rising gradient of 1 in 39; on the Südost railway it is 25 km. an hour on one of 1 in 20; while on the Landquart Davos line it is 20 km. on one of 1 in 22.

Rack Railways.—For gradients above 40 in 1000 a rack railway is the more economical. Some railways which are mainly adhesional operate the steeper grades by means of a rack. When the incline is above 40 in 1000 for the major part of the distance, the rack alone is employed. Above 250 in 1000 the rack is impracticable, partly because the locomotive has to be made disproportionately heavy, and partly because of the danger that the cog-wheel will mount the rack. Since the construction of the Mount Washington and the Rigi lines, the number of rack railways has rapidly increased; and many systems have been introduced, the development of which is illustrated by the names of the early Blenkinsop rack, the Washington, the Riggenbach, the Abt, the Klose, the Pilatus, and the Strub. On the Abt rack, which has the unique advantage that several rack-plates can be placed parallel, the teeth break joint at $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ of their pitch, according to the number of rack-plates. The cog-wheels are therefore constantly in action with the rack, an arrangement which conduces to smooth working. The rack introduced by Colonel Locker on the Pilatus railway is peculiar in having its teeth placed horizontally, in consequence of the heavy gradients, the steepest of which is 480 in 1000. The Strub rack introduced on the Jungfrau railway is very simple; a rail of the ordinary Vignoles type is employed, the teeth being cut in its head, which is made correspondingly higher than usual (Table XXV.).

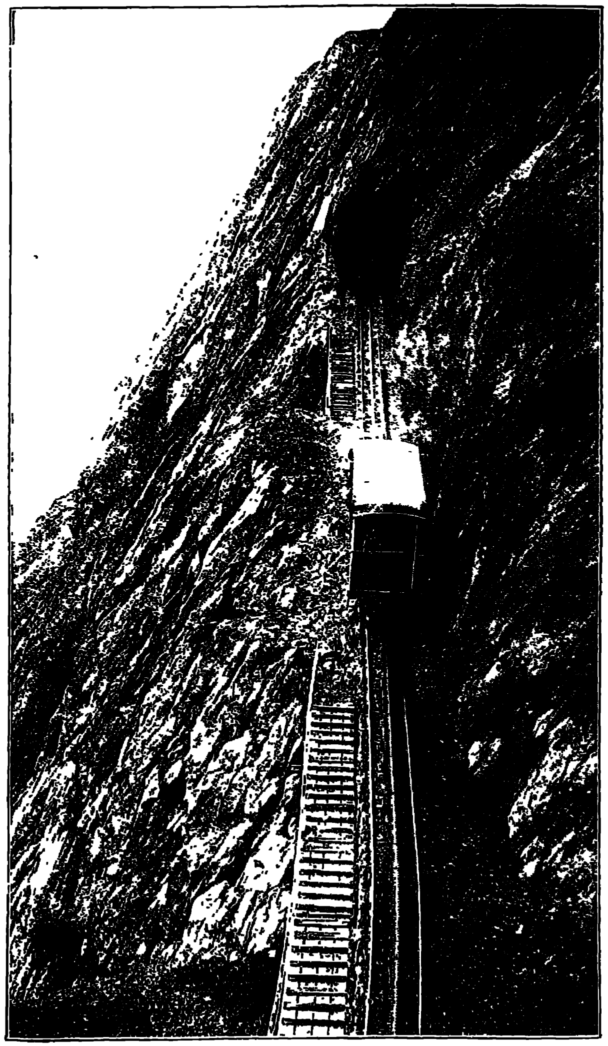
The permanent way has of late years mostly been made with steel rails and steel sleepers, bedded in ballast of coarse gravel. The rack is placed in the middle of the track, either fixed directly to the sleepers or elevated on chairs. As the space allowed for change of temperature must necessarily be kept as small as possible, the rack is composed of pieces 3 to 3·5 m. long. To prevent the permanent way from creeping downhill, stops are placed on the downside of the sleepers. Trains are transferred from one track to another either by means of sliding platforms or movable and fixed rack arrangements. On combined rack and adhesion lines the entrances to the rack sections are provided with a piece of rack placed in springs, to enable the pinions of the engine to pass on smoothly and without stoppage. Swiss engineers mostly prefer the Riggenbach rack, on account of its rigidity and

TABLE XXV.—*Rack Railways.*

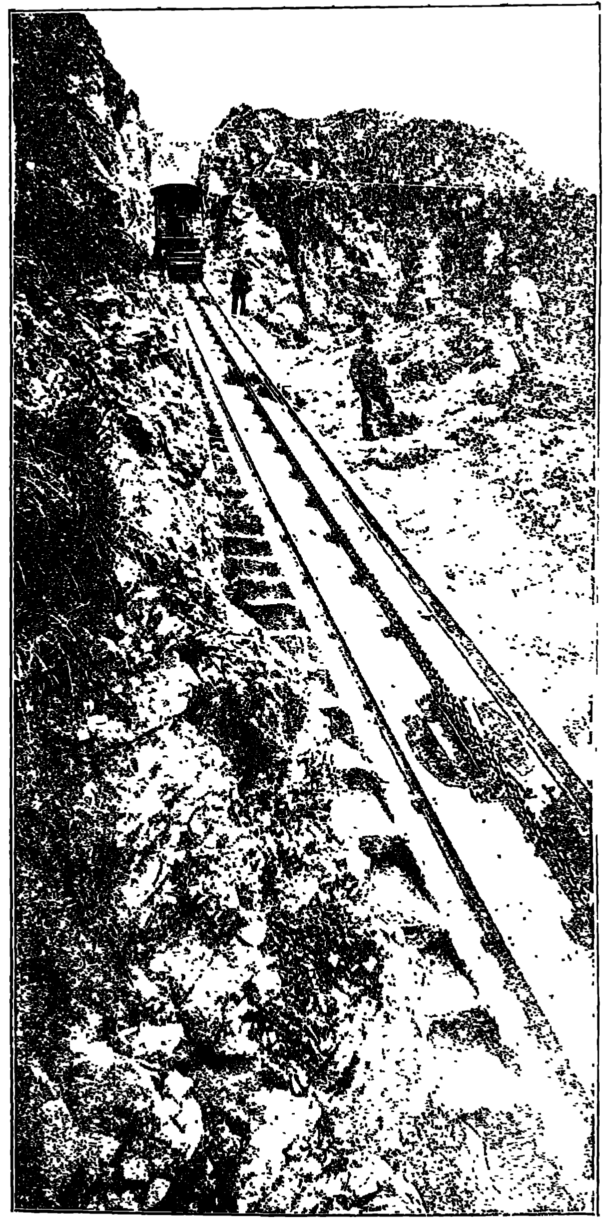
(Pure rack railways and rack and adhesion combined.)

	Harz Railway, Brunswick.	Mostar–Serajevo Railway, Bosnia.	Eisenerz–Vordernberg Railway, Styria.	Padang Railway, Sumatra.	Visp–Zermatt Railway, Switzerland.	Snowdon Railway, Wales, England.	Pike's Peak Railway, Colorado, U.S.A.	Rothhorn Railway, Switzerland.	Vitznau–Rigi Railway, Switzerland.	Salzburg–Gaisberg Railway, Austria.	Schafberg Railway, Austria.	Wengernalp Railway, Switzerland.
System	Combined Abt rack and adhesion	Combined Abt rack and adhesion	Combined Abt rack and adhesion	Riggenbach rack	Combined Abt rack and adhesion	Abt rack	Abt rack	Abt rack	Riggenbach rack	Riggenbach rack	Abt rack	Patented improvement on Riggenbach rack.
Gauge	4 ft. 8½ in.	2 ft. 6 in.	4 ft. 8½ in.	3 ft. 6 in.	1 metre	2 ft. 7½ in.	4 ft. 8½ in.	0·80 metre	4 ft. 8½ in.	1 metre	1 metre	0·80 metre
Cost of construction per mile	£10,458	...	£45,160	£11,400	£7150	£11,550	£11,409	£17,684	£26,208	£19,840	...	£10,040
Radius of sharpest curve—metres	200	125	180	150	80	80	115	60	180	150	80	60
Steepest gradient	1 : 16·6	1 : 16·6	1 : 14·7	1 : 12·5	1 : 8	1 : 5½	1 : 4	1 : 4	1 : 4	1 : 4	1 : 3·9	1 : 4
Length of incline	4½ miles of rack	6·7 and 12 miles of rack	9 miles of rack	19 miles of rack	4 miles of rack	4½ miles of rack	8·8 miles of rack	4·7 miles of rack	4·2 miles	3·4 miles of rack	3·7 miles of rack	10 miles of rack
Diameter of cylinder	17·7 in. adhesion 11·8 in. rack	13 in. adhesion 12 in. rack	19 in. adhesion 17 in. rack	17 in.	13 in. adhesion 14 in. rack	12 in.	17 in.	12 in.	11 in.	12 in.	13 in.	12 in.
Stroke	23·6 in.	18 in. adhesion 14 in. rack	20 in. adhesion 18 in. rack	20 „	18 in. adhesion 18 in. rack	24 „	20 „	22 „	16 „	20 „	23 „	20 „
Axles, number	3 coupled 1 trailing	3 coupled 1 trailing	3 coupled 1 trailing	2 coupled 1 trailing	2 coupled 1 trailing	3 {two-pinion axles	3 {two-pinion axles	3 {two-pinion axles	1 driving 1 trailing	2	3	2
Rigid wheel-base	10 ft.	7 ft. 8 in.	11 ft. 5 in.	8 ft. 2 in.	6 ft. 5 in.	4 ft. 2 in.	...	4 ft. 7 in.	...	8 ft. 10 in.	...	7 ft. 9 in.
Diameter of wheels	4 ft. 1 in. 2 ft. 5 in.	2 ft. 7 in.	3 ft. 5 in.	3 „ 3 „	3 ft.	23 in.	25·5 in.	pinions 24 in. wheels 27 in.	26 in.	28 in. adhesion 28 in. rack	28 in.	28 in.
Heating surface	1463 sq. ft.	763 sq. ft.	1560 sq. ft.	804 sq. ft.	697 sq. ft.	366 sq. ft.	...	400 sq. ft.	517 sq. ft.	678 sq. ft.	300 sq. ft.	550
Engine-weight loaded	56 tons	30·5 tons	55 tons	21 tons	29 tons	17·2 tons	23·8 tons	17·5 tons	16 tons	24 tons	17·3 tons	17·6 tons
Net train-load hauled up the incline	120 „	70 „	110 „	40 „	45 „	14 „	18·7 „	8·5 „	10·5 „	13 „	10 „	...
Load drawn per ton of locomotive weight	2·14 „	2·3 „	2 „	1·9 „	1·55 „	·81 „	0·78 „	0·49 „	0·7 „	0·54 „	0·57 „	...

Brünig Railway.



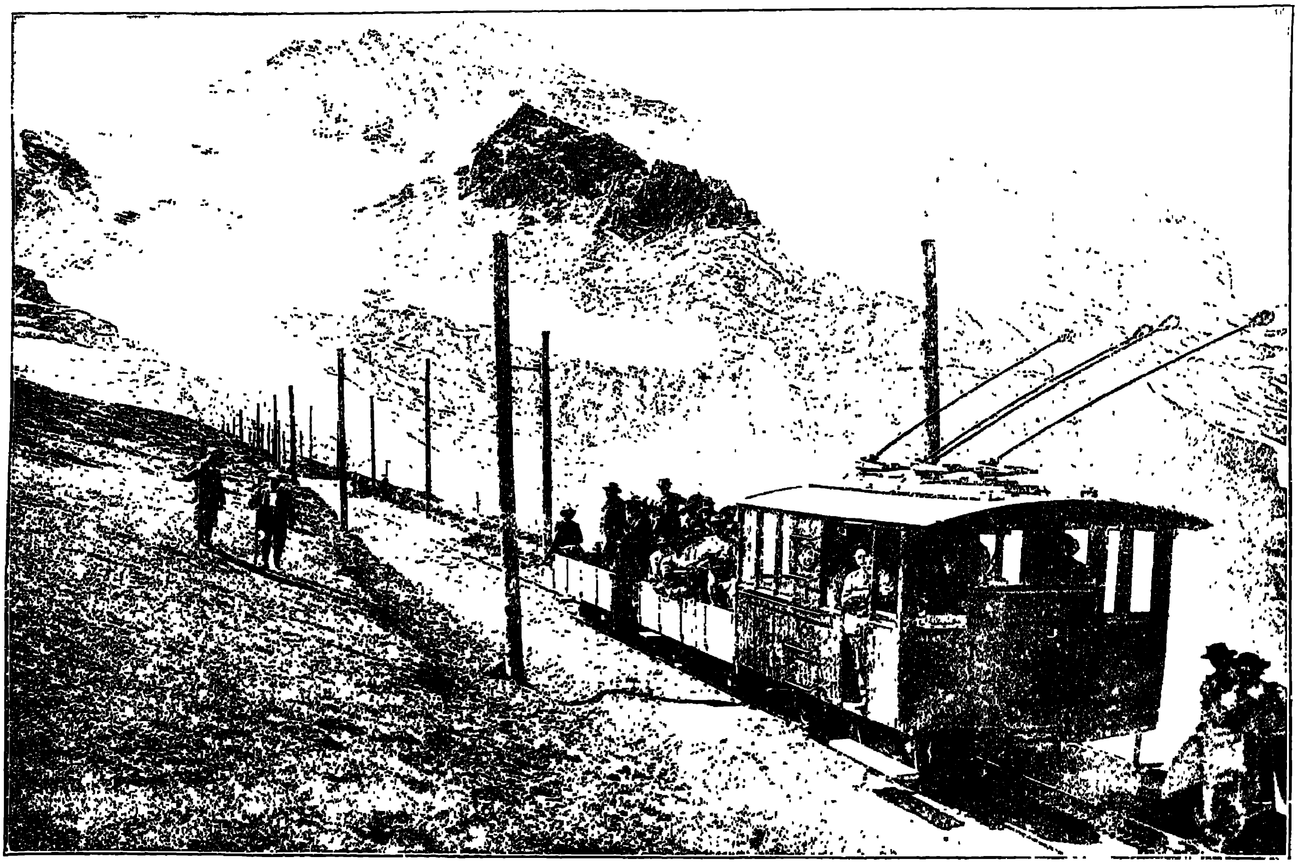
Pilatus Railway.



Salvatore Railway.

MOUNTAIN RAILWAYS.

(Reproduced from originals by the Photoglob Co., Zürich.)



Jungfrau Railway.

Viaduct on the Mürren Funicular Railway.

MOUNTAIN RAILWAYS.

(Reproduced from originals by the Photoglob Co., Zürich.)

simplicity. The Abt rack has the advantage of smoother working, and is more frequently employed outside of Switzerland. On street railways and railways with numerous level-crossings the Riggenbach system is preferred, because it only breaks the road in one line, and the rack teeth are on a level with the street. For the Abt at least three lineal spaces must be kept clear.

In designing rack-rail locomotives the same rules hold as for ordinary locomotives. In the later rack lines adhesion is not utilized, the wheels being loose on the axles. Originally the boilers were placed vertically; but it was not long before the present plan was adopted of arranging them in such a way that their axis is about horizontal when the engine is on the average gradient of the line. The fire-box and grate should be of the largest possible dimensions. In the most recent practice big locomotives working with combined rack and adhesion have separate mechanical arrangements for the two, each driven by its own pair of cylinders. Engines are fitted both with air-brakes and with a brake to be applied by the driver or fireman, the action in each case being on the cog-wheel axle. The discharge of smoke is so great, owing to the heaviness of the gradients and the slow rate of progress, that it is not only a great nuisance but in the larger tunnels positively dangerous. As far as possible, therefore, tunnels are avoided, especially on the heavy gradients, and apparatus for ventilation and smoke-consumption has to be provided.

Of late years electric motors have been largely used. They were first employed on the Barmen mountain railway, which is fitted with the Riggenbach rack and has a maximum gradient of 185 in 1000. Other electrically-driven lines are the Mont Salève (250 in 1000), the Salgo Tarjan (140 in 1000), the Gornergrat (200 in 1000), and the Jungfrau (250 in 1000). The engines on the Gornergrat railway have two independent, asynchronous, three-phase, six-pole motors, with wound armatures (rotors) and slip-rings; these with a current of 40 periods per second make 800 revolutions a minute, and develop together 180 horse-power at that speed with 540 volts in the trolley wires. They are fixed on the frame of the engine, and drive the cog-wheel axles by means of 12 : 1 gearing. At the normal speed of 7 kilometres ($4\frac{1}{3}$ miles) an hour, the tractional force is about 6 tons, the weight of the locomotive being 10·6 tons. There are two distinct brakes. A hand-brake apparatus acts on the driving axles, and the motors are supplied with braking drums and straps, the latter being applied (1) by hand, (2) automatically when a certain speed is exceeded, (3) as soon as the electric current is from any cause interrupted. The last arrangement is worked by means of a solenoid. The most remarkable mountain railway is perhaps the Jungfrau, which is to be carried—almost entirely in tunnel—4093 metres above sea-level, or more than 1000 metres above the line of perpetual snow, amid glacial surroundings of the most magnificent character.

Vehicles differ according to the type of line. On mixed rack and adhesion lines they depart but little if at all from the ordinary style. On the steep gradient pleasure lines they are built as light as possible, the dead weight being in some cases reduced to 75 kilometres per passenger place. The wheels are loose on the axles. Passenger carriages contain 48 to 60 places, while the goods vans have a carrying capacity of 6 tons, with a dead weight of 2 to 5 tons. All the waggons are fitted with 1 or 2 cog-wheels for braking purposes. On the tourist railways with heavy gradients the speed is 5 to 7 kilometres an hour; in easier gradients 8 to 10 kilometres, and on well-constructed rack lines and combined rack and adhesion, 12 to 15 kilometres on the rack and about 18 kilometres on the adhesion sections. On the heavier inclines the locomotive, as a matter of safety, is always behind the train and not coupled to it.

On the pure rack railways the slowness of the speed renders it impossible to get big returns from the rolling stock; hence the working expenses per mile of line appear high. Maintenance also costs more than with an ordinary adhesion line. For rack railways the cost of construction varies between £3000 and £32,000 a kilometre, and is only slightly influenced by the particular rack system chosen, apart from the expenses of the rack mechanism on the permanent way and engines; other expenses are quite independent of the system adopted. At the end of 1897 the number of rack railways in the world was 71, with a total length of 887·8 kilometres; and of these, 32 were on the pure rack principle. Of the Locker, Bissinger, and Telfner systems there was one example of each, of the Klose 2, of the Abt 29, and of the Riggenbach 35.

Cable Railways (Table XXVI.).—There are two main systems of cable railway: (1) that in which a continuous cable is carried over two main drums at each end of the line, the motion being derived either (*a*) from the weight of the descending waggons, or (*b*) from a motor acting on one of the main drums; (2) that in which each end of the cable is attached to waggons, one set of which accordingly ascends as the other descends. The latter is the system ordinarily applied on mountain cable railways. The weight required to cause the downward motion is obtained either by means of material that has to be transported to the foot of the hill, or by water ballast; while to aid and regulate the motion generally, steam or electric motors are arranged to act on the main drums, round which the cable passes in sufficient turns to prevent slipping. When water ballast is employed, the water is filled into a tank in the bottom of the waggon; if passengers are carried, its quantity is regulated by the number ascending or descending.

In order to control the acting force and render the working of the line as easy as possible, the longitudinal section must be laid out according to certain fixed rules, which, if strict economy is aimed at, must also be observed in cases where the movement of the waggons is governed by water-power acting on the main turning drums. The alignment is perfectly straight, but curves are admissible when they improve the lie of the railway. The permanent way consists of two, three, or four rails, facility of crossing being the end aimed at when more than two are used. In the modern system, however, which admits of very good crossing arrangements, only two rails are employed. On the Stanzerhorn cable railway, Switzerland, both the outer rails are through rails; while the inner ones are provided with counter rails, to leave room for the passage of the cable, which is guided by the rollers below the track. The cars have four wheels keyed to the axles. On one side these have double flanges, whereas on the other they are very broad and without flanges. When the car reaches the siding, the double-flanged wheel keeps it to the through rail, so that it is taken automatically through the siding, while the other broad wheels pass smoothly over the points. Each metal of the double-railed line being a through-rail on the outer half of the sidings, the two cars on each division of the track have their double-flanged wheels on opposite sides. The rails weigh 16 to 30 kilos a metre. Both wooden and steel sleepers are used; on the heavier gradients they are generally bedded in masonry, and on the gentler in gravel anchored to firm supports, to prevent sliding. The gauge, as a rule, is one metre. The total weight of the permanent way varies from 100 to 200 kilos per metre. The cable, which weighs from 2 to 6 kilos per metre, is of such a size as to give a factor of safety of 8 to 10 on the maximum strain, and its end is so

TABLE XXVI.—*Cable Railways of Switzerland.*

Name of Line.	Year of Opening.	Gauge.	Length of Line.	Elevation above Sea-Level at		Maximum Gradient per 1000	Cost of Construction of the Line.	Cost of Cable Motor and Rolling-Stock.	Total Cost.	1897. Train Miles.	1897. Working Expenses per Train Mile.	Remarks.
			Yards		Feet.		£	£	£		s d.	
Beatenberg	1889	Metre	1750	Lake of Thun Beatenberg	1863 3638	400	19,400	7,500	27,100	5,260	3 8	Water-tank, Riggenbach rack.
Biel-Maglingen	1887	,,	1777	Biel Maglingen	1430 2884	320	15,300	2,400	18,000	5,380	2 10	,, ,,
Bürgenstock	1888	,,	904	Lake of Four Cantons Burgenstock	1437 2880	575	8,600	5,900	14,600	3,420	5 2	Dynamo by hydraulic motor, Abt rack.
Ecluse-Pean (Neuchâtel)	1890	,,	402	Ecluse Pean	1450 1808	370	6,700	1,000	7,700	6,480	2 3	Water-tank, Riggenbach rack.
Giessbach	1879	,,	350	Lake of Brienz Hotel Giessbach	1880 2175	320	5,000	840	6,000	820	3 2	,, ,,
Gütsch (Lucerne)	1884	,,	155	Untergrund Gütsch	1454 1700	530	2,800	600	3,400	1,440	5 10	,, ,,
Lausanne-Ouchy	1877	4 ft. 8½ in.	1620	Lausanne Ouchy	1575 1240	116	121,300	1,200	134,900	43,000	2 9	Hydraulic motor (turbine).
Lauterbrunnen-Grutschalp	1891	Metre	1320	Lauterbrunnen Grütschalp	2677 4872	600	28,400	1,200	29,800	3,070	8 3	Water-tank, Riggenbach rack.
Lugano	1886	,,	260	Lugano Railway station	919 1106	238	6,400	900	7,400	10,720	1 3	,, Abt rack.
Marzili	1885	2 ft. 7½ in.	110	Marzili Bern	1667 1772	302	2,000	800	2,800	6,520	1 4	,, Riggenbach rack.
Salvatore	1890	Metre	1648	Paradiso San Salvatore	922 2894	600	22,200	1,200	23,600	3,890	5 3	Dynamo by hydraulic motor, Abt rack.
Rheineck-Walzenhausen	1896	1·20 metres	1340	Rheineck Walzenhausen	1328 2205	260	19,500	1,900	21,400	9,750	1 2	Water-tank.
Territet-Glion	1883	Metre	605	Territet Glion	1280 2261	570	17,400	1,200	18,900	7,790	5 0	Water-tank, Riggenbach rack.
Zürichberg	1889	,,	178	Limmatquai Polytechnicum	1355 1480	260	9,400	760	10,400	9,670	2 6	,, ,,
Ragaz-Wartenstein	1892	,,	833	Ragaz Wartenstein	1640 2316	304	8,800	1,600	10,400	5,010	1 4	,, ,,
Stanzerhorn	1893	,,	3959	Stanz Stanzerhorn	1483 6063	620	47,900	12,100	60,000	7,820	4 9	Dynamo by hydraulic motor, special braking rail.
Cossonay-Gare (Vand)	1894	,,	1334	Cossonay Gare (Jura Simplon)	1859 1417	130	15,200	1,800	17,000	3,710	3 3	Water tank, Abt rack.
St Gallen Mühleck	1896	1·20 metres	340	St Gallen Mühleck	2222 2437	228	10,000	1,600	11,600	10,970	0 11	Water-tank.
Dolder (Zürich)	1897	Metre	883	Zürich Dolder	1466 1794	177	11,300	1,200	12,500	15,000	1 2	Electric motor.

fastened that an automatic brake is brought into play if it slips from its grip. Guiding rollers are placed between the rails at such intervals that the cable does not touch the ground when the tension is least. For braking purposes a special rail—frequently a rack, either Abt or Riggenbach—is generally employed; and where the gradient exceeds 250 in 1000 a catch has to be introduced, to prevent the braking cog-wheels from mounting the rack. Other devices are sometimes used; on the Stanzerhorn line, for example, there are brake jaws, which are screwed down on the tapered head of the brake rail. Various methods of applying the brakes are employed. As a rule, there is an automatic brake, brought into action by turning a weighted lever, and a screw brake, manipulated by the guard; sometimes also an automatic brake applies itself when the speed exceeds a certain maximum. The steepest gradient used is about 650 in 1000. The waggons have rarely more than two axles; and the passenger coaches, which hold 32 to 48 persons, weigh from 6 to 18 tons. The cost of construction varies from £10,000 to £30,000 per kilometre.

Construction.—Mountain railways are frequently exposed to the special dangers of the regions they traverse, such as falls of stone, violent and sudden outbursts of torrents carrying heavy masses of débris, avalanches, and slips of various kinds, all of which have to be guarded against. The extent of these dangers is determined by the more or less close proximity of the snow line, the topographical nature of the country, and the character of the soil; so it may happen that a railway may attain a very great elevation above sea-level and yet encounter only conditions that are comparatively, or even absolutely, easy.

TABLE XXVII.—*Working Statistics.*

Name of Line.	Train Kilometres.	Gross Kilometre Tons.	Net Kilometre Tons.	Gross Weight per Train Tons.	Net Train Weight hauled per Train Tons.	Working Expenses. Cost per Train Kilometre.	Working Expenses. Per Gross Kilometre Tons.	Working Expenses. Per Net Kilometre Tons.	
						s. d.	d.	s. d.	
Südost Railway	256000	19·507000	11·008000	76	43	0 9·6	0·12	0 0·22	Adhesion railway (normal gauge, 4 ft. 8½ in.)
Rhätische ,,	343000	27·638000	15·995000	80	47	0 8·5	0·10	0 0·19	Adhesion railway, metre gauge.
Pilatus ,,	12100	127000	14000	10·5	...	3 2	3·6	2 8·5	Rack railway, 0·80 metre gauge.
Rigi ,,	28700	604000	188000	21	6·5	2 5·5	1·4	0 4·5	Rack railway, 4 ft. 8½ in. gauge.
Wengernalp ,,	46900	1·011000	299000	22	6·4	1 11	1·05	0 3·6	Rack railway, 0·80 metre gauge.
Brünig ,,	223000	14·376000	9·373000	64·5	42	0 9·6	0·15	0 0·23	Rack and adhesion combined, metre gauge.

Where falls of stone are to be feared, it is usually preferable to put the line in a tunnel or gallery. If it is to be in the open, the protective works consist of stone walls, with or without a backing of earth, or of heavy timber fences. In the case of torrents, the line is sometimes carried under their bed in a gallery; they are also guarded against by the systematic arrangement of their courses, or by the erection of cross-walls, which serve to arrest the velocity of the water and prevent débris from rushing down in too heavy masses. Avalanches are often avoided by means of tunnels or galleries; if these are too expensive or otherwise impracticable, the snow is held back by retaining walls or dams, or prevented from slipping by the friction of rows of poles, wattlework, or small stone-walls. To deal effectively with torrents, as well as avalanches, it is frequently necessary to carry the protective works to the highest regions of the mountains, where many of these dangers have their origin. (S. J. B.)

Raipur, a town and district of British India, in the Chhattisgarh division of the Central Provinces. The town is 994 feet above the sea, 188 miles east of Nagpur; railway station. Population (1881), 24,948; (1891), 23,759. There are ruins of an immense fort, with many tanks and old temples. Raipur is the cantonment for a wing of a Madras native infantry regiment. It has a German mission, four printing-presses, a Government high school, with 1014 pupils in 1896–97. The Rajkumar College, for the education of the sons of the chiefs of Chhattisgarh, was transferred here from Jubbulpore in 1894; there are 23 pupils, maintained by fees and an endowment.

The district of RAIPUR has an area of 11,724 square miles; population (1891), 1,584,427, showing an increase of 13 per cent., which had been continuous since 1872; (1901), 1,442,778, showing a decrease of 9 per cent., due to the results of famine. Land revenue, Rs.8,66,451, the incidence of assessment being under 4 annas per acre; cultivated area (1897–98), 2,382,308 acres, of which 40,422 were irrigated from tanks, &c.; number of police, 681; boys at school (1896–97), 15,384, being 13·2 per cent. of the male population of school-going age; registered death-rate (1897), 78·68 per thousand. The principal crop is rice. Manufactures of cotton goods and brass ware; steam cotton mill at Rajnandgaon, with 156 looms and 14,868 spindles, employing 800 hands. The north-west corner of the district is crossed by the main line of the Bengal-Nagpur Railway, and a branch tramway is now being constructed from Raipur town due south towards the state of Bastar. The district suffered severely from famine in 1896–97, and again in 1899–1900.

Rajahmundry, or RAJAMAHENDRI, a town of British India, in the Godavari district of Madras; on the left bank of the river Godavari, at the head of the delta, 367 miles north of Madras; a station on the East Coast Railway, which is here carried across the river by a bridge of twenty-one spans. Population (1881), 24,555; (1891), 28,397; municipal income (1897–98), Rs.38,840. The Government college, one of the four provincial schools established in 1854, had 88 students in 1896–97. There are also a training college and high school, two printing-presses, issuing one English and two vernacular newspapers; a public library and reading-room; and a teachers' association.

Rajendralala Mitra, Raja (1824–1891), Orientalist and author, was born in 1824 in a suburb of Calcutta, and died in that city on 26th July 1891. For half a century he was the life and soul of the Bengal Asiatic Society. Five years after his birth Dr H. H. Wilson proposed the admission of learned natives into the Society founded by Sir William Jones in 1784; and elected under this rule, Rajendralala Mitra filled successively the offices of librarian (1846), of vice-president (from 1861 onwards), and in 1885 of president of the Society. Of the Kayasth caste, descended from a family which had served with profit the Nawabs of Murshidabad, he devoted himself from childhood to the study of the classic languages of the East in his father's library. He owed none of his early education to British schools, although for a time he attended the Medical College and studied law. He held no public appointment except that of director of the studies of young zemindars, wards of Government. The distinction which he won, both in Europe and in Asia, for his ability, industry, and research was not the product of State-aided education, but of the spirit of inquiry infused into Indian society by the private efforts of such scholars and statesmen as Sir William Jones, Lord Teignmouth, Henry T. Colebrooke, Sir Charles Wilkins, Dr H. H. Wilson, and James Prinsep. The public service, and the professions of law and medicine, so attractive to Bengalis, seemed to Rajendralala only a distraction from the higher purposes of life opened to him by the Asiatic Society. As he wrote: "Neither Ganesa, the Hindu patron of wisdom, nor Saraswati, goddess of learning, seems ever to have paid any encouragement to history, and as a consequence Indian literature is almost void of all authentic historical records." He set himself to supply this deficiency, using the material supplied by poetry, fable, and tradition, and wresting from stone, brass, and pottery the secrets of the past. He brought to the task a rare knowledge of Sanskrit, Persian, and the classic languages of the East, and a power of writing pure English which few Europeans possess.

His principal work, published in 1875, *The Antiquities of Orissa*—described by him as "some relics of the past weeping over a lost civilization and extinguished grandeur"—is a storehouse of information on architecture, religion, and the social history of India. Three years later he published *Buddha Gaya*, the hermitage of Sakya Muni, containing the story of Buddha's penance, a learned discussion of chronology, and copious accounts of architectural remains, sculptures, and inscriptions. In the *Indo Aryans* he collected together many of his historical contributions to the Asiatic Society's *Journal*, and in the *Bibliotheca Indica* a large number of Sanskrit texts were supplied and explained by him. His catalogues, and his frequent papers published in the Bengal Asiatic Society's *Journals*, show the accuracy and wide range of his inquiry, and knowledge of religion, literature, philology, antiquities, and the manners and customs of India. Although he served as a member of the Calcutta municipality, he took little part in public affairs. Nevertheless, his influence upon modern Indian society was great; and inspired as he was by a fearless search after truth, he naturally came into conflict with the orthodox Hindus, who regarded any questioning of myths and traditions as both heresy and want of patriotism. The University of Calcutta made him a Fellow and Doctor of Law. Foreign societies enrolled him in their ranks, and his Sovereign conferred upon him the dignity of C.I.E. But the distinctions which he valued above all others were his election as president of the Bengal Asiatic Society, and the discovery of a key to the history of the past by diligent research into the relics which the ravages of time and climate were too quickly destroying. (W. L.-W.)

Rajgarh, a native state of Central India, in the Bhopal agency. Area, with the dependency of Sutalia, 655 square miles. Population (1881), 117,533; (1891), 119,489; average density, 182 persons per square mile. The estimated revenue is Rs.5,00,000 and the tribute to Sindhia, Rs.85,172. The chief, whose title is Rawat, is a Rajput of the Omat clan, claiming descent from Vikramaditiya. The grandfather of the present chief became a Mahommedan, but the family have now been received back into Hinduism. British currency has recently been adopted in the state. The town of RAJGARH, which is also called Biaora, has a population of (1881), 6881; (1891), 6476.

to cast upon him responsibility for the failure of Vatican policy towards France, and for the prevalence of reactionary tendencies during the later years of Leo XIII.'s pontificate, there is no evidence to show Cardinal Rampolla to have been more than a faithful exponent of ideas already formed, though not completely applied, before his appointment to the secretaryship of state.

Rampur, a stative state of India, in subordination to the North-Western Provinces. It lies in Rohilkhand, between the British districts of Moradabad and Pilibhit. Area, 945 square miles. Population (1891), 551,249; (1901), 532,067, showing a decrease of 3 per cent. Gross revenue, Rs.31,83,000; military force, 2556 men, including Imperial Service troops. The chief, whose title is Nawab, is a Rohilla Pathan, whose family have always been loyal to the British connexion. The state is crossed by a branch of the Oudh and Rohilkhand Railway from Bareilly to Moradabad. The town of RAMPUR is on the left bank of the river Kosila, 620 feet above the sea; railway station, 39 miles north-west of Bareilly. Population (1891), 76,733; (1901), 77,862. There are manufactures of damask and pottery.

Rampur Boalia, or BEULEAH, a town of British India, the administrative headquarters of Rajshahi district in Bengal; on the left bank of the Ganges. Population (1881), 19,228; (1891), 21,407. It was originally chosen as a commercial factory for the silk trade, which is again being officially encouraged by the Agricultural Department. The town contains a Government college, a collegiate high school, and an industrial school for sericulture; there are eight printing-presses, issuing two vernacular periodicals, a public library and debating club. Most of the public buildings were severely damaged by the earthquake of 12th June 1897. There is a regular steamer service with Damukdia Ghat, 50 miles south-east on the Eastern Bengal Railway.

Ramsay, Sir Andrew Crombie (1814–1891), British geologist, was born at Glasgow on 31st January 1814. Intended for commercial life, he was for a time actually engaged in business, but from spending his holidays in Arran he became interested in the study of the rocks of that island, and was thus led to acquire the rudiments of geology. A geological model of Arran, made by him on the scale of two inches to the mile, was exhibited at the meeting of the British Association at Glasgow in 1840, and attracted the notice of Murchison, with the result that he invited its maker to accompany him on a geological expedition to America. Ramsay accepted the offer, but the arrangement subsequently fell through, and instead he received, by Murchison's good offices, an appointment on the Geological Survey, on which he served for forty years, from 1841 to 1881. He was first stationed at Tenby, and to that circumstance may be attributed the fact that so much of his geological work dealt with Wales. He was chosen professor of geology at University College, London, in 1848, and lecturer in the same subject at the School of Mines in 1851. Eleven years later he was elected to the presidential chair of the Geological Society, and in 1871 he succeeded Murchison as director-general of the Geological Survey. In 1880 he acted as president of the British Association at Swansea, and in the following year retired from the public service, receiving at the same time the honour of knighthood. He died ten years later at Beaumaris, on 9th December 1891. The scope of his work may be gathered from the titles of the following, which are among his most important papers: "Denudation of South Wales," "Old Glaciers of Switzerland and North Wales," "Glacial Origin of Certain Lakes in Switzerland, the Black Forest, &c.," "The Red Rocks of England," and "River Courses of England and Wales." It will be seen that he was especially interested in tracing out the causes which have determined the physical configuration of a district, and he devoted much attention to the effects produced by ice, his name being identified with the hypothesis, which, however, has never commanded general assent, that in some cases lake-basins have been scooped out by glaciers. Sir Archibald Geikie, who published a biography of him in 1895, has characterized him as combining a faculty for bold and broad generalization with habits of patient observation and cautious induction. He received a Royal medal in 1880 from the Royal Society, of which he became a fellow in 1862, and he was also the recipient of the Neill prize of the Royal Society of Edinburgh in 1866, and of the Wollaston medal of the Royal Geological Society in 1871.

Ramsbottom, manufacturing town and urban district (1894), Lancashire, England, in the Heywood parliamentary division of the county, 13½ miles north of Manchester by rail. A Primitive Methodist chapel was erected in 1889, and a cottage hospital was opened in 1900. It has iron and brass foundries, machine factories, and establishments for calico printing, bleaching, spinning, and manufacturing. Population (1891), 16,726; (1901), 15,920.

Ramsgate, municipal borough and watering-place in the Isle of Thanet parliamentary division of Kent, England, 79 miles east-south-east of London by rail. The inner harbour covers (1899) an area of 12 acres; the outer, of 35 acres. In 1888, 895 vessels entered with 118,636 tons of cargo, and 857 vessels cleared with 114,906 tons. In 1901, 1666, vessels entered with 324,145 tons, and 1531 vessels cleared with 266,458 tons. Steamboats run during the season to London, Tilbury, Margate, Deal, Dover, Calais, and Boulogne. Electric trams connect Ramsgate with Broadstairs and Margate. Extensive improvements were carried out in 1895–96 on the sea-front. They include a new sea-wall and a widened approach to the sands. The corporation opened a public library in 1895. Technical schools occupy part of the same building. Ellington Park, area 12 acres, was opened in 1893. Population of the municipal borough (1891), 24,733; (1901), 27,693.

Ranavalo III. (1864– ——), formerly queen of Madagascar, born in 1864, was a great-niece of Radama I. Her name originally was Rasuaherina, but on succeeding to the throne of Madagascar after the death of Queen Ranavalo II., on 14th July 1883, she assumed the style of Ranavalo III. Although nominally queen, she took no share in the government, which her prime minister, Rainilaiarivony, had controlled since 1864. After placing her on the throne, he married her before the close of the year. Ranavalo became queen just after the French had revived their claim to a protectorate over the island. The Hova Government refusing to admit the claim, war broke out, and several sharp engagements took place. The French bombarded the coast towns, but were unable to reach the interior of the island, where the strength of the Hovas lay. In December 1885 a treaty was concluded by which it was agreed that the government of the French Republic should represent Madagascar in all foreign relations, but that in internal matters the Hova Government should be independent, as formerly. During the next ten years French influence was quietly extended over the island, in spite of the efforts of Rainilaiarivony, who pursued an anti-French policy, encouraging English and American planters and traders. In 1894 differences on commercial and territorial questions arose between the Hova Government and the French, which terminated in war. In 1895 a well-organized

expedition was despatched from France to subjugate the island. Many of the inhabitants sympathized with the invaders, and even the Hovas themselves were divided. Although Ranavalo endeavoured to arouse a martial spirit in her subjects, the French advanced on the capital without encountering any effective opposition. On 30th September they captured Antananarivo. Rainilaiarivony was sent into exile, where he died in the following year; but Ranavalo was suffered to remain as nominal head of the Government, under a strict French protectorate. In 1896, to avoid commercial difficulties with foreign Powers, the island was declared a French colony; but no change was made in the internal administration. Later in the year, however, the civil governor was replaced by a military resident, General Gallieni. A formidable insurrection broke out, which Gallieni suppressed, executing or exiling several prominent members of the Hova administration. Finding that the court had been a centre of intrigue, he abolished the sovereignty by proclamation early in 1897, and exiled Ranavalo to Réunion. In 1899 she was removed to Algiers, but was subsequently permitted to visit Paris.

Ranchi, a town of British India, headquarters of Lohardaga district and of the Chota Nagpur division in Bengal, situated in 23° 22′ N. and 85° 22′ E., 2100 feet above the sea. Population (1891), 20,306. It is an important centre of local trade, and the headquarters of the German Lutheran mission. There is a high school and an industrial school; also three printing-presses, issuing two periodicals, a public library and bar library.

Rand. See GOLD.

Randazzo, a town of the province of Catania, Sicily, Italy, at the north foot of Mount Etna, 25 miles north-west of Giarre by the circum-Etna railway. It is a mediæval-looking town, with Norman walls built of lava, a church dating from the 13th–14th centuries, a former ducal palace (now a prison), several mediæval private houses, and an antiquarian museum. Randazzo is the nearest town to the summit of Mount Etna, 9 miles distant, and stands 2474 feet above sea-level. Population (1881), 9908; (1899), about 8500.

Randers, a town of Denmark, 8 miles inland from Randers Fjord, and 36 miles by rail north by west of Aarhus in Jutland. The high school is housed in a mediæval monastery, which was restored in 1894–97. There is a statue to Steen S. Blicher (1782–1848), the national author of Jutland. There are distilleries and manufactories of gloves, railway carriages, &c., and large slaughter yards. In 1899 the port was entered by 648 vessels of 74,968 tons, and cleared by 652 of 76,275 tons. The chief exports are butter and eggs; the chief imports, sugar, petroleum, coal, and iron. Population (1890), 16,617; (1901), 20,057.

Ranenburg, a district town of Russia, in the government, and 105 miles south of the town, of Ryazan. A considerable trade in grain is carried on, and the inhabitants have gained a reputation for gardening. The population in 1897 was 15,347.

Range-Finder (or TELEMETER).—The judgment of the most highly trained observer, guided by the unassisted eye, is not sufficiently trustworthy to develop to the full the powers of modern weapons. Hence numberless inventors have produced instruments in endless variety to assist the gunner and infantry soldier in determining the distance or "range" to their objective. Such instruments are called telemeters, or, more generally, range-finders.

Among the many inventors of range-finders the following names may be mentioned:—Roosaudre (Austria); Deport, Goulier (France); Amici, Braccialini (Italy); Souchier (Russia); Unge (Sweden); Crehore and Squier, Fiske, Gordon, Leslie, Lewis, Pratt (United States of America); Adie, Barr and Stroud, Christie, Mallock, Watkin, Weldon, &c. (Great Britain).

Nearly all range-finders may be described as instruments which automatically solve a triangle. Usually it is a right-angled triangle, the length of the base of which is known, and one of the sides is the range it is desired to find. They are, in fact, goniometers, but the angle which they measure, whether it may be at the end of the measured base, or that subtended by it, is usually expressed as a function of the angle in terms of the measured base. In fact, the range is recorded directly in metres or yards without calculation. It has frequently been observed that, if a convenient telescope could be devised of sufficient focal length for the travel of the eyepiece in focussing to be made the measure of the distance of the objective from the observer, a perfect range-finder would be obtained.

It is proposed in this article to describe briefly the range-finding instruments in the British services (1) as used in the fleet; (2) by the army in the field; and (3) in harbour defence.

(1) The necessity for a range-finder afloat caused the British Admiralty in 1891 to issue an advertisement in the press inviting inventors to produce an instrument, which would, amongst other conditions, record ranges with an accuracy of 3 per cent. at 3000 yards. The resulting competition was declared in favour of a range-finder the joint invention of Professor Barr of the Glasgow University and Professor Stroud of the Yorkshire College.

The naval range-finder consists of a tube 60 inches in length by 3½ inches in diameter, which contains two telescopes. It is carried on a frame by bearings, in which the tube is free to revolve about its longer axis. To the frame is attached a weight capable of movement within a tank. This weight balances the range-finder and frame upon knife-edges. By means of the handle on the left of the instrument and an altitude worm beneath it, the motion of the tube is governed, and the line of sight is directed on the objective. By partially filling the tank with water, the swinging of the weight in a seaway can be checked. The frame is supported on a pedestal and can rotate in azimuth upon it (Fig. 1). A rubber guard is fitted round the eyepieces. Its functions are to guide the eyes of the observer into the correct position, and to protect them from side light and the distressing effect of wind. It also guards the forehead against the jar occasioned by firing heavy guns. The upper portion of the field presented to the left eye is used as a finder, the lower portion is occupied by the scale upon which the ranges are engraved. The finder is a low-power telescope of large field, to the centre of which the objective is brought. When the telescope is thus correctly aligned the objective will be seen with the right eye largely magnified, but as two partial images separated by a thin black horizontal line. When coincidence of the images is effected by means of the working head, the range can be read off against a pointer from the scale seen with the left eye. For night use, means are provided for illuminating the scale. The range to lights may be ascertained by the use of the astigmatizer, an optical device by which a point of light is drawn out into a vertical streak. A beam of light from the objective falls on each reflector (Fig. 2), and passing through the object glasses, each is received by an arrangement of prisms about the centre of the tube, and reflected through the right eyepiece. Two partial images are thus seen. The images could be united by the rotation of one of the reflectors, but owing to the small base used the necessary movement would be so extremely small that it would be practically impossible to measure it. The difficulty has been surmounted by utilizing fixed reflectors and effecting coincidence by means of a prism of small angle. The deflecting prism is situated in the line of the beam of light from the reflector at the right-hand end of the tube. Its multiplying action is of great delicacy. The angle available for subdivision, to measure ranges between infinity and 250 yards, is only one-third of a degree. In a travel of 6 inches the prism renders accurate measurements possible within the required limits. To bring images of distant objectives into coincidence, the prism must be moved towards the eyepiece, and for near objectives in the opposite direction. The range scale is attached to the prism. A consequent advantage is that the accuracy of the instrument is not affected by back lash arising from wear, or irregularity in the actuating mechanism. When once installed the instrument is always ready for use.

Should adjustment be required it is readily and easily applied. It is not within the sphere of this article to enter into the detail of the adjusting mechanism. For further particulars the reader is referred to the *Proceedings of the Institution of Mechanical Engineers*, 30th January 1896. The working of the range-finder is so simple that its use is quickly learnt by any man who can read, and with little instruction and practice he can "take a range" in 8 to 12 seconds. Besides its principal purpose, in connexion with gunnery, there are minor uses in navigation and nautical surveying to which the range-finder can be applied.

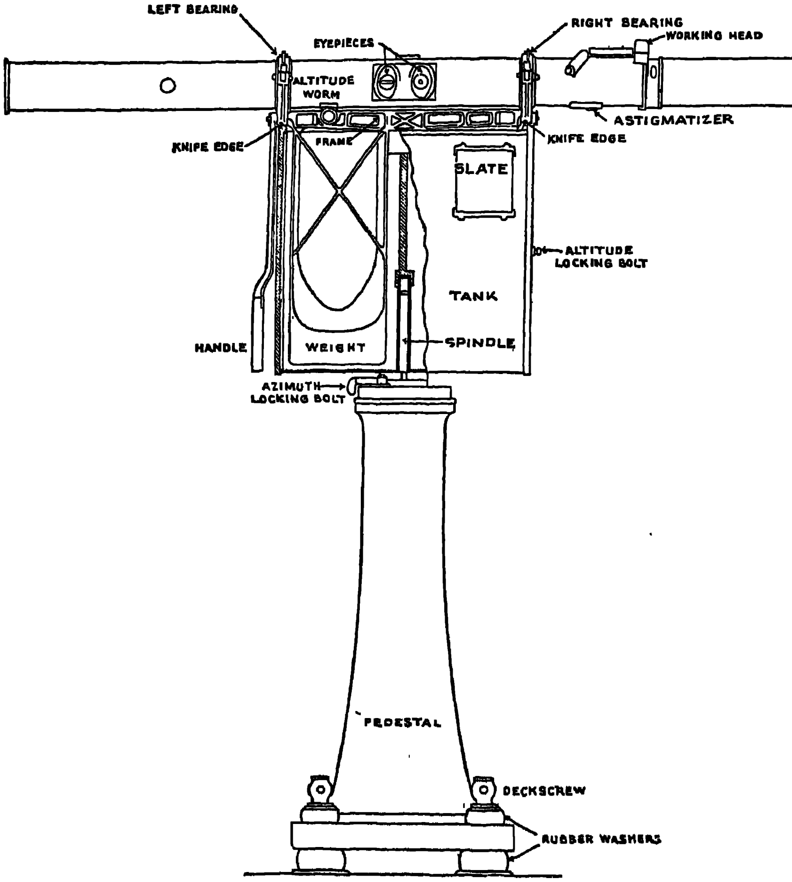


Fig. 1.

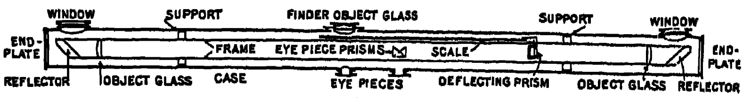


Fig. 2.

With the high speeds of modern war vessels, guns and their objective approach each other so quickly that unless ranges can be communicated from the instrument to the guns with rapidity and accuracy the range-finder is deprived of much of its value. In connexion with the naval range-finder an apparatus is provided, which though not part of the range-finder is sufficiently important to claim passing notice. The apparatus consists of a transmitting and a receiving instrument of clockwork mechanism electrically controlled. In appearance they resemble the ordinary engine-room telegraph, on the dials of which ranges take the place of orders. The transmitter can communicate with a number of receiving instruments, disposed as required in different parts of the ship.

(2) For the army in the field there is but one type of range-finder. To the set of instruments used the name of *mekometer* has been given. The instruments used by the cavalry and infantry are smaller and lighter than those of the artillery pattern, but the principle involved is identical.

The mekometer is practically a box sextant (Fig. 2). Two instruments are used simultaneously at the ends of a base of fixed length. One sextant called the right-angle instrument is fitted with index and horizon glasses permanently inclined at 45°. It consequently measures a right angle. In the other sextant, called the reading instrument, a graduated drum takes the place of the usual index arm and scale. The drum is graduated spirally with a scale of ranges. Both reading and right angle instruments are fitted with a vane of gun metal with a white strip down the centre to facilitate observations. Telescopes of low power can be fitted to the instruments, and two cords of 50 (or 25½) yards are provided with which to measure the base.

Two observers attach the ends of the cord of fixed length (usually 50 yards) to their instruments and separate until it is taut. The observer with the right angle instrument moves into such a position that coincidence of image will be given between the objective and the vane of the instrument at the other end of the base, *i.e.*, he makes ABC a right angle (Fig. 3).

When the right angle is established the observer at C turns the graduated drum of the reading instrument until the image of the vane of the right angle instrument coincides with the direction of the objective. The range AC is then read on the drum. The ranges on the drum are measures of the angle BAC when the base BC is 50 yards.

The mekometer is open to the objection which is common to all range-finders requiring more than one observer. There is always a danger that observers may cause coincidence on different objectives or on different parts of the same objective, and thus inaccuracy in the recorded range must result. The instruments are expected to give an accuracy of less than 2 per cent. at 2000 yards. For ranges over that distance, *i.e.*, for usual artillery ranges, it is desirable to use a double base (100 yards in length), in which case the range registered on the drum must be doubled. This operation, although slight, is a distinct disadvantage, because no calculation, however trifling, is desirable in action; since it adds to the time of taking a range and is a possible source of error. For field artillery, however, a range-finder is only an auxiliary adjunct. The true range can be found by a process of trial and error in as short a time as the mekometer observers take to report it. To quote from the field artillery drill book, "The first round is fired with the elevation due to the range as estimated, or given by the range taker. If it is short the elevation is increased by 100, 200, or 400 yards, and after every round observed short the same alteration is made until a round is observed over; the 'long bracket' is then said to be found. The difference between the two elevations that have bracketed the target is then halved—until the target is enclosed between two rounds the difference of whose elevation is 50 yards, which is termed the "short bracket."[1] Thus the correct elevation is found. It must,

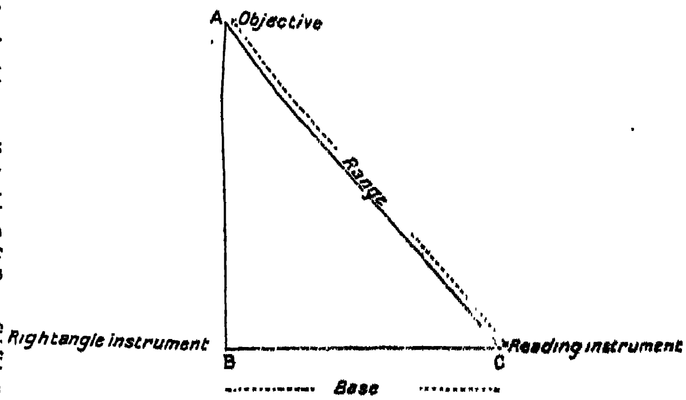


Fig. 3.

however, be remembered that as shrapnel shell is the principal projectile of field artillery, after the correct elevation has been given the true length of time fuze has to be found. This the

[1] At the battle of Omdurman the infantry and machine guns obtained the ranges from the field artillery.

range-finder cannot do. Hence it is that the range-finder for field artillery, although a valuable auxiliary, is not of the same importance as in purely defensive positions such as batteries for harbour defence and land forts. It is believed that in the German and French field artillery a range-finder is not used.

3. For harbour defence, owing to the long range of naval guns, and the fast targets which war vessels present, an accurate range-finder is of first importance. This is largely the case because "ranging" cannot be resorted to in the same manner as in the field, where the targets are comparatively motionless and the effective ranges are less. Successful artillery practice therefore depends, in a great measure, upon the range-finder.

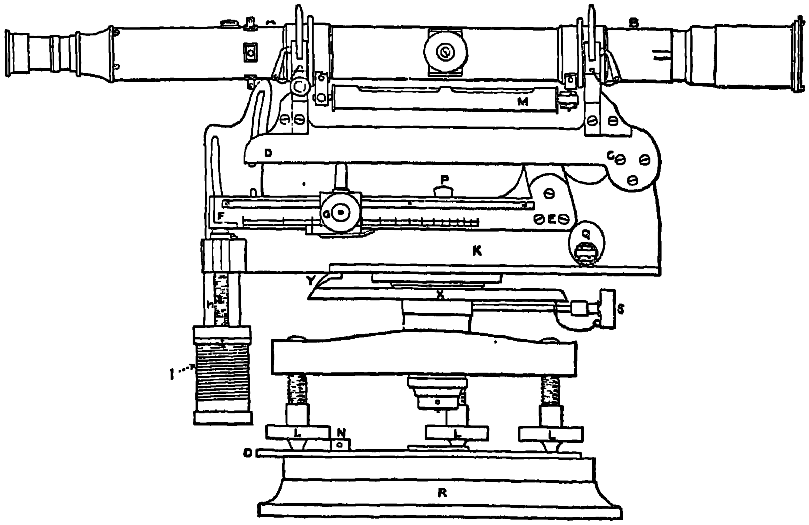


Fig. 4.

The instrument much used in harbour forts is known as the *depression* range-finder. As its name suggests, it solves a triangle in the vertical plane, of which the base is the height of the instrument above sea-level. Its appearance resembles some forms of theodolite (Fig. 4). A framework, capable of rotating in azimuth on a vertical pivot, is supported on a plate carried by levelling screws, L, L, L. To the framework are pivoted two arms DC and FE, at C and E respectively. The arm EF is supported at F by a vertical screw H ending in a drum, upon which, in a spiral scale, the ranges are graduated. Motion in altitude is thus given to the telescope. The arm CD is supported by a slider G. This slider is set by a rack and pinion to the height above sea-level (represented on a scale of feet on EF) at which the instrument may be used. A telescope AB is suitably fitted in jaws at the top of the frame. There are spirit levels at M and Q for adjusting purposes. The telescope is provided with cross wires which can be illuminated for night use. An azimuth circle X and pointer Y enable the direction of any vessel to be indicated, the range of which it is desired to know. The instrument rests on a base plate R to which it is locked by the top-plate O. The observer directs the cross wires of the telescope upon the water line of the objective, by means of the drum I and the azimuth handle P, the top of which just appears in the diagram. The reader watches the arrow on the drum and calls out the ranges as the figures arrive beneath it. The ranges are communicated to the officers at the guns by various devices, which differ according to local requirements.

The details of the *Position Finder* are carefully guarded as confidential. From the brief published descriptions it may be gathered that directing the telescope upon the objective electrically communicates the bearing and range to the gun detachments. The position finder, and also the depression range finder and mekometer, are inventions of Colonel Watkin, C.B.

The greatest advance in practical range-finding for harbour defence, in recent years, has been made in the apparatus to which the name has been given of *automatic sight*.

The mechanism is the invention of Sir George Clarke, K.C.M.G., F.R.S., &c. The principle of the sight is the outcome of a process of evolution in range-finding. The depression range-finder gives ranges from the objective to the range-finder. The position-finder goes a step further, and automatically communicates range and bearing to the vicinity of the guns. But by means of the automatic sight, the same muscular effort which aligns the laying points (or telescope) on the objective, imparts the requisite elevation and direction to the gun.

Such a system of laying ordnance has long been a requirement, but quick-firing guns and smokeless powder demand it as a necessity. The automatic sight renders it possible to regard the individual gun as an independent unit, and with it the largest gun becomes as a rifle in the hands of the man who lays it. Range-finders bind the guns they serve to one objective, and necessitate a rigid fire discipline in order that the guns may be ready to fire at the moment the anticipated range is reported. The automatic sight allows convergence or dispersion of accurate fire, and in a measure restores the elasticity of control of the days of smooth bores. It economizes men, and the gun-layer who uses it does not require the high training necessary for range-finding specialists.

The principle of the apparatus is made clear by Fig. 5. AB is a bar carrying the fore and hind sights, or a telescope fitted at the focus with a pointer. AB is pivoted at C. CD is the attachment of the apparatus to the cradle E. (As the gun recoils through E, the gunner can continue to look over the sights whilst firing.) At right angles to AB is a bar FG, fitted at H with a guide working in a cam plate K. L is a case containing a spring, whose function it is to keep the guide H in contact with the cam. It will be seen that as the gun is elevated or depressed, motion in altitude is imparted to the sight bar AB. The amount of motion is regulated by the form of the cam K, which is cut in accordance with the range table of the gun and the height above sea-level. The sight, therefore, is a depression range-finder, having for its base the height of the axis of the gun above the sea. A compensation for rise and fall of tide is consequently necessary, and is effected by the handle M. M works through a suitably engraved scale and, actuating an eccentric at N, imparts the necessary correcting motion about the pivot R to the cam plate K. The reader is referred for further details to *Garrison Artillery Drill*, 1899, or the *Journal of the United States Artillery*, vol. xiii. p. 323.

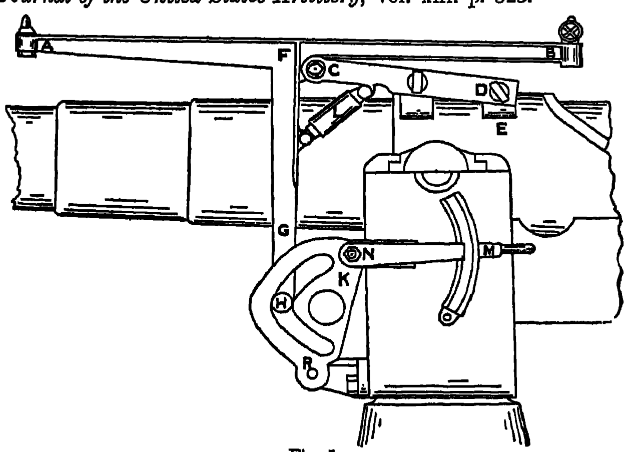


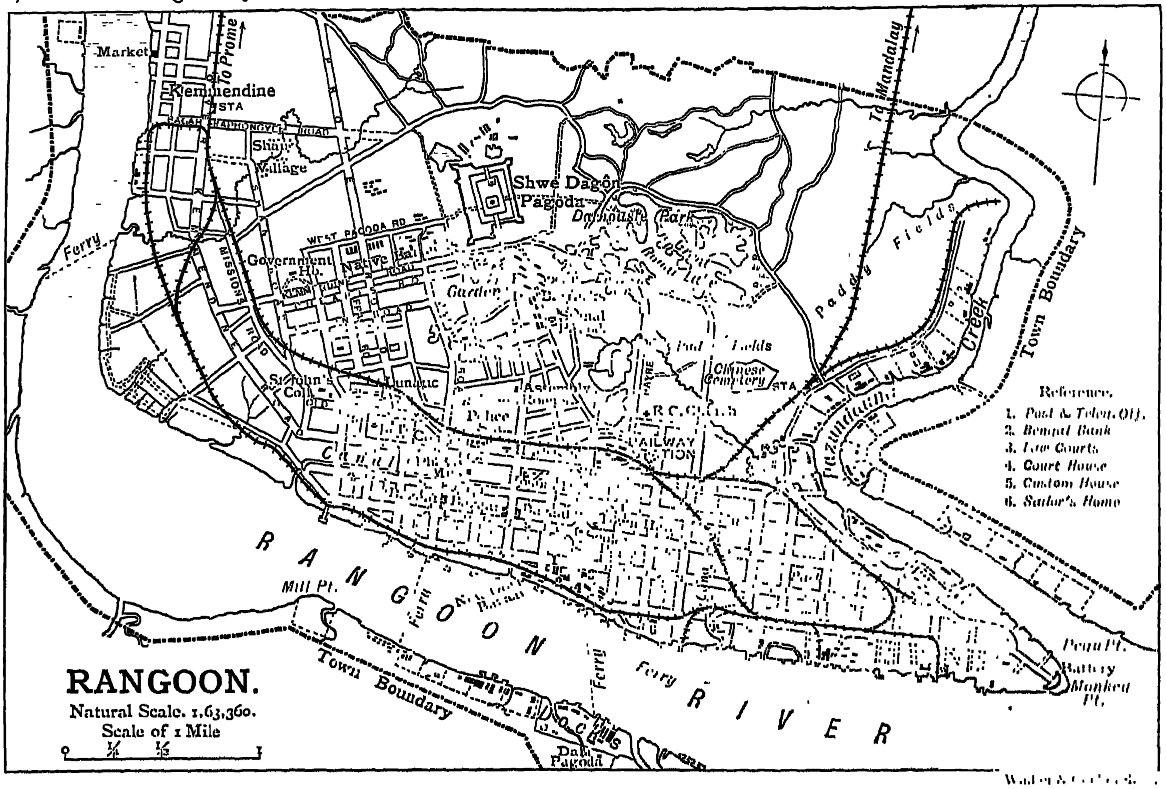
Fig. 5.

AUTHORITIES.—War Office publications: *Handbook for the Depression Range-Finder for Elevated Batteries, Handbook for the Mekometer, Garrison Artillery Drill, Field Artillery Drill, Handbook for the Position Finding Instruments.*—BARR and STROUD. "Telemeters and Range-Finders," *Proceedings Inst. Mech. Engineers*, January 1896.—LASSITER. "Range and Position Finding," *Journal of U.S. Artillery*, April 1895.—DE KERILLIS. "Automatic Sights," *Revue Maritime et Coloniale*, August 1895. (F. M. L*.)

Rangoon, the capital of Burma, situated on the left bank of the river Hlaing or Rangoon, 21 miles from the sea, in 16° 47′ N. and 96° 13′ E. In 1880 Rangoon town was detached from the main district, called Hanthawaddy, and formed into a separate district, with an area of 22 square miles. Population of Rangoon (1891), 181,871; (1901), 232,326.

Until 1874 the management of the town was in the hands of the local government, which devoted itself to raising the centre of the

town above the river level, providing land fit for building purposes from the original swamp, which was flooded at spring-tides, and making roads, bridges, culverts, and surface drains. In 1892 was introduced the Shone sewage system, which now includes 6 miles of sewage mains, 22 miles of gravitating sewers, 4⅜ miles of air mains, and 44 Shone's ejectors. The water-works for Rangoon proper and for the shipping were not completed till 1893. The water-supply is now derived from Victoria Lake, a reservoir near Kokine, five miles distant. The town proper of Rangoon with the Kemmendine suburb is laid out on the block system, each block being 800 by 860 feet, intersected with regular streets. In the extensions of Rangoon to the east and west it has been decided to have no streets less than 50 feet wide. The roads are still lighted by kerosene oil lamps, although Moulmein has adopted a lighting system of oil gas. The lighting extends over 42 miles of roads. Steam tramways run from the town to Pazundaung in one direction and to Alôn and Kemmendine in the other, as well as to the foot of the Shwe Dagôn Pagoda hill. Latterly the erection of masonry buildings, instead of plank houses, has been insisted on in the central portion of the town, with the result that fires have decreased in number. There are two large maidans, or commons, which are used as military parade



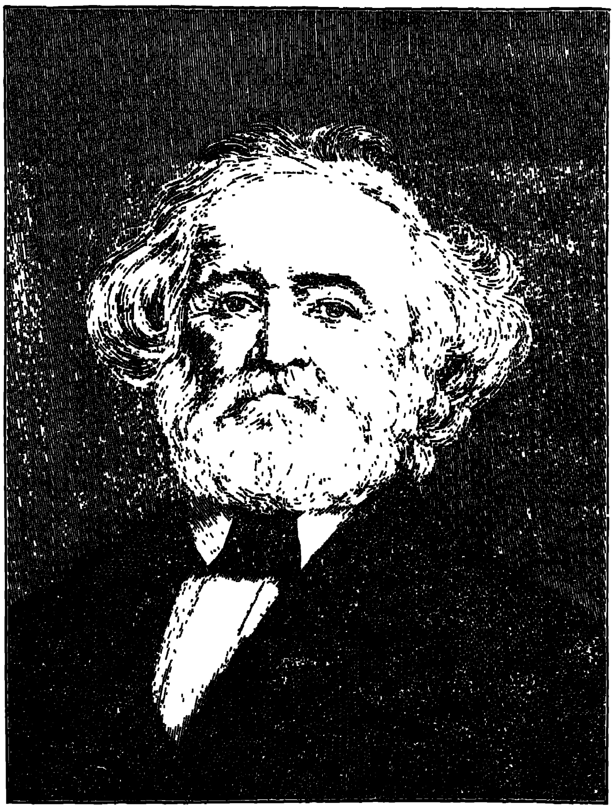
MAP OF RANGOON.

grounds and for racing, as well as for golf links and other purposes of amusement. There is a garden round the Phayre Museum, managed by the Agri-Horticultural Society, and an extremely pretty and well-kept garden in the cantonments under the Pagoda. Beyond these, however, the Royal Lake and Dalhousie Park, with 160 acres of water and 205 acres of well-laid-out and well-timbered park land, form one of the finest recreation grounds of which any city can boast. There are two cathedrals, Church of England and Roman Catholic, a Presbyterian church, and, besides the cantonment church, many other houses of various forms of Christian worship. Religious buildings and lands, indeed, occupy an area in Rangoon out of all proportion to its total size. Christians, Buddhists, Mussulmans, Hindus, Parsis, Armenians, and Jews all own lands and churches, pagodas, temples, mosques, and synagogues. The Buddhist monasteries, in particular, occupy wide spaces in very central portions of the town and cantonments. They are very far from being properly kept, but the ground is devoted in perpetuity to religion, and cannot be resumed, for reasons of public policy. Burial-grounds are equally extensive, and exist in every direction in what were once the outskirts, but are now fast becoming central parts of the city. A large necropolis is being prepared outside Rangoon, and most of the graveyards, many of which are already dangerously overcrowded, will soon be closed. The civil general hospital has accommodation for 368 patients, and over 7000 in-patients and 55,000 out-patients are annually treated in it. The military authorities have a hospital in cantonments. The Dufferin Institute for providing female medical aid to women has a branch and a small hospital in Rangoon, and a new hospital is in course of construction. Contagious diseases, cholera and small-pox, are treated in separate hospitals built outside the crowded part of the town. There are three municipal and eight private markets in Rangoon, which are being improved and extended. Everything, from sacking to jewellery, is sold in them. The introduction of pure water and the establishment of compulsory vaccination have greatly improved the health of Rangoon. The aggregate death-rate, which was 31·41 per mille in 1896, had fallen to 23·16 in 1898–99. The rate is still high, and is due partly to the swampy nature of the outskirts of the town proper, and still more to the deaths among the Hindu immigrants from the Madras Presidency. The death rate among Christians is only 7 per mille. Of the population in 1898–99, the number of Buddhists and Jains was 79,857; Hindus, 57,845; Mahommedans, 28,836; Christians, 12,698, of whom 4686 were natives, 1075 Karens and Shans, and 33 Parsis. The total rainfall in 1898–99 was 109·05 inches. The highest thermometer reading in May was 97·5, and the lowest reading in December 60·8° F. (J. G. Sc.)

Rangpur, or RUNGPORE, a town and district of British India, in the Rajshahi division of Bengal. The town is situated on the little river Ghaghat. Population (1891), 14,216. There is a high school, a normal school, and an industrial school. A public library was established in 1854. The earthquake of 12th June 1897 destroyed many of the public buildings, and diverted the drainage channels.

The DISTRICT of Rangpur has an area of 3486 square miles. The population in 1891 was 2,065,464, showing a slight decrease; average density, 592 persons per square mile. Classified according to religion, in 1891 Mahommedans numbered 1,295,411; Hindus, 768,233; Christians, 243, of whom 86 were Europeans; "others," 1577. In 1901 the population was 2,152,518, showing an increase of 4 per cent. The land revenue and rates in 1897–98 were Rs.11,46,765; number of police, 465; boys at school in 1896–97, 26,068, being 16·3 per cent. of the male population of school-going age; registered death-rate (1897), 38 per thousand. After rice, the most important crop is jute. There are 21 jute presses, with a capital of Rs.5,28,000, producing 181,000 bales, valued at Rs.26,87,000. Tobacco also is largely grown. The Eastern Bengal Railway has two branches, one of which crosses the district to the Brahmaputra, and the other runs north to Cooch Behar. The railway bridge over the Tista at Kaunia was opened in 1901.

Ranke, Leopold von (1795-1886), German historian, was born, 21st December 1795, in the small town of Wiehe, in Thuringia, which then formed part of the electorate of Saxony. His father was an advocate, but his ancestors, so far back as the family can be traced, had been ministers of religion. To the end of his days he maintained the deep religious feeling and family affection which he had acquired as a child. He received his education first at Donndorf, a boarding-school established in an old monastery near his home, and then at Schulpforta. Thence he passed to the University of Leipzig. His studies, both at school and university, were predominantly classical and theological; he received no special training in, and during his early years he displayed no special vocation for, history. The great political events which occurred during his boyhood and youth seem to have had less effect on him than on many of his contemporaries, and he was not carried away either by enthusiastic admiration for Napoleon or by the patriotic fervour of 1813; nor was he implicated in the political movements which during the following years attracted many of the students. He already displayed that detachment of mind which was to be so characteristic of him. At the age of twenty-two he became master in a school at Frankfort-on-the-Oder. He thereby entered the service of the Prussian Government: his birthplace had already been annexed to Prussia. The headmaster was Poppo, the celebrated Grecian. But besides his classical work, Ranke was entrusted with the teaching of history. With the scholar's dislike of text-books, he rapidly acquired a thorough knowledge of the ancient historians, quickly passed on to mediæval times, and here it was that he formed as the ideal of his life the study of universal history—the works of God as displayed in the history of the human race. Here, too, he composed his first work, which deals with the period to which most of his life was to be devoted, *On the History of the Romance and German Races from 1494 to 1516* (Berlin, 1824). To it was appended a critical dissertation on the historians who had dealt with the period, which, showing as it did how untrustworthy was much of traditional history, was to be for modern history as epoch-marking as the critical work of Niebuhr—who in this was his master—had been in ancient history. A copy of the book was sent to the Prussian minister of education, Kampz, the notorious hunter of democrats. Within a week he received the promise of a post at Berlin, and in less than three months was appointed supernumerary professor, with a small salary—a striking instance of the promptitude with which the Prussian Government recognized scientific merit when, as in Ranke's case, it was free from dangerous political opinions. The connexion thus established was to last for fifty years. At the Berlin Library Ranke found a collection of MS. records, chiefly Italian, dealing with the period of the Reformation: from a study of them he found how different were the real events as disclosed in contemporary documents from the history as recorded by most writers; and the result of his researches was embodied in his second work, *The Princes and Peoples of Southern Europe* (1827). (In later editions the title of this was altered to *The Osmans and the Spanish Monarchy in the 16th and 17th Centuries.*) It was now his ambition to continue his exploration of the new world thus opened to him: the Prussian Government provided the means, and in September 1827 he started for Italy. His first sojourn was in Vienna: the friendship of Gentz and the protection of Metternich opened to him the Venetian archives, of which many were preserved in that city—a virgin field, the value of which he first discovered, and which is still unexhausted. He found time, in addition, to write a short book on *Servia and the Servian Revolution*, from material supplied to him by Wuk Stephanowich, a Servian, who had himself been witness of the scenes he related. In 1828 he at last crossed the Alps, and the next three years were spent in Italy. The recommendations of Metternich opened to him almost every library except the Vatican; and it was during these three years of study in Venice, Ferrara, Rome, and other cities, that he obtained that acquaintance with European history which was to make him the first historian of his time. At Rome, as he said, he learned to see events from the inside. He wrote nothing but a critical examination of the story of Don Carlos, but he returned to Germany a master of his craft. He then for a time engaged in an occupation of a different nature, for he was appointed editor of a periodical which Perthes designed to defend the Prussian Government against the democratic press. Ranke, contemptuous in politics, as in history, of the men who warped facts to support some abstract theory, especially disliked the doctrinaire Liberalism so fashionable at the time. He hoped, by presenting facts as they were, to win the adhesion of all parties. We need not be surprised that he failed: men desired not the scientific treatment of politics, but satire and invective. Exposed to the attacks of men like Heyne and Börne, his weakness, if not his venality, was long an article of faith among the Liberals. He did not satisfy the Prussian Conservatives, and after four years the *Historische Politische Blätter* came to an end. Two-thirds of the matter had been contributed by the editor, but the two stout volumes in which the numbers were collected contained the best political thought which had for long appeared in Germany. For Ranke the failure was not to be regretted: the rest of his life was to be wholly devoted to that in which he excelled. During 1834-37 appeared the three volumes of his *History of the Popes*, in form, as in matter, the greatest of his works, containing the results of his studies in Italy. Henceforth



LEOPOLD VON RANKE.
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his name was known in all European countries; the English translation by Mrs Austin was the occasion of one of Macaulay's most brilliant essays. Before it was completed he had already begun the researches on which was based the second of his masterpieces, the *History of Germany during the Reformation* (1839–47), a necessary pendant to his book on the Popes, and the most popular of his works in his own country. In 1837 he became full professor; in 1841 Frederick William IV., always ready to recognize intellectual eminence, appointed him Prussian historiographer. Stimulated by this, he brought out his *Nine Books of Prussian History* (1847–48; subsequently expanded to twelve), a work which, chiefly owing to the nature of the subject, makes severe demands on the attention of the reader—he is the "Dryasdust" of Carlyle's Frederick; but in it he laid the foundation for the modern appreciation of the founders of the Prussian State. He took no immediate part in the movements of 1848, but in the following years drew up several memoranda for the king, whom he encouraged in his efforts to defend the character and identity of the Prussian State against the Revolution. Though never admitted into the inner circle of the king's associates (for indeed what place was there for him among the Gerlachs, Stahls, and Radowitzs?), he found the king the most appreciative of readers and stimulating of companions, and the queen one of the most faithful of his friends; in biographical works and on other occasions he always defended the memory of the unfortunate monarch. A friend even more sympathetic he found in Maximilian II. of Bavaria, whom he advised in his expansive schemes for the promotion of learning and letters. In the quieter years that followed he wrote the third of his masterpieces, the *History of France, chiefly in the 16th and 17th Centuries* (1852–61), which was followed by the *History of England, chiefly in the 17th Century* (1859–67). This, the longest of his works, added much to existing knowledge, especially as to the relations between England and the Continent, but it lacked something of the freshness of his earlier books; he was over seventy when it was completed, and he was never quite at home in dealing with the parliamentary foundations of English public life. It is impossible even to enumerate his other and minor works, which chiefly deal with the German history of the last three centuries. In his later years his small alert figure was one of the most distinguished in the society of Berlin, and every honour open to a man of letters was conferred upon him. He was ennobled in 1865, and in 1885 received the title of Excellenz. When the weakness of his eyes made it necessary for him to depend almost entirely on the service of readers and secretaries, in his eighty-first year he began to write the *History of the World*. Drawing on the knowledge accumulated during sixty years, he lived to bring it down to the time of the Crusades.

Ranke married, at Windermere, in 1843, Miss Clara Graves, daughter of an Irish barrister. She died in 1870, leaving two sons and one daughter.

At the time of his death Ranke was, not in his own country alone, generally regarded as the first of modern historians. It is no disparagement to point out that the recognition he obtained was due not only to his published work, but also to his success as a teacher. His public lectures, indeed, were never largely attended, but in his more private classes, where he dealt with the technical work of a historian, he trained generations of scholars: no one since Heyne has had so great an influence on German academical life, and for a whole generation the Berlin school had no rival. He took paternal pride in the achievements of his pupils, and delighted to see, through them, his influence spreading in every university. While his own work lay chiefly in more modern times, he trained in his classes a school of writers on German mediaeval history. As must always happen, it is only a part of his characteristics which they learnt from him, for his greatest qualities were incommunicable. The critical method which has since become almost a formal system, aiming at scientific certainty, was with him an unexampled power, based on the insight acquired from wide knowledge, which enabled him to judge the credibility of an author or the genuineness of an authority; but he has made it impossible for any one to attempt to write modern history except on the "narratives of eye-witnesses and the most genuine immediate documents" preserved in the archives. From the beginning he was determined never to allow himself to be misled, in his search for truth, by those theories and prejudices by which nearly every other historian was influenced—Hegelianism, Liberalism, Romanticism, religious and patriotic prejudice; but his superiority to the ordinary passions of the historian could only be attained by those who shared his elevation of character. "My object is simply to find out how the things actually occurred." "I am first a historian, then a Christian," he himself said. In another way no historian is less objective, for in his greatest works the whole narrative is coloured by the quality of his mind expressed in his style. An enemy to all controversy and all violence, whether in act or thought, he had a serenity of character comparable only to that of Sophocles or Goethe. Apt to minimize difficulties, to search for the common ground of unity in opponents, he turned aside, with a disdain which superficial critics often mistook for indifference, from the base, the violent, and the common. As in a Greek tragedy, we hear in his works the echo of great events and terrible catastrophes: we do not see them. He also made it a principle not to relate that which was already well known, a maxim which necessarily prevented his works attaining a popularity with the unlearned equal to their reputation among historians. But no writer has surpassed him in the clearness and brevity with which he could sum up the characteristics of an epoch in the history of the world, or present and define the great forces by which the world has been influenced. His classicism led to his great limitations as a historian. He did not deal with the history of the people, with economic or social problems—the dignity of history was to him a reality: he belonged to the school of Thucydides and Gibbon, not of Macaulay and Taine; he deals by preference with the rulers and leaders of the world, and he strictly limits his field to the history of the state, or, as we should say, political history; and in this he is followed by Seeley, one of the greatest of his adherents. The leader of modern historians, he was in truth a man of the *ancien régime*.

There is a collected edition of Ranke's works in fifty-four volumes, published by Dunkler and Humblot, 1881, &c. This does not include the *Weltgeschichte*. The last two volumes contain letters and autobiographical fragments. Besides the *History of England* and the *History of the Papacy*, there are English translations of his *History of the Romance and Teutonic Peoples* by Ashworth; of the *Princes and Peoples of Southern Europe*, and of the first volume of the *History of the World*, by Prothero. See also the article in the *Allgemeine deutsche Biographie* by Dove.—Guglia. *Leopold v. Ranke*. 1893. Ottokar Lorenz. *Die Geschichtswissenschaft*. Berlin, 1891.—Lord Acton on "German Schools of History," in *English Historical Review*, vol. i. No. i.—Guilland. *L'Allemagne Nouvelle et ses historiens*. Paris, 1899.

(J. W. He.)

Raoult, François Marie (1830–1901), French chemist, was born at Fournes, in the Département du Nord, on 10th May 1830. He became *aspirant répétiteur* at the lycée of Rheims in 1853, and after holding several intermediate positions was appointed in 1862 to the professorship of chemistry in Sens lycée, where he prepared the

thesis on electromotive force which gained him his doctor's degree at Paris in the following year. In 1867 he was put in charge of the chemistry classes at Grenoble, and three years later he succeeded to the chair of chemistry, which he held until his death on 1st April 1901. Raoult's earliest researches were physical in character, being largely concerned with the phenomena of the voltaic cell, and later there was a period when more purely chemical questions engaged his attention. But his name is best known in connexion with the work on solutions, to which he devoted the last two decades of his life. His first paper on the depression of the freezing points of liquids by the presence of substances dissolved in them was published in 1878; and continued investigation and experiment with various solvents, such as benzene and acetic acid, in addition to water, led him to the discovery of a simple relation between the molecular weights of the substances and the freezing point of the solvent, which he expressed as the "loi générale de la congélation," that if one molecule of a substance be dissolved in 100 molecules of any given solvent, the temperature of solidification of the latter will be lowered by 0·63° C. Another relation at which he worked was that the diminution in the vapour-pressure of a solvent, caused by dissolving a substance in it, is proportional to the molecular weight of the substance dissolved—at least when the solution is weak. These two generalizations not only afforded a valuable new method of determining the molecular weights of substances in the liquid state, but have also been utilized by van 't Hoff and Ostwald, among other chemists, in support of the hypothesis of electrolytic dissociation in solutions. An account of Raoult's life and work was given by Professor van t' Hoff in a memorial lecture delivered before the London Chemical Society on 26th March 1902.

Rapallo, a town and winter resort of the province of Genoa, Liguria, Italy. It occupies a beautiful and well sheltered situation on the east side of the Gulf of Rapallo, 18 miles east by south from Genoa, on the railway to Pisa. It has a fine church, a mediæval castle (now used as a prison), and a Roman bridge. Olives and other fruit are grown. Lace is made, and coral and tunny fishing carried on. Rapallo is a zoological and meteorological station. Population (1899), 3000.

Rappoltsweiler, in French *Ribeauville*, a town of Germany, in Alsace-Lorraine, district of Upper Alsace, 33 miles by rail south-south-west of Strasburg, is still in part surrounded by walls, and is known as "the pipers' town." In the town-hall is a collection of antiquities. The parish church (Roman Catholic) dates from 1473. Population (1900), 6099.

Rasht (*Resht*), the capital of the province of Gílán, in Persia. A carriage road connecting it with Tehran was opened to traffic in 1899. There is also a good main road from the city to Pír Bazar, the depôt for goods coming from Enzeli, the port on the Caspian, 16 miles north of Rasht. Conflagrations are frequent, particularly in the months of December and January, when hot, dry winds, resembling the foehn of the Alps, come down from the snow-capped Elburz. In December 1899 several caravanserais and bazaars, containing large quantities of merchandise, were burned. For 1897–98 the value of the exports was estimated at £900,000, and that of the imports at £850,000. The principal exports were: rice, £270,000; dry fruit, £190,000; fish, £70,000; sheep and cattle, £40,000; wool, £10,000; cotton, £270,000; and the principal imports: sugar, £400,000; silk-worm seed, £40,000; cotton goods, £240,000; petroleum, £15,000; glass and china, £30,000. The trade in dried (silkworm) cocoons has increased remarkably since 1893, when 76,150 ℔, valued at £6475, were exported, but in 1900 no less than 1,615,488 ℔, valued at £150,265, were exported.

Raspopina, a Cossack village of Russia, in the province of the Don Cossacks, on the right bank of the Don river, 85 miles north-west of Tsaritsyn. It has considerable trade in corn and cattle, and in 1897 had a population of 15,330.

Rastatt, a town of Germany, grand-duchy of Baden, 15 miles by rail south-west of Carlsruhe. Rastatt ceased to be a fortress in 1890. It has a museum and an industrial school, and manufactures cooking-stoves, tobacco, &c. Population (1885), 11,743; (1900), 13,940.

Rastenburg, a town of Prussia, province of East Prussia, 64 miles by rail south-east of Königsberg. It has a parish church dating from 1359, a large lunatic asylum, a provincial stud, and iron-works, oil and flour mills, breweries, &c. Population (1885), 7189; (1900), 11,140.

Rathenow, a town of Prussia, on the Havel, 45 miles west by north of Berlin by rail. Rathenow has a Protestant and a Catholic (1893) church, a *real* progymnasium, a higher-grade school, 9 optical instrument, 4 stove, 2 machinery, and 2 furniture works, 2 shipbuilding yards, an asbestos and 2 glue factories. Population (1880), 11,394; (1900), 21,043.

Ratibor, a town of Prussia, Silesia, 97 miles by rail south-east of Breslau and 13 from the Austrian frontier, on the Oder, with manufactures of ironware, furniture, tobacco, paper, sugar, glass, machinery, chemicals, &c.; it also produces vegetables. Population (1885), 19,524; (1900), 25,236.

Ratisbon, in German *Regensburg*, a town and episcopal see of Bavaria, Germany, district Upper Palatinate, on the Danube, 86 miles by rail north-north-east from Munich. The church of St Ulrich contains a large portion of the antiquarian collections of the Historical Society, the rest being in the St Erhard House. The northern gate of the old Roman town was unearthed in 1885. Among the public institutions should be mentioned the public library, picture gallery, botanical garden, institute for glass staining, and some seminaries. Population (1885), 36,093; (1900), 45,426.

Ratlam, or Rutlam, a native state of India, in the Malwa agency. Area, 729 square miles. Population (1881), 87,314; (1891), 89,160. Estimated gross revenue, Rs.1,30,000; tribute, Rs.84,000. The chief, whose title is raja, is a Rahtor Rajput of the Jodhpur family. The town of Ratlam is 1577 feet above the sea. Population (1881), 31,066; (1891), 29,822. It is a junction on the Rajputana–Malwa Railway, and an important centre of trade, especially in opium. In 1897–98 the number of chests of opium exported through the Ratlam sub-agency was 1428, paying a duty of Rs.8,02,450.

Ratnagiri, a town and district of British India, in the Konkan division of Bombay. The town is on the seacoast, 136 miles south of Bombay. Population (1881), 12,616; (1891), 14,303. Ratnagiri is a seaport, with a lighthouse, and an old fort sheltering a tidal creek. It has a good water supply. There is a Government high school and a school of industry. The district of Ratnagiri has an area of 3922 square miles. Population (1881), 997,090; (1891), 1,105,926. In 1901 the population was 1,166,890, showing an increase of 6 per cent., compared with an increase of 11 per cent. in the previous decade. Land revenue and rates, Rs.9,84,448, the incidence of assessment being just over 8 annas per acre; number of police, 703; children at school (1897–98), 18,781, being 2·1 per cent. of the total population;

registered death-rate (1897), 30 per thousand. The Bombay survey tenure has not been extended to the district, which possesses a peculiar land system, called *khoti*. Fishing and maritime trade are active, there being twenty-nine ports altogether.

Ratnapura (which means "The City of Gems") is the chief town in the province of Sabaragamuwa, Ceylon, and is the centre of a native industry in digging for precious stones—rubies, sapphires, cat's-eyes, &c.—which has existed from time immemorial. There is also much rice and fruit cultivation and planting of tea in the district. Population of town, about 4100; of district, 133,000; of province, 322,000.

Rat Portage, a town and port of entry in Ontario, Canada, and the chief town of Rainy River district, situated in 49° 47′ N., 94° 30′ W., at an altitude of 1087 feet above the sea. It is 133 miles by rail east of Winnipeg, on the Canadian Pacific Railway, and at the outlet of the Lake of the Woods. The Winnipeg river has at this point a fall of 16 feet, which, with the lake as a great reservoir, furnishes an abundant and unfailing water-power. The industrial establishments comprise reduction works, saw-mills, and flour-mills, one of the latter being the largest in Canada. It is the distributing point for the gold mines of the district, and during the summer months steamboat communication is maintained on the lake. There is important sturgeon fishing. Population (1891), 1806; (1901), 5202.

Raudnitz (Czech, *Roudnice nad Labem*), a district town on the Elbe, in northern Bohemia. Its chief attraction lies in the interesting and valuable collections in the 17th-century château of Prince Lobkowitz. These include an extensive library, with a large number of the earliest specimens of printing and valuable MSS., together with a series of pictures from the time of Charles V. to the Thirty Years' War. In 1350 Rienzi, "the last of the tribunes," was confined by the emperor Charles IV. in the castle, which then occupied the site of the present château, previous to his despatch under arrest to the Pope at Avignon. The chief industries comprise tanning, distilling, brewing, and the manufacture of liqueurs, oil, vinegar, malt, chemicals, and metal goods; its trade also including live stock, timber, and agricultural produce. In 1890 the population of the commune was 6615, and of the town 3349; in 1900, 7973, chiefly Czech.

Ravenna, a city and archiepiscopal see of Italy, Emilia, capital of the province of Ravenna, stands in a marshy plain, more than 4 miles from the sea, and 45 miles by rail east of Bologna. In addition to its numerous ancient churches, for which it is principally famous, it possesses an archiepiscopal palace (5th century); the remains of the palace of Theodoric; the tomb of Theodoric (6th century); the small temple (1482, rebuilt 1782) which contains the tomb of Dante, who died here in 1321; Byron's house; the Academy of Fine Arts (1827), with schools of design, a picture gallery, and a library; a public library, with several incunabula and MSS.; a small museum; a statue of Pope Clement XII. (1738); a monument to the statesman Farini; outside the walls, a monument to Gaston de Foix and to the victory which the French won over the Hispano-Papal troops in 1512. The industries are few—the growing of wine, breeding of silkworms, making of agricultural instruments, printing, and the manufacture of laces being the chief. There is a technical school. In 1897 the port (4 miles distant) was cleared by 1088 vessels of 52,729 tons. Population (1881), 34,270; (1901), 63,839.

Rawalpindi, a city of British India, which gives its name to a district and a division in the Punjab. The city is situated on both banks of the river Leh, 1726 feet above the sea, 111 miles east by south of Peshawar; it has a railway station. Population (1881), 52,975; (1891), 73,795; municipal income (1897–98), Rs.2,09,817; death-rate (1897), 44 per thousand. It is the headquarters of a military district, with a strong force of all arms and there is a first-class fortress, containing an arsenal. Rawalpindi is the starting-point of the cart-road to Murree, and the centre of trade with Kashmir. There is an annual horse fair. A Gordon mission college was opened in 1893. There are three high schools, a normal school, an industrial school, and schools for European boys and girls. There are eight printing-presses, issuing three newspapers.

The district of RAWALPINDI has an area of 4844 square miles. Population (1881), 820,512; (1891), 887,194. In 1901 the population was 780,080, showing a decrease of 12 per cent., compared with an increase of 8 per cent. in the preceding decade. Land rev nue and rates (1897–98), Rs.11,38,686, the incidence of assessment being 11 annas per acre; cultivated area, 739,172 acres, of which 58,111 were irrigated from wells, &c.; number of police, 1056; number of schools, 623, attended by 15,483 boys, being 16·7 per cent. of the boys of school-going age; death-rate (1897), 32·7 per thousand. The principal crops are wheat, millet, pulse, barley, maize, oil-seeds, and cotton. The district is traversed by the main line of the North-Western Railway, crossing the Indus at Attock, and also by a branch to the Indus at Kushalgarh for Kohat; total length, 167 miles. Another branch roughly following the Indus, from Attock to Mari, was opened in 1899. The two boundary rivers are navigable for 178 miles.

The division of RAWALPINDI lies in the north of the Punjab, between Lahore and Peshawar. It consists of the six districts of Sialkot, Gujrat, Gujranwala, Shahpur, Jhelum, and Rawalpindi. Total area, 20,738 square miles. Population (1891), 3,560,699; average density, 172 persons per square mile.

Rawlinson, George (1812–1902), English scholar and historian, was born at Chadlington, Oxfordshire, 23rd November 1812, being the younger brother of Sir Henry Rawlinson (*q.v.*). Having taken his degree at Oxford (from Trinity College) in 1838, he was elected to a fellowship at Exeter College in 1840, of which from 1842 to 1846 he was fellow and tutor. He was ordained in 1841; was Bampton lecturer in 1859, and Camden professor of ancient history from 1861 to 1889. In 1872 he was appointed canon of Canterbury, and after 1888 he was rector of All Hallows, Lombard Street. In 1873 he was appointed to the office of proctor in Convocation for the Chapter of Canterbury. He married Louisa, daughter of Sir R. A. Chermside, in 1846. His chief publications are his translation of the *History of Herodotus* (in collaboration with his brother Sir Henry Rawlinson, and Sir Gardner Wilkinson), 1858–60; *The Five Great Monarchies of the Ancient Eastern World*, 1862–67; *The Sixth Great Oriental Monarchy* (Parthian), 1873; *The Seventh Great Oriental Monarchy* (Sassanian), 1875; *Manual of Ancient History*, 1869; *Historical Illustrations of the Old Testament*, 1871; *The Origin of Nations*, 1877; *History of Ancient Egypt*, 1881; *Egypt and Babylon*, 1885; *History of Phœnicia*, 1889; *Parthia*, 1893; *Memoir of Major-General Sir H. C. Rawlinson*, 1898. He was a contributor to the *Speaker's Commentary*, the *Pulpit Commentary*, Smith's *Dictionary of the Bible*, and various similar publications; and he was the author of the article "Herodotus" in the ninth edition of the *Encyclopædia Britannica*. He died 7th October 1902.

Rawlinson, Sir Henry Creswicke (1810–1895), English soldier and Orientalist, was born at Chad-

lington, Oxfordshire, on 11th April 1810. In 1827 he went to India as cadet under the East India Company; and after six years' life with his regiment as subaltern, during which time he had become proficient in the Persian language, he was sent to Persia in company with some other English officers who were entrusted with the task of drilling and reorganizing the Shah's troops. It was during the years he spent in Persia at this time that he was first attracted to the study of inscriptions, more particularly those in the hitherto undeciphered cuneiform character. In the course of the two years during which he was in its immediate neighbourhood, he transcribed as much as he was able of the great cuneiform inscription in the Persian language on the rock at Behistun; but his exertions in this direction were temporarily checked by the friction between the Persian Court and the English Government, which ended in the departure of the English military officers from the Shah's dominions.

His experience and the ability he had shown in Persia gained him the appointment as political agent at Kandahar in 1840. In that capacity he served for three years with conspicuous success, his political labours being as meritorious as was his gallantry during various engagements in the course of the Afghan war; for these he was rewarded by the distinction of C.B. in 1844. A fortunate chance, by which he became personally known to the governor-general, led to his being appointed, at his own desire, as political agent in Turkish Arabia; thus he was enabled to settle in Baghdad, where his official duties were sufficiently light to allow of his devoting much time to the cuneiform studies which so strongly attracted him. He was now able, under considerable difficulties and with no small personal risk, to make a complete transcript of the Behistun inscription, which he was also successful in deciphering and interpreting. Having collected a large amount of invaluable information on this and kindred topics, in addition to much geographical knowledge gained in the prosecution of various explorations (including visits with Mr Layard to the ruins of Nineveh), he returned to England on leave of absence in 1849. He remained at home for two years, in the course of which he received from various learned societies the honour due to his achievements in connexion with the decipherment of Babylonian and Assyrian inscriptions; published, in 1851, his Memoir on the Behistun inscription; and was promoted to the rank of lieutenant-colonel. He disposed of his valuable collection of Babylonian, Sabæan, and Sassanian antiquities to the Trustees of the British Museum, who also made him a considerable grant to enable him to carry on the Assyrian and Babylonian excavations initiated by Layard. In 1851 he returned to his post at Baghdad. The excavations were carried on under his direction with valuable results, among the most important being the discovery of material that greatly contributed to the final decipherment and interpretation of the cuneiform character. An accident with which he met in 1855 hastened his determination to return to England and devote himself to the elaboration of the knowledge he had gained by his researches, and consequently in that year he resigned his post in the East India Company. On his return to England the distinction of K.C.B. was conferred upon him, and he was appointed a crown director of the East India Company. The remaining forty years of his life were full of activity—political, diplomatic, and scientific—and were mainly spent in London. In 1858 he was appointed a member of the first India Council, but resigned in 1859 on being sent to Persia as envoy extraordinary and minister plenipotentiary. The latter post he held only for a year, owing to his dissatisfaction with circumstances connected with his official position there. Previously he had sat in Parliament as M.P. for Reigate from February to September 1858; he sat again as M.P. for Frome 1865–68. He was appointed to the Council of India again in 1868, and continued to serve upon it until his death. He was a strong advocate of the forward policy in Afghanistan, and counselled the retention of Kandahar. His views were more particularly expressed in *England and Russia in the East*, 1875. He was a Trustee of the British Museum from 1876 till his death. He was created G.C.B. in 1889, and a baronet in 1891; was president of the Geographical Society from 1874 to 1875, and of the Asiatic Society from 1878 to 1881; and received honorary degrees at Oxford, Cambridge, and Edinburgh. He married, in September 1862, Louisa Caroline Harcourt Seymour, who bore him two sons and died in 1889. He died in London on 5th March 1895. His published works, which were very largely concerned with his remarkable achievement in the transliteration and decipherment of the cuneiform character, and his equally remarkable geographical knowledge, include (exclusive of minor contributions to the publications of learned societies) four volumes of cuneiform inscriptions, published under his direction between 1870 and 1884 by the Trustees of the British Museum; *The Persian Cuneiform Inscription at Behistun*, 1846–51, and *Outline of the History of Assyria*, 1852, both reprinted from the Asiatic Society's Journals; *A Commentary on the Cuneiform Inscriptions of Babylon and Assyria*, 1850; *Notes on the Early History of Babylonia*, 1854; *England and Russia in the East*, 1875. He contributed to the *Encyclopædia Britannica* (ninth edition) the articles on Baghdad, the Euphrates, and Kurdistan, and several other articles dealing with the East; and assisted in editing a translation of Herodotus by his brother, Canon George Rawlinson. (R. F. S.)

Rawlinson, Sir Robert (1810–1898), English engineer and sanitarian, was born at Bristol on 28th February 1810. His father was a mason and builder at Chorley, Lancashire, and he himself began his engineering education by working in a stonemason's yard. In 1831 he obtained employment under Jesse Hartley in the engineer's office at the Liverpool docks, and for four years from 1836 he was engaged under Robert Stephenson as assistant resident engineer for the Blisworth section of what is now the London and North-Western main line from London to the North. Returning to Liverpool, he spent some years as assistant surveyor to the corporation—a position in which he doubtless had ample opportunities of studying the connexion between dirt and disease—and then in 1844 accepted an engineering post on the Bridgewater Canal. Three years later he returned to Liverpool, to superintend the design and construction of the famous brick arched ceiling in the St George's Hall, in succession to his friend H. L. Elmes, who was obliged to give up the work in consequence of illness that quickly proved fatal. During this period Rawlinson's reputation as a sanitarian had been growing, and when the Public Health Act was passed in 1848 he was appointed one of the first inspectors under it. In the course of his duty he had to inspect many of the chief towns of England, and the reports he was obliged to make of the insanitary conditions he found brought him in many cases into great unpopularity with the municipal rulers whose shortcomings he exposed. Seven years later a still wider field was opened to his energies. Early in 1855 popular feeling was so aroused by the waste of life that was going on among the British troops in the Crimea through disease, and by the mismanagement of the campaign, that the Aberdeen Ministry was forced to resign, and Lord Palmerston, who then became prime minister,

had to adopt vigorous measures for improving the condition of affairs. To this end a Sanitary Commission, consisting of Rawlinson and two medical members (Dr Sutherland and Dr H. Gavin), was despatched, with full and absolute powers from the War Office, to do whatever it thought would lead to better hygienic conditions in camp and hospital. The Commission reached Constantinople in March, and, by insisting on what now seem the most simple and obvious precautions, succeeded within a few weeks in reducing the death-rate in the Levantine hospitals from 42 to $2\frac{1}{4}$ per cent. Passing on to the Crimea, it effected a similar improvement there, and by the end of the year the health of the whole British army in the field was even better than it enjoyed at home. The lesson was not thrown away, and from that time forward sanitary measures were systematically adopted, not only by the British but also by other armies of the world, which resulted in a large diminution of the death-rate from disease. Rawlinson's next great public service, for which he was made C.B. in 1865, was in connexion with the distress caused in Lancashire by the collapse of the cotton-manufacturing industry consequent on the American Civil War. In 1863 it was suggested that, in order to provide employment for the starving operatives, the Government should start works of "utility, profit, and ornament," and Rawlinson being sent to make an official investigation into the question, reported, after visiting nearly 100 towns, that $1\frac{1}{2}$ million sterling might be advantageously expended in providing water-supply and drainage, forming streets, &c., in those places. The result was that the Treasury was authorized to advance £1,200,000 (the amount was afterwards increased) at $3\frac{1}{2}$ per cent. for carrying out such works, which proved of enormous public benefit. In 1866 he acted as chairman of the Royal Commission on the Pollution of Rivers, and a few years later was appointed chief engineering inspector to the Local Government Board; on retiring from this position in 1888 was promoted to be K.C.B. In 1894 he served as president of the Institution of Civil Engineers. He died in London on 31st May 1898. (H. M. R.)

Rawtenstall, a municipal borough (since 1891) of Lancashire, England, in the Rossendale parliamentary division, 12 miles south-east of Blackburn. Liberal Club buildings were erected in 1894, and the Grand Theatre in 1899. Population (1881), 28,913; (1901), 31,052.

Rayleigh, John William Strutt, 3RD BARON (1842——), English physicist, was born in Essex on 12th November 1842, being the son of the second baron. Going to Trinity College, Cambridge, he graduated as senior wrangler in 1865, and obtained the first Smith's prize of the year, the second being gained by Professor Alfred Marshall. He married in 1871 a sister of the Right Hon. A. J. Balfour, and succeeded to the title in 1873. From 1879 to 1884 he was Cavendish professor of experimental physics in the University of Cambridge, in succession to Clerk Maxwell; and in 1887 he accepted the post of professor of natural philosophy at the Royal Institution of Great Britain. His early mathematical and physical papers, written under the name of J. W. Strutt, made him known over Europe; and his powers rapidly matured until, at the death of Clerk Maxwell, he stood at the head of British physicists, Sir George Stokes and Lord Kelvin alone excepted. The special feature of his work is its extreme accuracy and definiteness; he combines the highest mathematical acumen with refinement of experimental skill, so that the idea of ranking him as higher in one department than another does not arise. His experimental investigations are carried out with plain and usually home-made apparatus, the accessories being crude and rough, but the essentials thoughtfully designed so as to compass in the simplest and most perfect manner the special end in view. A great part of his theoretical work consists in resurveying things supposed superficially to be already known, and elaborating their theory into precision and completeness. In this way he has gone over a great portion of the field of physics, and in many cases has either said the last word for the time being, or else started new and fruitful developments. Possessing an immense range of knowledge, he has filled up lacunæ in nearly every part of physics, by experiment, by calculation, and by clear accurate thought. The following branches have especially felt his influence:—chemical physics, capillarity and viscosity, theory of gases, flow of liquids, photography, optics, colour vision, wave theory, electric and magnetic problems, electrical measurements, elasticity, sound, and hydrodynamics. The numerous scientific memoirs in which his original work is set forth are being collected in four large volumes, under his own editorship. His most extensive single work is a book on *Sound*, which, in the second edition, has become a treatise on vibrations in general, and is one of the finest examples of a scientific treatise extant. His familiarity with the methods of mathematical analysis and a certain refinement of taste in their application have resulted in great beauty of form. His papers are often difficult to read, but never diffuse or tedious; his mathematical treatment is never needlessly abstruse, for when his analysis is complicated it is only so because the subject-matter is complicated. Of discoveries superficially sensational there are few or none to record, and the weight of his work is for the most part only to be appreciated by professed physicists. One remarkable discovery, however, of general interest, was the outcome of a long series of delicate weighings and minute experimental care in the determination of the relative density of nitrogen gas undertaken in order to determine the atomic weight of nitrogen namely, the discovery of argon, the first of a series of strange new substances, chemically inert, which occur, some only in excessively minute quantities, as constituents of the earth's atmosphere (see the article ARGON in these new volumes, which is from his pen). He was also the author of the articles OPTICS and WAVE THEORY in the ninth edition of this Encyclopaedia. Lord Rayleigh has taken some interest in abnormal psychological investigations, and has long been a member and vice president of the Society for Psychical Research. He was one of the few selected for admission to the Order of Merit instituted in connexion with the coronation of His Majesty King Edward VII.

For a popular but authentic account of some of Lord Rayleigh's scientific work and discoveries, see an article by Sir Oliver Lodge in the *National Review* for September 1898.

Razgrad, chief town of a department in the principality of Bulgaria, on the Biéli-lom or Ak-lom, near a station on the railway from Rustchuk to Varna, 40 miles south-east of Rustchuk. Owing to evacuation by the Turks after the Russo-Turkish war of 1877, a large part of the town lapsed into ruin, but it is regaining its prosperity, and has a large agricultural and general trade. It possesses a magnificent mosque, built in 1614 by Ibrahim Pasha, but it is now in a partly ruined condition. Population (1892), 13,295.

Reading, the county town and a municipal, parliamentary, and county borough and market town of Berkshire, England. It lies on the Kennet, just above its junction with the Thames, 36 miles by rail and 47 by river west of London. Its situation in a fertile vale, and in

proximity to the charming reaches of the upper Thames, has of late years made it a favourite place of residence; and through the excellent railway accommodation provided by the Great Western, South-Western, and South-Eastern railways, it may be said to have been drawn into suburban London. The site of the old Hospice of St John is now occupied by the University Extension College, opened in 1892, which, affiliated to Oxford University and with accommodation for 600 students, was the first attempt to popularize higher university education. Its agricultural department is particularly flourishing. The Lady Warwick Hostel, named after its founder, is an institution for instructing young women in the lighter branches of agriculture—fruit and poultry-farming, and gardening. The Great Western Railway station, so long an eyesore to passengers, has been rebuilt, the lines relaid, and thereby the through express traffic greatly facilitated. The great biscuit manufactory of Huntley and Palmer has lately been much enlarged, and employs nearly 5000 hands. The extensive seed nurseries of Messrs Sutton, which vie with those of Erfurt and Quedlinburg in Germany, cover nearly 10,000 acres, and are of world-wide renown. Adjoining the free library is a museum containing a collection of Romano-British antiquities from Silchester. A public park 59 acres in extent, the gift of Mr G. Palmer, was opened in 1891.

Besides its manufactures, which are in a flourishing condition, and embrace sauces, velvet, sacking, silk, ribbons, and tin boxes, Reading is also an important mart for corn and other agricultural produce. Reading returns only one member to Parliament since 1885, in which year the parliamentary borough was also extended. Area of municipal borough, 5878 acres; area of parliamentary borough, 2441 acres. Population (1891), 60,054; (1901), 72,214.

Reading, a city of Pennsylvania, U.S.A., the capital of Berks county. It is situated in 40° 20′ N. and 75° 55′ W., on the east bank of the Schuylkill river, on the Schuylkill canal, and on the Pennsylvania, the Philadelphia and Reading, and the Wilmington and Northern railways, in the south-eastern part of the state, at an altitude of 206 feet. Laid out on a fairly level site, the city is divided into sixteen wards, has a good water-supply, the works being owned by the city, is paved with asphalt, cobble-stones, and macadam, is sewered, and has a steam heating plant. Reading is an important manufacturing centre, especially of iron and steel. In 1900 it contained 843 manufacturing establishments, with a total capital of $27,975,628. These employed 12,165 hands, and the product was valued at $36,902,511. Iron and steel goods were valued at $9,530,286, hardware at $1,611,268, and foundry and machine-shop products at $2,437,355, and cars and general shop construction and repairs at $6,315,128. Tobacco and cigars had a value of $1,683,466, fur hats, $1,133,688, and hosiery and knitted goods, $1,326,397. Reading contains also the principal workshops of the Philadelphia and Reading Railway Company. In 1899 the assessed valuation of real and personal property was $43,480,679, the net debt of the city was $1,371,567, and the rate of taxation was $14·50 per $1000. Population (1890), 58,661; (1900), 78,961, of whom 5940 were foreign-born and 534 negroes.

Rechberg und Rothenloewen, Johann Bernard, Count von (1809–1899), Austrian statesman, sprang from a noble family which from the 12th century has held a prominent position in Swabia. At the time of the Revolution the fief had been divided between the modern kingdoms of Bavaria and Würtemberg, and his father, Count Aloys (1766–1849), was one of the foremost Bavarian statesmen during the first quarter of the 19th century, and took a great part at the celebrated Carlsbad Conferences. Count Johann, who was the second son, was destined for the Bavarian public service, his elder brother being a hereditary member of the Upper House in the Parliament of Würtemberg. He was educated at the universities of Strasburg and Munich, but the part he took as second in a duel brought upon him the displeasure of King Ludwig, and at the age of twenty he transferred himself to the Austrian service. After holding various inferior diplomatic appointments, he was in 1843 sent as envoy to Brazil. He returned to Europe in 1847, and on the outbreak of the revolution in 1848 was of great service to Prince Metternich, whom he accompanied and assisted when, deserted by all his former friends, the aged statesman had to fly from Austria to England. In 1853 he was appointed civil coadjutor to Radetzky, who was governor of the Lombardo-Venetian kingdom—a very difficult post, owing to the jealousy with which he was regarded by the army. In 1855 he was made Austrian representative at, and president of, the Germanic diet at Frankfort. As a pupil of Metternich he would have wished to preserve the good understanding with Prussia which seemed the necessary foundation for a conservative policy; he was, however, made the instrument for the anti-Prussian policy of Buol; this brought about constant disputes with Bismarck, at that time Prussian envoy at the Diet, which were sharpened by Rechberg's choleric temper, and on one occasion nearly led to a duel. Bismarck, however, both in his despatches and his memoirs, always expressed a high appreciation of his character and abilities. In May 1859, on the eve of the war with France and Sardinia, Rechberg was chosen to succeed Buol as foreign minister. This post he held for five of the most eventful years of Austrian history. After the defeat of Magenta he accompanied the emperor to Italy, and he had to meet the crisis caused by a war for which he was not responsible. He began the concessions to Hungary, but the chief influence in the Council soon passed to colleagues, especially Schmerling, with whose policy he was not in agreement. His attempts to establish a good understanding with Prussia were constantly frustrated, and in 1863 he offered his resignation as a protest against the Furstentag at Frankfort, which had been decided on without his knowledge. The emperor refused to accept his resignation, and, unfortunately for his own reputation, he did not insist on it, for it was the inconsistent and variable policy arising from the conflicting aims of different ministers which brought so many disasters on Austria. Rechberg succeeded, indeed, in establishing a close co-operation with Prussia in regard to the Elbe duchies; but this was very unpopular in Austria, where it was said he had been made the dupe of Bismarck. He still hoped to establish a firm and permanent alliance with Prussia, but for this he had not sufficient influence, either in his own ministry or at Berlin; and when his proposals for a customs union were rejected by the Prussian ministry, his fall was inevitable. He resigned in October 1864, foretelling the speedy outbreak of a war which he had long striven to avert, and for which he saw that Austria was not strong enough. From this time he lived in complete retirement till his death, which took place at his country house at Schwechat in 1899.

See also an article by Friedjung in *Bettelman's Biographische Jahrbucher*, Berlin, 1900; also *Der Kampf um die Vorherrschaft in Deutschland*, Stuttgart, 1898, by the same author.—Sybel. *Die Begründung des deutschen Reiches* and Bismarck's *Reflections and Reminiscences*. (J. W. He.)

Recklinghausen, a town of Prussia, province of Westphalia, 22 miles by rail north-west of Dortmund, with coal-mines, limestone quarries, brick-works, and manufacture of linen, lamp-wicks, and tobacco, saw-mills and distilleries. Population (1885), 9199; (1900), 34,042.

Reclus, Jean Jacques Elisée (1830–——), French geographer, was born at Sainte-Foy la Grande (Gironde), on 15th March 1830. He was the second son of a Protestant pastor, who had a family of twelve children, several of whom have also acquired some celebrity either as men of letters, politicians, or members of the learned professions. His education, begun in Rhenish Prussia, was continued in the Protestant College of Montauban, and completed at the University of Berlin, where he followed a long course of geography under Karl Ritter. Withdrawing from France in consequence of the events of December 1851, he spent the next six years (1852–57) visiting the British Isles, the United States, Central America, and Colombia, losing no opportunity of studying the physical features and economic conditions of these lands, and acquiring a practical knowledge of English, Spanish, and several other European languages. On his return to Paris he contributed to the *Revue des Deux Mondes*, to the *Tour du Monde* and other serials, a large number of articles embodying the results of his geographical work. During the siege of Paris, Reclus shared in the aerostatic operations conducted by M. Nadar, and also served in the National Guard, while as a member of the Association Nationale des Travailleurs he published in the *Cri du Peuple* a hostile manifesto against the Government of Versailles in connexion with the Communist rising of 18th March 1871. Continuing to serve in the National Guard, now in open revolt, he was taken prisoner on 5th April, and on 16th November sentenced to transportation for life; but, largely at the instance of influential deputations from England, the sentence was commuted in January 1872 to perpetual banishment. Thereupon, after a short visit to Italy, he settled at Clarens, in Switzerland, where he resumed his literary labours, and wrote nearly the whole of his great work, *La Nouvelle Géographie Universelle, La Terre et les Hommes*, 19 vols. (1875–94), a stupendous compilation, profusely illustrated with maps, plans, and engravings, and crowned with the gold medal of the Paris Geographical Society in 1892. An English edition appeared simultaneously, also in 19 vols., the first four by E. G. Ravenstein, the rest by A. H. Keane. A preliminary work, entitled *La Terre, Description des Phénomènes de la Vie du Globe*, 2 vols., had already appeared in 1867–68, the two forming the most comprehensive geographical series ever issued in any language. Extreme accuracy and brilliant exposition form the leading characteristics of these, as of all the author's writings, which thus possess permanent literary and scientific value. In 1882 M. Reclus initiated the "Anti-Marriage Movement," in accordance with which he allowed his two daughters to marry without any civil or religious sanction whatever. This step caused no little embarrassment to many of his well-wishers, and was followed by Government prosecutions, instituted in the High Court of Lyons, against the anarchists, members of the International Association, of which M. Reclus and Prince Kropotkin were designated as the two chief organizers. The Russian socialist was arrested and condemned to five years' imprisonment, but M. Reclus, being resident in Switzerland, escaped the arm of French justice. After 1892 he filled the chair of comparative geography in the University of Brussels, and contributed several important memoirs to French, German, and English scientific journals. Amongst these may be mentioned "The Progress of Mankind" (*Contemp. Rev.*, 1896); "Attila de Gerando" (*Rev. Géograph.*, 1898); "A Great Globe" (*Geograph. Journ.*, 1898); "L'Extrême-Orient" (*Bul. Antwerp Geo. Soc.*, 1898), a thoughtful study of the political geography of the Far East and its possible changes; "La Perse" (*Bul. Soc. Neuchateloise*, 1899); "La Phénicie et les Phéniciens" (*ibid.*, 1900); *La Chine et la Diplomatie européenne* ("L'Humanité Nouvelle" series, 1900); *L'Enseignement de la Géographie* (Instit. Géograph. de Bruxelles, No. 5, 1901).

Red Bank, a town of Monmouth county, New Jersey, U.S.A. It is at the head of navigation of the Shrewsbury river, on the Central of New Jersey and the Pennsylvania railways, in the eastern part of the state. Population (1890), 4145; (1900), 5428, of whom 508 were foreign-born and 620 negroes.

Redcar, a watering-place and parish in the North Riding of Yorkshire, England, in the Cleveland parliamentary division, 8 miles north-east of Middlesbrough, with a station on a branch of the North-Eastern Railway. Its long range (from Tees to Saltburn, a distance of 10 miles) of firm sands has made it a popular summer resort. Race meetings are held on the racecourse here on Whitsun Monday and Tuesday, and in August. Since 1894 the town has been governed by an urban district council. Population of the parish and urban district (1891), 2818. Population of area, extended in 1898 to include Coatham parish (1901), 7695.

Redditch, a town and parish in the county of Worcester, England, in the Eastern parliamentary division of the county, 16 miles south-west of Birmingham by railway. The church of St Stephen was restored in 1894. Other places of worship have been rebuilt or enlarged. The Smallwood Hospital was erected in 1895, and the Smallwood Almshouses in 1897. Redditch is the centre of a district noted for its needles and fishhooks. The division of labour in the production of needles necessitates each passing through nearly twenty pairs of hands. Population of urban district (1891), 11,311; (1901), 13,493.

Redgrave, Richard (1801–1888), English artist, was born at Pimlico on 30th April 1801, and worked at first as a designer. He became a student in the Royal Academy Schools in 1826, and was elected an Associate in 1840 and an Academician in 1851 (retired, 1882). His "Gulliver on the Farmer's Table" (1837) made his reputation as a painter. He began in 1847 a connexion with the Government Art Schools which lasted for a long term of years, and among other posts he held those of inspector-general of art in the Science and Art Department, and art director of the South Kensington Museum. He was greatly instrumental in the establishment of this institution, and he claimed the credit of having secured the Sheepshanks and Ellison gifts for the nation. He was also surveyor of the Royal Pictures. He was offered, but declined, a knighthood in 1869. Redgrave was an assiduous painter of landscape and *genre*; his best pictures being "Country Cousins" (1848) and "The Return of Olivia" (1848), both in the national collection, "The Sempstress" (1844), "Well Spring in the Forest" (1865). He died on 14th December 1888.

See F. M. REDGRAVE, *Richard Redgrave, C.B., R.A.: A Memoir, compiled from his Diary*. London, 1891.

Redon, chief town of arrondissement, department of Ille-et-Vilaine, France, 40 miles south-south west of Rennes, on railway from Savenay to Landerneau, on the right bank of the Vilaine above the confluence of the Oust, and on the canal from Nantes to Brest. The church of St Sauveur, formerly abbatial, has a fine 14th-century belfry with spire, and a plain 14th-century square tower, with rounded angles. The choir, with deambulatory and radiating

chapels, forms one of the most remarkable ecclesiastical buildings of the 13th century in Brittany. One of the ancient tombs, partly destroyed during the Revolution, is supposed to be that of Francis I. The abbey has been converted into an ecclesiastical college. Some 16th-century timbered houses have interesting carvings. French emery is manufactured on an extensive scale, and plate powder, coal-tar, agricultural implements, and tanning represent other branches of industry. The port is accessible, at high tides, for vessels of 600 to 700 tons, and a line of railway connects the quays with the station. The port traffic, exclusive of coasting, amounted in 1900 to 12,529 tons, of which 12,147 tons were carried in British vessels. Including coasting trade, the total movement was 18,295 tons. Population (1886), 4847; (1896), 5599.

Redonda. See ANTIGUA.

Redondela, a town of Spain, province of Pontevedra, to the north-east of Vigo, in a bend of the estuary of that name; it is a station on the Orense Vigo and Pontevedra lines. Population, 11,399 in 1887 and 10,966 in 1897. The river is only accessible for small coasting vessels. The town has a fine square, regular clean streets, markets, a casino, convents, and interesting parish church. The railway viaducts are fine structures, running actually over the town. In the neighbourhood are ruins of several feudal castles, and the fine hall of Marquess Vega de Armijo.

Redruth, a market-town and urban district, Cornwall, England, in the Camborne parliamentary division, about 9 miles west of Truro by rail. This is the chief mining town of the county, and the bulk of its population is engaged in the tin mines or at the numerous tin-streaming works. Among modern public buildings are a mining exchange (1880), science and art school (1883), Liberal hall (1886), and Primitive Methodist chapel (1888). In 1895 Mr Passmore Edwards erected a public free library, at a cost of £2000. Population of the urban district (1881), 9335; (1901), 10,451.

Red Sea.—The Red Sea is a narrow strip of water extending south-south-east from Suez to the Strait of Bab-el-Mandeb in a nearly straight line, and separating the coasts of Arabia from those of Egypt, Nubia, and Abyssinia. Its total length is about 1200 miles, and its breadth varies from about 250 miles in the southern half to 130 miles in 27° 45′ N., where it divides into two parts, the Gulf of Suez and the Gulf of Akaba, separated from each other by the peninsula of Sinai.

Depths.

The Gulf of Suez is shallow, and slopes regularly down to the northern extremity of the Red Sea basin, which has a maximum depth of 640 fathoms, and then over a shoal of 60 fathoms goes down to 1200 fathoms in 22° 7′ N. The Gulf of Akaba is separated from the Red Sea by a submarine bank only 70 fathoms from the surface, and in 28° 39′ N. and 34° 43′ E. it attains the considerable depth of 700 fathoms. South of the 1200-fathom depression a ridge rises to 500 fathoms in the latitude of Jedda, and south of this again a similar depression goes down to 1190 fathoms. Throughout this northern part, *i.e.*, to the banks of Suakin and Farisan in 20° N., the 100-fathom line keeps to a belt of coral reef close inshore, but in lower latitudes the shallow coral region, 300 miles long and 70 to 80 miles across, extends farther and farther seaward, until in the latitude of Hodeida the deep channel (marked by the 100-fathom line) is only 20 miles broad, all the rest of the area being dangerous to navigation, even for small vessels. In the middle of the gradually narrowing channel three depressions are known to exist; soundings in two of these are: 1110 fathoms in 20° N. and 890 fathoms in 16° N., a little to the north of Massawa. To the north-west of the volcanic island of Zebayir the depth is less than 500 fathoms; the bottom of the channel rises to the 100-fathom line at Hanish Island (also volcanic), then shoals to 45 fathoms, and sinks again in about the latitude of Mocha in a narrow channel which curves westward round the island of Perim (depth 170 fathoms), to lose itself in the Indian Ocean. This western channel is 16 miles wide in the Strait of Bab-el-Mandeb; the eastern channel of the strait is 2 miles broad and 16 fathoms deep.

Area, volume, and mean depth.

Murray estimates the total area at 158,750 square miles, and its volume at 67,700 cubic miles, giving a mean depth of 375 fathoms. Karstens gives the area at 448,810 square kilometres (130,424 square geographical miles) and the volume at 206,901 cubic kilometres (32,413 cubic geographical miles), which gives a mean depth of 252 fathoms. Both these computations, however, were made before the date of the Austrian exploring expeditions (1896–98). Bludau's measurements give the total area draining to the Red Sea at about 255,000 square geographical miles.

Formation.

The Red Sea is formed by a line of fracture, probably dating from Pliocene times, crossing the centre of a dome of Archæan rocks, on both flanks of which, in Egypt and Arabia, rest Secondary and Tertiary deposits. The granite rocks forming the core of the dome appear at the surface on the Red Sea coast, at the western end of the transverse line of heights crossing El Nejed (see ARABIA). Along the line of fracture traces of volcanic activity are frequent; a group of volcanic islands occurs in 14° N., and on Jebel Teir, farther north, a volcano has only recently become extinct. The margin of the Red Sea itself consists, on the Arabian side, of a strip of low plain backed by ranges of barren hills of coral and sand formation, and here and there by mountains of considerable height. The greater elevations are for the most part formed of limestones, except in the south, where they are largely volcanic. The coasts of the Gulf of Akaba are steep, with numerous coral reefs on both sides. On the African side there are in the north wide stretches of desert plain, which towards the south rise to elevated tablelands, and ultimately to the mountains of Abyssinia. The shores of the Red Sea are little indented; good harbours are almost wanting in the desert regions of the north, while in the south the chief inlets are at Massawa, and at Kamaran, almost directly opposite. Coral formations are abundant; immense reefs, both barrier and fringing, skirt both coasts, often enclosing wide channels between the reef and the land. The reefs on the eastern side are the more extensive; they occur in places as much as 25 miles from the land. It has long been known that the whole Red Sea area is undergoing gradual elevation, and much has been done in recent years in investigating the levels of raised beaches found in different localities, but our knowledge is not yet sufficiently complete to justify general statements as to the nature and progress of these movements.

Meteorology.

In the northern part, down to almost 19° N., the prevailing winds are north and north-west. The middle region, to 14°–16° N., has variable winds in an area of low barometric pressure, while in the southern Red Sea south-east and east winds prevail. From June to August the north-west wind blows over the entire area; in September it retreats again as far as 16° N., south of which the winds are for a time variable. In the Gulf of Suez the westerly, or "Egyptian," wind occurs frequently during winter, sometimes blowing with violence, and generally accompanied by fog and clouds of dust. Strong north-north-east winds prevail in the Gulf of Akaba during the greater part of the year; they are weakest in April and May, sometimes giving place at that season to southerly breezes. During fine weather and near the coasts, land and sea breezes are met with in all latitudes—in some places strongly developed. The high temperature and great relative humidity make the summer climate of the Red Sea one of the most disagreeable in the world.

Temperature.

The mean annual temperature of the surface waters near the head is 77° F.; it rises to 80° in about 22° N., to 84° in 16° N., and drops again to 82° at the Strait of Bab-el-Mandeb. Daily variations of temperature are observable to a depth of over 50 fathoms. Temperature is, on the whole, higher near the Arabian than the Egyptian side, but it everywhere diminishes with increase of depth and latitude, down to 380 fathoms from the surface; below this depth a uniform constant temperature of 70·7° F. is observed throughout. In the Gulf of Suez temperature is relatively low,

falling rapidly from south to north. The waters of the Gulf of Akaba are warmer towards the Arabian than the Sinai coasts; a uniform temperature of 70·2° is observed at all depths below 270 fathoms.

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Circulation.

The movements of the waters are of great irregularity and complexity, rendering navigation difficult and dangerous. Two features stand out with special distinctness: the exchange of water between the Red Sea and the Indian Ocean, and the tidal streams of the Gulf of Suez. From the observations of salinity it is inferred that a surface current flows inwards to the Red Sea in the eastern channel of the Strait of Bab-el-Mandeb, while a current of very salt water flows outward to the Indian Ocean, through the western channel, at a depth of 50 to 100 fathoms from the surface. In the Gulfs of Suez and Akaba, almost the only part of the Red Sea in which tidal phenomena are well developed, a sharply defined tidal circulation is found. Elsewhere the surface movements at least are controlled by the prevailing winds, which give rise in places to complex "transverse" currents, and near the coasts are modified by the channels enclosed by the coral reefs. During the prevalence of the north and north-west winds the surface level of the northern part of the Red Sea is depressed by as much as 2 feet. The great evaporation going on from the surface probably causes a slow vertical circulation in the depth, the salter colder waters sinking, and ultimately escaping to the Indian Ocean. Extensive collections of the deposits forming the bed were made by the expeditions of the Austrian ship *Pola* (1896 and 1898). These have been subjected to analysis by Dr K. Natterer, whose conclusions, however, have been disputed by a number of other investigators. The detailed reports on the zoological collections of the *Pola* expeditions have not yet been published, but their examination has already shown that certain well-defined districts are extremely rich in plankton, while others are correspondingly poor; and it appears that the latter occur in districts surrounded by currents of relatively low temperature, while the richer parts are where the movements of water are blocked by irregularities in the coast-line.

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Refrigerating and Ice-Making Machinery.—Refrigeration is the cooling of a body by the transfer of a portion of its heat to another and therefore a cooler body. For ordinary temperatures it is performed directly with water as the cooling agent, especially when well water, which usually has a temperature of from 52° to 55° Fahr., can be obtained. There are, however, an increasingly large number of cases in which temperatures below that of any available natural cooling agent are required, and in these it is necessary to resort to machines which are capable of producing the required cooling effect by taking in heat at low temperatures and rejecting it at temperatures somewhat above that of the natural cooling agent, which for obvious reasons is generally water. The function of a refrigerating machine, therefore, is to abstract heat at a low temperature and reject it at a higher one.

This involves the expenditure of a quantity of work W, the amount in any particular case being found by the equation $W = Q_2 - Q_1$, where W is the work, expressed by its equivalent in British thermal units; Q_2 the quantity of heat, also in B.T.U., given out at the higher temperature T_2; and Q_1 the heat taken in at the lower temperature T_1. It is evident that the discharged heat Q_2 is equal to the abstracted heat Q_1, plus the work expended, seeing that the work W, which causes the rise in temperature from T_1 to T_2, is the thermal equivalent of the energy actually expended in raising the temperature to the level at which it is rejected. The relation then between the work expended and the actual cooling work performed denotes the efficiency of the process, and this is expressed by $\frac{Q_1}{Q_2 - Q_1}$; but as in a perfect refrigerating machine it is understood that the whole of the heat Q_1 is taken in at the absolute temperature T_1, and the whole of the heat Q_2 is rejected at the absolute temperature T_2, the heat quantities are proportional to the temperatures, and the expression $\frac{T_1}{T_2 - T_1}$ gives the ideal coefficient of performance for any stated temperature range, whatever working substance is used. These coefficients for a number of cases met with in practice are given in the following table. They show

TABLE I.

T_1. Temperature at which Heat is extracted in Degrees Fahr.	T_2. Temperature at which Heat is rejected in Degrees Fahr.					
	50°.	60°.	70°.	80°.	90°.	100°.
−10°	7·5	6·4	5·6	5·0	4·5	4·1
0°	9·2	7·7	6·6	5·8	5·1	4·6
10°	11·7	9·4	7·8	6·7	5·9	5·2
20°	16·0	12·0	9·6	8·0	6·8	6·0
30°	24·5	16·3	12·2	9·8	8·2	7·0
40°	50·0	25·0	16·7	12·5	10·0	8·3

that in all cases the heat extracted exceeds by many times the heat expended. As an instance, when heat is taken in at 0° and

falling rapidly from south to north. The waters of the Gulf of Akaba are warmer towards the Arabian than the Sinai coasts; a uniform temperature of 70·2° is observed at all depths below 270 fathoms.

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Reformed Episcopal Church, The, a small community, with branches in the United States, Great Britain, and Canada, was established in 1873 by Dr Cummins, who had just resigned his office as assistant-bishop of Kentucky in the Protestant Episcopal Church in the United States. Dr Cummins (then canonically under suspension and unable to perform any episcopal act) consecrated a bishop to assist him, and through this succession the Reformed Episcopal Church claims to derive historically valid orders. Its supreme authority is vested in a General Synod, in which the laity are represented. Each congregation is self-governing. The distinguishing characteristics of the Church are indicated in its revised version of the English Prayer-Book, in which everything that might be construed as "sacerdotal" is eliminated. In Great Britain and Canada it is reported that there are 35 congregations, with 2200 communicants, and in the United States 92 congregations, with 9500 communicants.

Cf. ELDRIDGE, *Origin, Orders, Organization, and Worship of R.E.C.*, London. **Periodicals:** *Work and Worship*, London. *Evangelical Episcopalian* and *Episcopal Recorder*, U.S.A.

Refrigerating and Ice-Making Machinery.—Refrigeration is the cooling of a body by the transfer of a portion of its heat to another and therefore a cooler body. For ordinary temperatures it is performed directly with water as the cooling agent, especially when well water, which usually has a temperature of from 52° to 55° Fahr., can be obtained. There are, however, an increasingly large number of cases in which temperatures below that of any available natural cooling agent are required, and in these it is necessary to resort to machines which are capable of producing the required cooling effect by taking in heat at low temperatures and rejecting it at temperatures somewhat above that of the natural cooling agent, which for obvious reasons is generally water. The function of a refrigerating machine, therefore, is to abstract heat at a low temperature and reject it at a higher one.

This involves the expenditure of a quantity of work W, the amount in any particular case being found by the equation $W = Q_2 - Q_1$, where W is the work, expressed by its equivalent in British thermal units; Q_2 the quantity of heat, also in B.T.U., given out at the higher temperature T_2; and Q_1 the heat taken in at the lower temperature T_1. It is evident that the discharged heat Q_2 is equal to the abstracted heat Q_1, plus the work expended, seeing that the work W, which causes the rise in temperature from T_1 to T_2, is the thermal equivalent of the energy actually expended in raising the temperature to the level at which it is rejected. The relation then between the work expended and the actual cooling work performed denotes the efficiency of the process, and this is expressed by $\frac{Q_1}{Q_2 - Q_1}$; but as in a perfect refrigerating machine it is understood that the whole of the heat Q_1 is taken in at the absolute temperature T_1, and the whole of the heat Q_2 is rejected at the absolute temperature T_2, the heat quantities are proportional to the temperatures, and the expression $\frac{T_1}{T_2 - T_1}$ gives the ideal coefficient of performance for any stated temperature range, whatever working substance is used. These coefficients for a number of cases met with in practice are given in the following table. They show that in all cases the heat extracted exceeds by many times the heat expended. As an instance, when heat is taken in at 0° and

TABLE I.

T_1. Temperature at which Heat is extracted in Degrees Fahr.	T_2. Temperature at which Heat is rejected in Degrees Fahr.					
	50°.	60°.	70°.	80°.	90°.	100°.
−10°	7·5	6·4	5·6	5·0	4·5	4·1
0°	9·2	7·7	6·6	5·8	5·1	4·6
10°	11·7	9·4	7·8	6·7	5·9	5·2
20°	16·0	12·0	9·6	8·0	6·8	6·0
30°	24·5	16·3	12·2	9·8	8·2	7·0
40°	50·0	25·0	16·7	12·5	10·0	8·3

rejected at 70°, a perfect refrigerating machine would abstract 6·6 times as much heat as the equivalent of the energy to be applied. If, however, the heat is to be rejected at 100°, then the coefficient is reduced to 4·6.

By examining Table I. it will be seen how important it is to reduce the temperature range as much as possible, in order to obtain the most economical results. No actual refrigerating machine does, in fact, take in heat at the exact temperature of the body to be cooled and reject it at the exact temperature of the cooling water, but, for economy in working, it is of great importance that the differences should be as small as possible.

There are two distinct classes of machines used for refrigerating and ice-making. In the first refrigeration is produced by the expansion of atmospheric air, and in the second by the evaporation of a more or less volatile liquid.

Compressed-air Machines.—A compressed-air refrigerating machine consists in its simplest form of three essential parts—a compressor, a compressed-air cooler, and an expansion cylinder. It is shown diagrammatically in Fig. 1 in connexion with a chamber which it is keeping cool. The compressor compresses air from the room, the work it expends

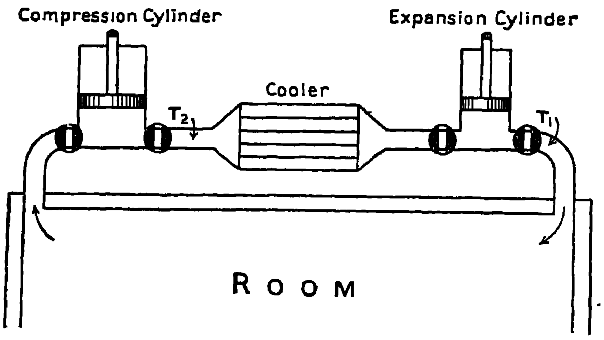


Fig. 1.—Compressed-Air Refrigerating Machine.

being converted into heat. The compressed air, leaving the compressor at the temperature T_2, passes through the cooler, where it is cooled by means of water, and then is admitted to the expansion cylinder, where it is expanded, performing work on the piston, to atmospheric pressure. The heat equivalent of the mechanical work performed on the piston is abstracted from the air, which is discharged at the temperature T_1. This temperature T_1 is necessarily very much below the temperature to be maintained in the room, because the cooling effect is produced by transferring heat from the room or its contents to the air, which is thereby heated. The rise in temperature of the air in its passage through the room is, in fact, the measure of the cooling effect produced. If such a machine could be constructed with reasonable mechanical efficiency to compress the air to a temperature but slightly above that of the cooling water, and to expand the air to a temperature but slightly below that required to be maintained in the room, we should of course get a result approximating in efficiency somewhat nearly to the figures given in Table I. Unfortunately, however, such results cannot be obtained in practice, because the extreme lightness of the air and its very small heat capacity (which at constant pressure is ·2379) would necessitate the employment of a great volume, with extremely large and mechanically inefficient cylinders and apparatus. A pound of air, representing about 12 cubic feet, if raised 10° Fahr. will only take up about 2·4 B.T.U. Consequently to make such a machine mechanically successful a comparatively small weight of air must be used, and the temperature difference increased; in other words, the air is discharged at a temperature very much below that to be maintained in the room.

This theory of working is founded on the Carnot cycle for a perfect heat motor, a perfect refrigerating machine being simply a reversed heat motor. Another theory involves the use of the Stirling regenerator, which, as is well known, was proposed in connexion with the Stirling heat engine. The air machine invented by Dr A. Kirk in 1862, and described by him in a paper on the "Mechanical Production of Cold" (*Proc. Inst. C.E.* vol. xxxvii. 1874, p. 244), is simply a reversed Stirling air engine, the air working in a closed cycle instead of being actually discharged into the room to be cooled, as is the usual practice with ordinary compressed-air machines. Kirk's machine was used commercially with success on a fairly large scale, chiefly for ice-making, and it is recorded that it produced about 4 ℔ of ice for 1 ℔ of coal. In 1868 Mr J. Davy Postle read a paper before the Royal Society of Victoria, suggesting the conveyance of meat on board ship in a frozen state by means of refrigerated air, and in 1869 he showed by experiment how it could be done; but his apparatus was not commercially developed. In 1877 a compressed-air machine was designed by Mr J. J. Coleman of Glasgow, and in the early part of 1879 one of his machines was fitted on board the Anchor liner *Circassia*, which successfully brought a cargo of chilled beef from America—the first imported by the aid of refrigerating machinery, ice having been previously used. The first successful cargo of frozen mutton from Australia was also brought by a Bell-Coleman machine in 1879, and from this period the practical application of refrigerating machinery in this country received a great impetus. In the Bell-Coleman machine the air was cooled during compression by means of an injection of water, and further by being brought into contact with a shower of water. Another, perhaps the principal, feature was the interchanger, an apparatus whereby the compressed air was further cooled before expansion by means of the comparatively cold air from the room in its passage to the compressor, the same air being used over and over again. The object of this interchanger was not only to cool the compressed air before expansion, but to condense part of the moisture in it, so reducing the quantity of ice or snow produced during expansion. A full description of the machine may be found in a paper on "Air-Refrigerating Machinery" by Mr Coleman (*Proc. Inst. C.E.* vol. lxviii. 1882). At the present time the Bell-Coleman machine has practically ceased to exist. In such compressed-air machines as are now made there is no injection of water during compression, and the compressed air is cooled in a surface cooler, not by actual mixture with a shower of cold water. Further, though the interchanger is still used by some makers, it has been found by experience that, with properly constructed valves and passages in the expansion cylinder, there is no trouble from the formation of snow, when, as is the general practice, the same air is used over and over again, the compressor taking its supply from the insulated room or compartment. So far as the air discharged from the expansion cylinder is concerned, its humidity is precisely the same so long as its temperature and pressure are the same, inasmuch as when discharged from the expansion cylinder it is always in a saturated condition for that temperature and pressure. The manufacture of compressed-air machines has practically been confined to Great Britain.

In an actual machine the air is compressed to about 65 ℔ absolute, and its temperature is then about 300° Fahr. With cooling water at 60° and without an interchanger it will enter the expansion cylinder at about 70°, and after expansion will be cooled to about 70° below zero. The power given off in expansion is utilized for driving the compressor, the balance over and above that restored in expansion being applied either by a steam engine coupled to the machine or by some other source of power. With such a machine the ideal coefficient of performance is about 1, but the actual coefficient will be about $\frac{6}{10}$, after allowing for the losses incidental to working. Moisture, from which atmospheric air is never free, exercises an important effect in the working of

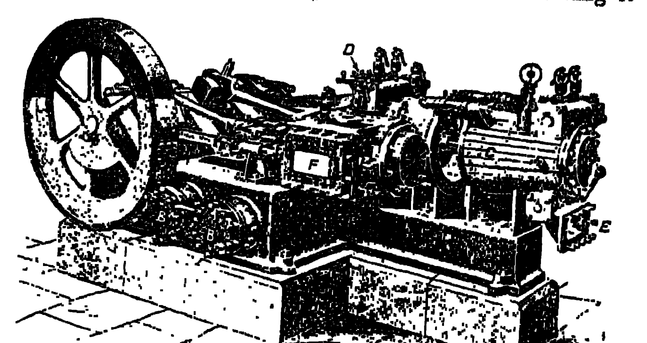


Fig. 2.—Compressed-Air Refrigerating Machine.

compressed-air machines. Even when the same air is used over and over again, moisture is abstracted from the cold room and its

contents, and the bulk of this must be got rid of in the machines, either in the form of water or of ice. A steam-driven compressed-air machine in a simple form is shown in Fig. 2. It consists of a compressor A, air coolers BB, an expansion cylinder C, and a steam engine F. Air, drawn into the compressor at D, is compressed to about 50 ℔ per square inch above the atmosphere, and then passed through the coolers BB, which are constructed like the surface condenser of a steam engine, the cooling water being pumped through the tubes and the air being on the outside. In the coolers it loses a portion of its moisture, which is condensed and runs off as water, and it then passes into the expansion cylinder C, where it is cut off at about one-third of the stroke and expanded behind a piston, thus giving back a portion of the power expended in compression. The thermal equivalent of the power given off on the piston, less an allowance for losses, is taken from the air, and the cold expanded air is discharged at E, to be utilized in the desired manner. The difference between the power expended in compression and that restored in expansion, plus the friction of the machine, is supplied by means of the steam engine F coupled to the crank-shaft. In the figure the expansion cylinder is placed tandem to the compressor, the two pistons being on the same rod. For marine purposes two complete machines are mounted on one bed-plate, the machines either being worked together, or in case of accident to one, separately. They are also made without a steam engine, the power being applied by means of a belt.

Liquid Machines.—Machines of the second class may conveniently be divided into three types:—(*a*) Those in which there is no recovery of the refrigerating agent, water being the agent employed; they will be dealt with as "Vacuum machines." (*b*) Those in which the agent is recovered by means of mechanical compression; they are termed "Compression machines." (*c*) Those in which the agent is recovered by means of absorption by a liquid; they are known as "Absorption machines."

Vacuum machines.

In the first class, since the refrigerating liquid is itself rejected, the only agent cheap enough to be employed is water. The boiling point of water varies with pressure; thus at one atmosphere or 14·7 ℔ per square inch it is 212° Fahr., whereas at a pressure of ·085 ℔ per square inch it is 32°, and at lower pressures there is a still farther fall in temperature. This property is made use of in vacuum machines. Water at ordinary temperature, say 60°, is placed in an air-tight glass or insulated vessel, and when the pressure is reduced by means of a vacuum pump it begins to boil, the heat necessary for evaporation being taken from the water itself. The pressure being still farther reduced, the temperature is gradually lowered until the freezing point is reached and ice formed when about one-sixth of the original volume has been evaporated.

The earliest machine of this kind appears to have been made in 1755 by Dr Cullen, who produced the vacuum by means of a pump alone. In 1810 Leslie combined with the air pump a vessel containing strong sulphuric acid for absorbing the vapour from the air, and is said to have succeeded in producing 1 to 1½ ℔ of ice in a single operation. Carré later adopted the same principle. In 1878 Windhausen patented a vacuum machine for producing ice in large quantities, and in 1881 one of these machines, said to be capable of making about 12 tons of ice per day, was put to work in London. The installation was fully described by Carl Pieper (*Trans. Soc. of Engineers*, 1882, p. 145) and by Dr John Hopkinson (*Journal of Soc. of Arts*, 1882, vol. xxxi. p. 20). The process, however, not being successful from a commercial point of view, was abandoned. At the present time vacuum machines are only employed for domestic purposes. The hand apparatus invented by Mr Fleuss consists of a vacuum pump capable of reducing the air pressure to a fraction of a millimetre, the suction pipe of which is connected first with a vessel containing sulphuric acid, and second with the vessel containing the water to be frozen. Both these vessels are mounted on a rocking base, so that the acid can be thoroughly agitated while the machine is being worked. As soon as the pump has sufficiently exhausted the air from the vessel containing the water, vapour is rapidly given off and is absorbed by the acid until sufficient heat has been abstracted to bring about the desired reduction in temperature, the acid becoming heated by the absorption of water vapour, while the water freezes. The small Fleuss machine will produce about 1¼ ℔ of ice in one operation of 20 minutes. Iced water in a carafe for drinking purposes can be produced in about three minutes. The acid vessel holds 9 ℔ of acid, and nearly 3 ℔ of ice can be made for each 1 ℔ of acid before the acid has become too weak to do further duty. Another machine, which can be easily worked by a boy, will produce 20 to 30 ℔ of ice in one hour, and is perhaps the largest size practicable with this method of freezing. The temperature attainable depends on the strength and condition of the sulphuric acid; ordinarily it can be reduced to zero Fahr., and temperatures 20° lower have frequently been obtained.

Compression machines.

Though prior to 1834 several suggestions had been made with regard to the production of ice and the cooling of liquids by the evaporation of a more volatile liquid than water, the first machine actually constructed and put to work was made by John Hague in that year from the designs of Jacob Perkins (*Journal of Soc. of Arts*, 1882, vol. xxxi. p. 77). This machine, though never used commercially, is the parent of all modern compression machines. Perkins in his patent specification states that the volatile fluid is by preference ether. In 1856 and 1857 James Harrison of Geelong, Victoria, patented a machine embodying the same principle as that of Perkins, but worked out in a much more complete and practical manner. It is stated that these machines were first made in New South Wales in 1859, but the first Harrison machine adopted successfully for manufacturing purposes was applied in the year 1861 for cooling oil in order to extract the paraffin. In Harrison's machine the agent used was ether $(C_2H_5)_2O$. Improvements were made by Siebe and Company, of London, and a considerable number of ether machines both for ice-making and refrigerating purposes were supplied by that firm and others up to the year 1880. In 1870 the subject of refrigeration was investigated by Professor Carl Linde of Munich, who was the first to consider the question from a thermodynamic point of view. He dealt with the coefficient of performance as a common basis of comparison for all machines, and showed that the compression vapour machine more nearly reached the theoretic maximum than any other (*Bayerisches Industrie und Gewerbeblatt*, 1870 and 1871). Linde also examined the physical properties of various liquids, and after making trials with methylic ether in 1872, built his first ammonia compression machine in 1873. Since then the ammonia compression machine has been most widely adopted, though the carbonic acid machine, also compression, which was first made in 1880 from Linde's designs, has of late years been used to a considerable extent.

A diagram of a vapour compression machine is shown in Fig. 3. There are three principal parts, a refrigerator or evaporator, a compression pump, and a condenser. The refrigerator, which

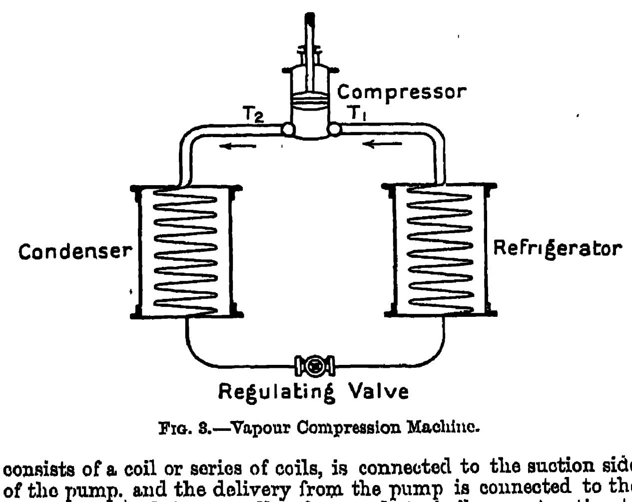


FIG. 3.—Vapour Compression Machine.

consists of a coil or series of coils, is connected to the suction side of the pump, and the delivery from the pump is connected to the condenser, which is generally of somewhat similar construction to

the refrigerator. The condenser and refrigerator are connected by a pipe in which is a valve named the regulator. Outside the refrigerator coils is the air, brine, or other substance to be cooled, and outside the condenser is the cooling medium, which, as previously stated, is generally water. The refrigerating liquid (ether, sulphur dioxide, anhydrous ammonia, or carbonic acid) passes from the bottom of the condenser through the regulating valve into the refrigerator in a continuous stream. The pressure in the refrigerator being reduced by the pump and maintained at such a degree as to give the required boiling point, which is of course always lower than the temperature outside the coils, heat passes from the substance outside, through the coil surfaces, and is taken up by the entering liquid, which is converted into vapour at the temperature T_1. The vapours thus generated are drawn into the pump, compressed, and discharged into the condenser at the temperature T_2, which is somewhat above that of the cooling water. Heat is transferred from the compressed vapour to the cooling water and the vapour is converted into a liquid, which collects at the bottom and returns by the regulating valve into the refrigerator. As heat is both taken in and discharged at constant temperature during the change in physical state of the agent, a vapour compression machine must approach the ideal much more nearly than a compressed-air machine, in which there is no change of state.

This will be seen by taking as an example a case in which the cold room is to be kept at 10° Fahr., the cooling water being at 60°. Under these conditions, the actual evaporating temperature T_1, in a well-constructed ammonia compression machine, after allowing for the differences necessary for the exchange of heat, would be about 5° below zero, and the discharge temperature T_2, would be about 70°. An ideal machine, working between 5° below zero and 70° above, has a coefficient of about 6·1, or more than 6 times that of an ideal compressed-air machine of usual construction to perform the same useful cooling work.

A vapour compression machine does not, however, work precisely in the reversed Carnot cycle, inasmuch as the fall in temperature between the condenser and the refrigerator is not produced, nor is it attempted to be produced, by the adiabatic expansion of the agent, but results from the evaporation of a portion of the liquid itself. In other words, the liquid refrigerating agent enters the refrigerator at the condenser temperature and introduces heat which has to be taken up by the evaporating liquid before any useful refrigerating effect can be performed. The extent of this loss is determined by the relation between the liquid heat and the latent heat of vaporization at the refrigerator temperature. If r represents the latent heat of the vapour, and q_2 and q_1 the amounts of heat contained in the liquid at the respective temperatures of T_2 and T_1, then the loss from the heat carried from the condenser into the refrigerator is shown by $\frac{q_2 - q_1}{r}$ and the useful refrigerating effect produced in the refrigerator is $r - (q_2 - q_1)$. Assuming, as in the previous example, that T_2 is 70° Fahr., and that T_1 is 5° below zero, the results for various refrigerating agents are as follows:—

TABLE II.

	Latent Heat. r	Liquid Heat. $q_2 - q_1$	Net Refrigeration. $r-(q_2-q_1)$	Proportion of Loss. $\frac{q_2-q_1}{r}$
Anhydrous ammonia	590·9	67·5	523·4	·110
Sulphurous acid .	173·1	27·3	145·8	·157
Carbonic acid . .	119·9	42·6	77·3	·351

The results show that the loss is least in the case of anhydrous ammonia and greatest in the case of carbonic acid. At higher condenser temperatures the results are even much more favourable to ammonia. As the critical temperature (88·4° Fahr.) of carbonic acid is approached the value of r becomes less and less and the refrigerating effect is much reduced. When the critical point is reached the value of r disappears altogether and a carbonic acid machine becomes dependent for its refrigerating effect on the reduction in temperature produced in the expansion of carbonic acid from the condenser pressure to that in the refrigerator. The abstraction of heat does not then take place at constant temperature. The vapour enters the refrigerator at a temperature much below that of the substance to be cooled, and whatever cooling effect is produced is brought about by the superheating of the vapour, the result being that above the critical point of carbonic acid the difference $T_2 - T_1$ is much increased and the efficiency of the machine is reduced. The critical temperature of anhydrous ammonia is about 266° Fahr., which is of course never approached in the ordinary working of refrigerating machines. Some of the principal physical properties of sulphurous acid, anhydrous ammonia, and carbonic acid are given in Tables III., IV., and V.

TABLE III.—*Ledoux's Table for Saturated Sulphur Dioxide Vapour* (SO_2).

t Temp. of Ebullition. Degs. Fahr.	Vapour-tension in Pounds per sq. in. Absolute.	q Heat of Liquid from 32° Fahr. B.T.U.	r Latent Heat of Evaporation. B.T.U.	u Volume of one Pound of Saturated Vapour. Cub. ft.
−22	5·546	−19·55	176·98	13·168
−13	7·252	−16·31	174·94	10·268
− 4	9·303	−13·05	172·91	8·122
5	11·803	− 9·79	170·82	6·504
14	14·789	− 6·85	168·75	5·254
23	18·544	− 3·26	166·63	4·293
32	22·468	0·00	164·47	3·540
41	27·445	3·27	162·39	2·931
50	33·275	6·55	160·24	2·451
59	39·958	9·83	158·08	2·066
68	47·637	13·10	155·89	1·746
77	56·311	16·38	153·67	1·490
86	66·407	19·69	151·49	1·266
95	77·641	22·99	149·27	1·089
104	90·297	26·28	147·02	0·913

TABLE IV.—*Mollier's Table for Saturated Anhydrous Ammonia Vapour* (NH_3).

t Temp. of Ebullition. Degs. Fahr.	Vapour-tension in Pounds per sq. in. Absolute.	q Heat of Liquid from 32° Fahr. B.T.U.	r Latent Heat of Evaporation. B.T.U.	u Volume of one Pound of Saturated Vapour. Cub. ft.
−40	10·238	−60·048	600·00	25·630
−31	13·324	−53·064	597·24	20·120
−22	16·920	−45·918	595·08	15·971
−13	21·472	−38·646	593·00	12·783
− 4	27·000	−31·212	590·00	10·316
5	33·701	−23·634	586·82	8·394
14	41·522	−15·894	581·00	6·888
23	50·908	− 8·028	576·00	5·703
32	61·857	0·000	571·00	4·742
41	74·513	8·172	562·50	3·973
50	89·159	16·506	555·48	3·364
59	105·939	24·966	550·00	2·851
68	124·994	33·528	541·00	2·435
77	146·908	42·354	531·00	2·098
86	170·782	51·282	523·00	1·810
95	197·800	60·336	512·50	1·570
104	227·662	69·552	501·50	1·361

TABLE V.—*Mollier's Table for Saturated Carbon Dioxide Vapour* (CO_2).

t Temp. of Ebullition. Degs. Fahr.	Vapour-tension in Pounds per sq. in. Absolute.	q Heat of Liquid from 32° Fahr. B.T.U.	r Latent Heat of Evaporation. B.T.U.	u Volume of one Pound of Saturated Vapour. Cub. ft.
−22	213·345	−24·80	126·72	·4165
−13	248·903	−21·06	123·25	·3508
− 4	288·727	−17·19	119·43	·2964
5	334·240	−13·17	115·25	·2515
14	385·443	− 9·00	110·65	·2114
23	440·913	− 4·63	105·53	·1778
32	503·497	0·00	99·81	·1490
41	573·187	4·93	93·35	·1233
50	649·991	10·28	85·93	·1025
59	733·906	16·22	77·40	·082
68	826·356	23·08	66·47	·0625
77	930·184	31·63	51·80	·0449
86	1039·701	45·45	27·00	·0208
87·8	1062·458	51·61	15·12	·0112
88·43	1070·991	59·24	0·00	0·00

The action of a vapour compression machine is shown in Fig. 4. Liquid at the condenser temperature being introduced into the refrigerator through the regulating valve, a small portion evaporates and reduces the remaining liquid to the temperature T_1. This is shown by the curve AB, and is the useless work represented by the expression $\frac{q_2 - q_1}{r}$. Evaporation then continues at the constant temperature T_1 abstracting heat from the substance outside the refrigerator as shown by the line BC. The vapour

is then compressed along the line CD to the temperature T_2, when, by the action of the cooling water in the condenser, heat is abstracted at constant temperature and the vapour condensed along the line DA. Fig. 5 shows a complete ammonia compression machine applied to the cooling of a liquid such as water or brine. B is the refrigerator, consisting of a series of iron or steel coils placed inside a tank containing the liquid to be cooled, the liquid ammonia being admitted to the coils through a regulating valve. The compressor D draws off the vapour through the pipe C and compresses into the condenser F, the compressed vapour first passing through vessel E to separate any oil that may be held in suspension by the ammonia. The condenser is constructed on the same lines as the refrigerator, the cooling water being contained in the tank. A pipe takes the liquid from the bottom of the condenser coil to the regulating valve. A steam engine placed alongside the compressor supplies the necessary driving power, but the compressor may be driven by a belt or in any other convenient manner. The condenser is often made up of a series of coils without a tank, the cooling water falling over the coils into a collecting tray below; and this form is perhaps the most convenient for ordinary use, as it affords great facilities for inspection and painting. A compression machine using carbonic acid may be constructed on precisely the same lines as an ammonia machine, due allowance being made for the increased working pressures. In

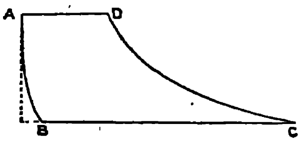


Fig. 4.—Action of Vapour Compression Machine.

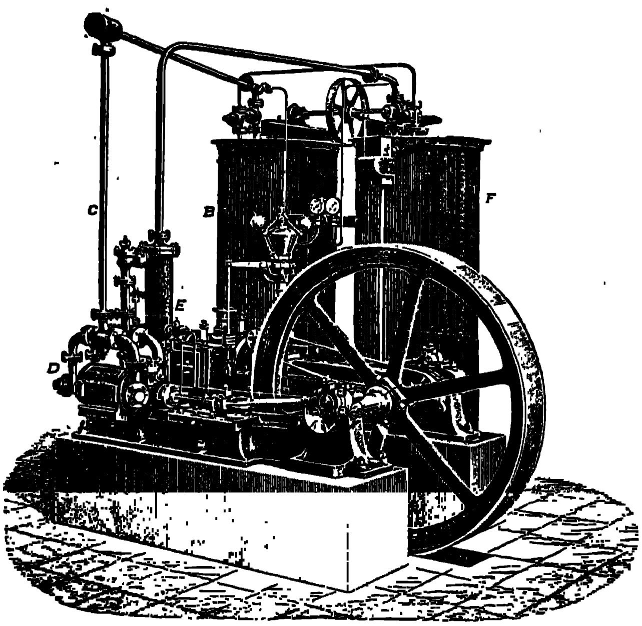


Fig. 5.—Ammonia Compression Machine.

the case of ammonia, copper and copper alloys must be avoided, though for carbonic acid they are not objectionable.

The compression of ammonia is sometimes carried out on what is known as the Linde or "wet" system, and sometimes on the "dry" system. When wet compression is used the regulating valve is opened to such an extent that a little more liquid is passed than can be evaporated in the refrigerator. This liquid enters the compressor with the vapour, and is evaporated there, the heat taken up preventing the rise in temperature during compression which would otherwise take place. The compressed vapour is discharged at a temperature but little above that of the cooling water. With dry compression, vapour alone is drawn into the compressor, and the temperature rises to as much as 180 or 200 degrees. Besides being more economical in working, wet compression possesses practical advantages in keeping the working parts of the compressor cool, and it also greatly facilitates the regulation of the liquid, to ensure the full duty of the machine being continuously performed. Some makers use a compression intermediate between the two systems. Very exact comparative trials have been made by Prof. Schroeter and others with compression machines using sulphur dioxide and ammonia. The results are published in *Vergleichende Versuche an Kältemaschinen*, by M. Schroeter, Munich, 1890, and in Nos. 32 and 51 of *Bayerisches Industrie und Gewerbeblatt*, 1892. Some of the results obtained by Prof. Schroeter in 1893 with an ordinary brine cooling machine on the Linde ammonia system are given in the following table.

Table VI.

Temperature reduction in refrigerator. Degs. Fahr.	42·8 to 37·4	28·4 to 23	14 to 8·6	−0·4to −5·8
I.H.P. in steam cylinder .	15·79	16·48	15·29	14·25
I.H.P. in compressor .	14·32	14·3	13·54	11·98
Pressure in refrigerator in pounds per sq. inch above atmosphere . .	45·2	32·6	19·8	9·9
Pressure in condenser in pounds per sq. inch above atmosphere . . .	116·0	115·0	110·0	108·0
Heat abstracted in refrigerator. B.T.U. per hr.	342192	263400	171545	121218
Heat rejected in condenser. B.T.U. per hour	377567	301200	214347	158594

The principle of the absorption process is chemical or physical rather than mechanical; it depends on the fact that many vapours of low boiling-point are readily absorbed in water, and can be separated again by the application of heat. In its simplest form an absorption machine consists of two iron vessels connected together by a bent pipe. One of these contains a mixture of ammonia and water, which on the application of heat gives off a mixed vapour containing a large proportion of ammonia, a liquid containing but little ammonia being left behind. In the second vessel, which is placed in cold water, the vapour rich in ammonia is condensed under pressure. To produce refrigeration the operation is reversed. On allowing the weak liquor to cool to normal temperature, it becomes greedy of ammonia (at 60° Fahr. at atmospheric pressure water will absorb about 760 times its own volume of ammonia vapour), and this produces an evaporation from the liquid in the vessel previously used as a condenser. This liquid, containing a large proportion of ammonia, gives off vapour at a low temperature and therefore becomes a refrigerator, abstracting heat from water or any surrounding body. When the ammonia is evaporated the operation as described must be again commenced. Such an apparatus is not much used now. Larger and more elaborate machines were made by Carré in France; but no very high degree of perfection was arrived at, owing to the impossibility of getting an anhydrous product of distillation. In 1867 Rees Reece, taking advantage of the fact that two vapours of different boiling-points, when mixed, can be separated by means of fractional condensation, brought out an absorption machine in which the distillate was very nearly anhydrous. By means of vessels termed the analyser and the rectifier, the bulk of the water was condensed at a comparatively high temperature and run back to the generator, while the ammonia passed into a condenser, and there assumed the liquid form under the pressure produced by the heat in the generator and the cooling action of water circulating outside the condenser tubes.

Absorption machines.

Fig. 6 is a diagram of an absorption apparatus. The ammonia vapour given off in the refrigerator is absorbed by a cold weak solution of ammonia and water in the absorber, and the strong liquor is pumped back into the generator through an interchanger through which also the weak hot liquor from the generator passes on its way to the absorber. In this way the strong liquor is heated before it enters the generator, and the weak liquor is cooled before it enters the absorber. The generator being heated by means of a steam coil, ammonia vapour is driven off at such a pressure as to cause its condensation in the condenser. From the condenser it passes into the refrigerator through a regulating valve in the usual manner. The process is continuous, and is identical with that of the compression machine, with the exception of the return from the temperature T_1 to the temperature T_2 which is brought about by the direct application of heat instead of by means of mechanical compression. With the same temperature range, however, the same amount of heat has to be acquired in both cases, though from the nature of the process the actual amount of heat demanded from the steam is much greater in the absorption system than in the compression. This is chiefly due to the fact that in the former the heat of vaporization acquired in the refrigerator is rejected in the absorber, so that the whole heat of vaporization has to be supplied

again by the steam in the generator. In the latter the vapour passes direct from the refrigerator to the pump, and power has to be expended merely in raising the temperature to a sufficient degree to enable condensation to occur at the temperature of the cooling water. On the other hand, a great advantage is gained in the absorption machine by using the direct heat of the steam, without first converting it into mechanical work, for in this way its

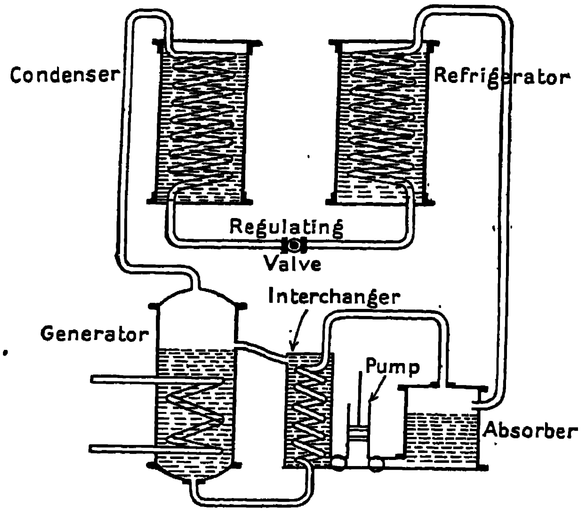


Fig. 6.—Absorption Apparatus.

latent heat of vaporization can be utilized by condensing the steam in the coils and letting it escape in the form of water. Each pound of steam can thus be made to give up some 950 units of heat; while in a steam engine only about 160 units are utilized in the steam cylinder per pound of steam, and in addition allowance has to be made for mechanical inefficiency. In the absorption machine the cooling water has to take up about twice as much heat as in the compression system, owing to the ammonia being

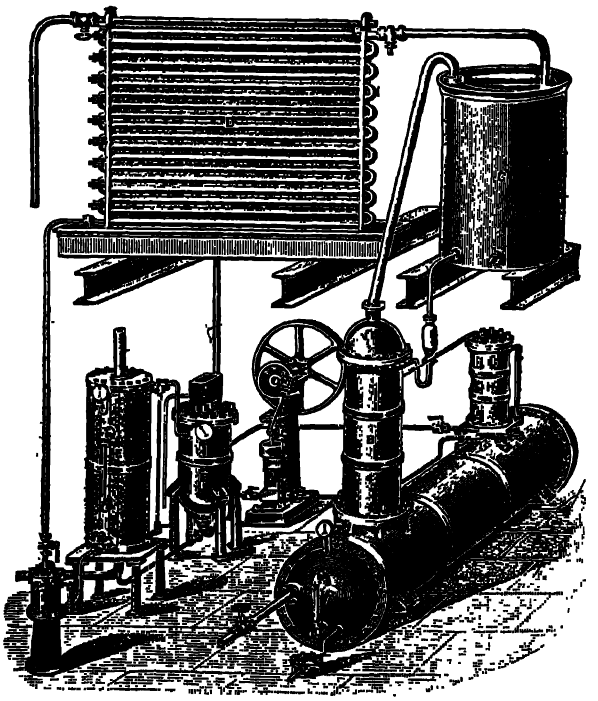


Fig. 7.—Modern Absorption Apparatus.

twice liquefied—namely, once in the absorber and once in the condenser. It is usual to pass the cooling water first through the condenser and then through the absorber.

The absorption machine is not so economical as the compression, but an actual comparison between the two systems is difficult to make. Information on this head is given in papers read by Dr Linde and by Professor Ewing before the Society of Arts (*Journal of the Society of Arts*, vol. xlii. 1894, p. 822, and Society of Arts 1897 Howard Lectures, January, February, and March 1897). The heat to be expended in the generator must at least equal the heat of absorption, plus the latent heat rejected in the condenser, plus the heat for superheating the vapours so as to give the pressure required for condensation. A modern absorption apparatus as applied to the cooling of liquids is shown in Fig. 7. A is the generator containing the coils, to which steam is supplied from an ordinary boiler not shown; B is the analyser; C, the rectifier; D, the condenser, which is shown of the open type; E, the refrigerator or cooler, in which the nearly anhydrous ammonia obtained in the condenser is allowed to evaporate; F, the absorber, through which weak liquor from the generator continually flows and absorbs the anhydrous vapour produced in the refrigerator; and G, the pump for forcing the strong liquor produced in the absorber back through the economizer, H, into the analyser, where, meeting with steam from the generator, the ammonia is again driven off, the process being thus carried on continuously. Sometimes an additional vessel is employed for heating the strong liquor by means of the exhaust steam from the engine driving the ammonia pump. Absorption machines are also made without a pump for returning the strong liquor to the generator. In these cases they work intermittently. In some machines the same vessel is used alternately as a generator and absorber, while in others, in order to minimize the loss of time, two vessels are provided which can be used alternately as generators and absorbers.

Applications.—Apart from the economical working of the machine itself, whatever system may be adopted, it is of importance that cold once produced should not be wasted, and it is therefore necessary to use some form of insulation to protect the vessels in which liquids are being cooled, or the rooms or ships' holds in which the freezing or storage processes are being carried on. Such insulation generally consists of materials such as charcoal, silicate cotton, granulated cork, small pumice, hair-felt, sawdust, &c., held between layers of wood or brick, and forming a more or less heat-tight box. There is no recognized standard of insulation. For a cold store to be erected inside a brick or stone building, and to be maintained at an internal temperature of from 18° to 20° Fahr., a usual plan is shown in Fig. 8. The same insulation is used for the floors and ceilings, except that the

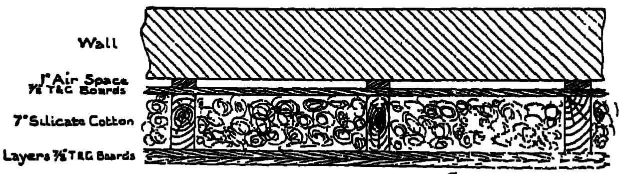


Fig. 8.—Insulation of a Cold Store.

wearing surface of the floor is generally made thicker than the inside lining of the sides. Should the walls or floor be damp, waterpoof paper is added. Granulated cork has practically the same insulating properties as silicate cotton, and the same thicknesses may be used. About 10 inches of flake charcoal and vegetable silica, or 11 of small pumice, are required to give the same protection as 7 inches of silicate cotton. In Germany cork bricks are largely used; these are made of granulated cork and some binding material, and they measure about 10 inches × 4⅞ × 2⅝ inches thick. For temperatures of about 35° Fahr. two courses of these bricks are laid against the wall of the building, and finished off on the inside with cement. For 20° three courses are used. The floors are similarly covered, and the bricks are protected by concrete or in some other manner according to the nature of the traffic on them. For lager-beer cellars and fermenting rooms, for bacon-curing cellars, and for similar purposes, brick walls with single or double air spaces are used, and sometimes a space filled with silicate cotton. In Australia and New Zealand pumice, which is found in enormous quantities in the latter country, takes the place of charcoal and silicate cotton. In Canada air spaces are largely used either alone or in combination

with silicate cotton or planer shavings. The air spaces, two or three in number, are formed between two layers of tongued and grooved wood, and the total thickness of the insulation is about the same as when silicate cotton alone is used. On board ship up to the present time charcoal has been almost entirely employed, but lately several vessels have been insulated with silicate cotton. The charcoal is either placed directly up to the skin of the vessel, and kept in place by a double lining of wood inside, in which case a thickness of about 10 inches is used, or it is placed between two layers of wood. With an air space, about 6 inches of flake charcoal is employed for the insulation of ships' holds, but for deck-houses and other parts exposed to the sun the thickness must be greater. A layer of sheet zinc or tin has frequently to be used as protection from rats. Given a certain allowable heat transmission, the principal points to be considered in connexion with insulation are, first cost, durability, weight, and space occupied, the two last named being specially important factors on board ship. No exact rules can be laid down, as the conditions vary so greatly; and though experiments have been made to determine the actual heat conduction of various materials per unit of surface, thickness, and temperature difference, the experience of actual practice is at present the only accepted guide.

Compressed-air machines discharge the cold air direct into the insulated room or hold, a snow box being generally provided close to the outlet of the expansion cylinder to catch the snow and congealed oil. The air is distributed by means of wood air trunks with openings controlled by slides, and similar trunks are provided in connexion with the suction of the compressor to conduct the air back to the machine. With machines of the compression and absorption system, the rooms are either cooled by means of cold pipes or surfaces placed in them, or by a circulation of air cooled in an apparatus separated from the rooms. The cold pipes may be direct-expansion pipes in which the liquid ammonia evaporates, or they may be pipes or walls through which circulates an uncongealable brine previously cooled to the desired temperature. The pipes are placed on the ceilings or walls, according to circumstances, but they must be arranged so as to induce a circulation of air throughout the compartment and ensure every part being cooled. With what is termed the air circulation system the air is generally circulated by means of a fan, being drawn from the rooms through ducts, passed over a cooler, and returned again to the rooms by other ducts. In some coolers the cooling surfaces consist of direct-expansion pipes placed in clusters of convenient form; in others brine pipes are used; in others there is a shower of cold brine, and in some cases combinations of cold pipes and brine showers. Whether pipes in the rooms or air circulation give the best results is to some extent a matter of opinion, but at the present time the tendency is decidedly in favour of air circulation, at any rate for general cold storage purposes. Whichever system be adopted, it is important for economical reasons that ample cooling surface be allowed, and that all surfaces be kept clean and active, to make the difference between the temperature of the evaporating liquid and the rooms as small as possible. Small surfaces reduce first cost, but involve higher working expenses by increasing the value of $\frac{T_1}{T_2 - T_1}$, and thus demanding more energy, and consequently more fuel to effect the given result than if larger surfaces were employed.

Liquids are generally cooled in a refrigerator similar to that shown in Fig. 5, entering the tank at the top and passing off at the bottom.

The general arrangement of an ice factory for producing can ice is shown in Fig. 9. The water to be frozen is contained in galvanized or terned steel moulds suspended in a tank filled to the proper level with brine maintained at the desired temperature. The moulds are frequently arranged in frames, so that by means of an overhead crane one complete row is lifted at a time. When the water is frozen the moulds are dipped in a tank containing warm water, and on being tipped the blocks of ice fall out. Ordinary water contains air, and ice made from it is generally opaque, due to the inclusion of numerous small air-bubbles. To produce clear ice the water must be agitated during the freezing process, or previously boiled to get rid of the air. Distilled water is frequently used, as well as the water produced by the condensation of the steam from the engine, which of course must be thoroughly purified and filtered. It should be noted, however, that with an ice-making plant of moderate size and a steam engine of good construction the weight of steam used will not nearly equal the weight of ice produced, so that the difference must be made up either by distillation, which is a costly process, or by ordinary water. Can ice is usually made in blocks weighing 56, 112, or 224 lb, and from 4 to 8 inches thick. For cell ice ordinary water is used, agitated during freezing. The cells are flat and constructed of galvanized iron, so as to form a hollow space of about 2 inches in width, through which cold brine is circulated by a pump. They are placed vertically in a tank, the distance between them being from 8 to 14 inches, according to the thickness of the ice to be produced. The tank is filled with water, which is kept in agitation by means of a reciprocating paddle or piston; in this way the air escapes, and with proper care a block of great transparency is produced. To thaw it off warm brine is circulated through the cells. A usual size for cell ice is 4 feet by 3 feet by

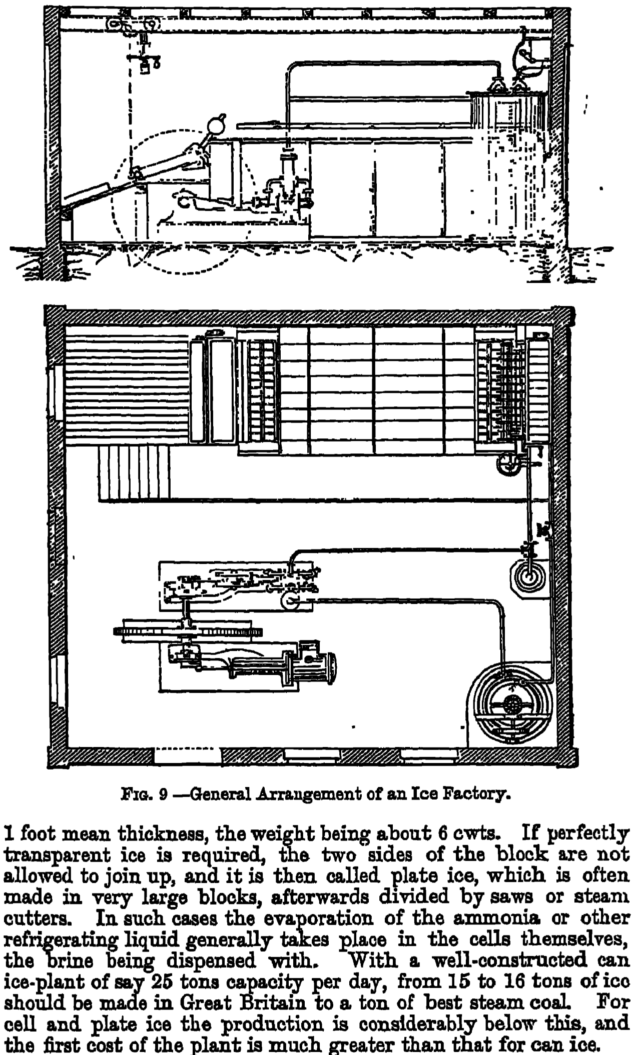


FIG. 9 —General Arrangement of an Ice Factory.

1 foot mean thickness, the weight being about 6 cwts. If perfectly transparent ice is required, the two sides of the block are not allowed to join up, and it is then called plate ice, which is often made in very large blocks, afterwards divided by saws or steam cutters. In such cases the evaporation of the ammonia or other refrigerating liquid generally takes place in the cells themselves, the brine being dispensed with. With a well-constructed can ice-plant of say 25 tons capacity per day, from 15 to 16 tons of ice should be made in Great Britain to a ton of best steam coal. For cell and plate ice the production is considerably below this, and the first cost of the plant is much greater than that for can ice.

Fig. 10 shows an arrangement of cold storage on land, refrigerated on the air circulation system. The insulated rooms, on two floors, are approached by corridors, so as to exclude external air, which if allowed to enter would deposit moisture upon the goods. The air cooler is placed at the end, and the air is distributed by means of wood ducts furnished with slides for regulating the temperature of the rooms which are insulated according to the method shown in Fig. 9. In some cases, instead of the entrance being at the sides or ends, it is at the top, all goods being raised to the top floor in lifts and lowered by lifts into the rooms. With good machinery the cost of raising is not great, and is probably equalled by the saving in refrigeration, since the rooms hold the heavy cold air as a glass holds water.

Large passenger vessels and yachts are now generally fitted with refrigerating machinery for preserving provisions, cooling water and wine, and making ice. Usually two insulated compartments are provided, one for frozen meats at about 20° Fahr., and one for vegetables, &c., at about 40°. They have a capacity of from 1500 to 3000 cubic feet, according to the number of passengers carried, and they are generally cooled by means of brine pipes, though direct expansion and air circulation are sometimes adopted. A passenger

vessel requires from 2 to 4 cwts. of ice per day. On battle-ships and cruisers the British Admiralty use small compressed-air machines for ice-making, the present standard being a production of 80 lb of ice per day, without provision rooms. A modern frozen meat carrying vessel will accommodate as much as 120,000 carcases, partly sheep and partly lambs, requiring a hold capacity of about 300,000 cubic feet. In some vessels both fore and aft holds and 'tween decks are insulated. Lloyd's Committee now issue certificates for refrigerating installations, if constructed according to their rules, and most modern cargo-carrying vessels have their refrigerating machinery classed at Lloyd's. In the meat trade between the River Plate, the United States, Canada, and

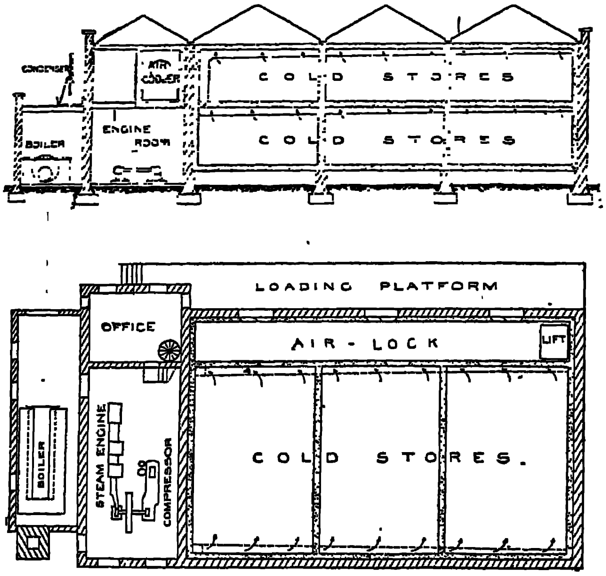


FIG. 10.—Cold Stores.

Great Britain, ammonia or carbonic acid machines are now exclusively used, but for the Australian and New Zealand frozen meat trade compressed-air machines are still to some extent adopted. The holds of meat-carrying vessels are refrigerated either by cold air circulation or by brine pipes.

Though the adoption of refrigerating and ice-making machinery for industrial purposes practically dates from the year 1880, the manufacture of these machines has already assumed very great proportions; indeed, in no branch of mechanical engineering, with the exception of electrical machinery, has there been so remarkable a development in recent years. The sphere of application is extending year by year. The cooling of residential and public buildings in hot countries is yet untouched, the manufacture of ice and the preservation of perishable foods (apart from the frozen meat trade) have in many countries hardly received serious consideration, while in breweries, dairies, margarine works, and many other industries there is a large and increasing field for refrigerating and ice-making machinery.

For further information reference may be made to the following: SIEBEL. *Compend. of Mechanical Refrigeration.* Chicago.—REDWOOD. *Theoretical and Practical Ammonia Refrigeration.* New York.—STEPHANSKY. *Practical Running of an Ice and Refrigerating Plant.* Boston.—LEDOUX. *Ice-Making Machines.* New York.—WALLIS-TAYLOR. *Refrigerating and Ice-Making Machines.* London.—RITCHIE LEASK. *Refrigerating Machinery.* London.—DE VOLSON WOOD. *Thermodynamics, Heat Motors and Refrigerating Machinery.* New York.—LINDE. *Kälteerzeugungsmaschine Lexikon der gesamten Technik.*—BEHREND. *Eis und Kälteerzeugungs Maschinen.* Halle.—DE MARCHENA. *Kompressions Kältemaschinen.* Halle.—HANS LORENZ. *Neuere Kühlmaschinen.* Munich.—THEODORE KOLLER. *Die Kälteindustrie,* Vienna.—VOORHEES. *Indicating the Refrigerating Machine.* Chicago.—NORMAN SELFE. *Machinery for Refrigeration.* Chicago. (T. B. L.)

Regeneration of Lost Parts.—A loss and renewal of living material, either continual or periodical, is a familiar occurrence in the tissues of higher animals. The surface of the human skin, the inner lining of the mouth and respiratory organs, the blood corpuscles, the ends of the nails, and many other portions of tissues are continuously being destroyed and replaced. The hair of many mammals, the feathers of birds, the epidermis of reptiles, and the horns of stags are shed and replaced periodically. In these normal cases the regeneration depends on the existence of special formative layers or groups of cells, and must be regarded in each case as a special adaptation, with individual limitations and peculiarities, rather than as a mere exhibition of the fundamental power of growth and reproduction displayed by living substance. Many tissues, even in the highest animals, are capable of replacing an abnormal loss of substance. Thus in mammals, portions of muscular tissue, of epithelium, of bone, and of nerve, after accidental destruction or removal, may be renewed. The characteristic feature of such cases appears to be, in the higher animals at any rate, that lost cells are replaced only from cells of the same morphological order—epiblastic cells from the epiblast, mesoblastic from the mesoblast, and so forth. The process is in direct relation to the general power of growth and reproduction possessed by protoplasm, and is regarded by pathologists as the consequence of "removal of resistances to growth." It is much less common in the tissues of higher plants, in which the adult cells have usually lost the power of reproduction, and in which the regeneration of lost parts is replaced by a very extended capacity for budding. Still, more complicated reproductions of lost parts occur in many cases, and are more difficult to understand.

Fraisse has shown that in Amphibia the entire epidermis, together with the slime-glands and the integumentary sense-organs, is regenerated by the epidermic cells in the vicinity of the defect. The whole limb of a Salamander or a Triton will grow again and again after amputation. Similar renewal is either rarer or more difficult in the case of Siren and Proteus. In frogs regeneration of amputated limbs does not take place. Chelonians, crocodiles, and snakes are unable to regenerate lost parts to any extent, while lizards and geckoes possess the capacity in a high degree. The capacity is absent almost completely in birds and mammals. In cœlenterates, worms, and tunicates the power is exhibited in a very varying extent. In Hydra, Nais, and Lumbriculus, after transverse section, each part may complete the whole animal. In most worms the greater, and in particular the anterior part, will grow a new posterior part, but the separated posterior portion dies. In Hydra, sagittal and horizontal amputations result in the completion of the separated parts. In worms such operations result in death, which no doubt may be a mere consequence of the more severe wound. Extremely interesting instances of regeneration are what are called "Heteromorphoses," where the removed part is replaced by a dissimilar structure. The tail of a lizard, grown after amputation, differs in structure from the normal tail: the spinal cord is replaced by an epithelial tube which gives off no nerves; the vertebræ are replaced by an unsegmented cartilaginous tube. Loeb produced many heteromorphoses on lower animals. He lopped off the polyp head and the pedal disc of a Tubularia, and supported the lopped stem in an inverted position in the sand; the original pedal end, now superior, gave rise to a new polyp head, while the neck-end, on regeneration, formed a pedal disc. In Cerianthus, a sea-anemone, and in Cione, an ascidian, regeneration after his operations resulted in the formation of new mouth-openings in abnormal places, surrounded by elaborate structures characteristic of normal mouths.

It appears that, in the same fashion as more simply organized animals display a capacity for reproduction of lost parts greater than that of higher animals, so embryos and embryonic structures generally have a higher power of renewal than that displayed by the corresponding adult organs or organisms. Moreover, experimental work on the young stages of organisms has revealed a very striking series of phenomena, similar to the heteromorphoses in adult tissues, but more extended in range. Driesch, O. Hertwig, and others, by separating the segmentation spheres, by destroying some of them, by compressing young embryos by glass plates, and by many other means, have caused cells to develop so as to give rise to structures which in normal development they would not have formed.

It is clear that there are at least three kinds of factors involved in regeneration, and that theoretical explanations must take into account, more definitely than has yet been done, these essential differences. There are: (1) Regenerations due to the presence of undifferentiated, or little differentiated, cells, which have retained the normal capacity

of multiplication when conditions are favourable. (2) Regenerations due to the presence of special complicated rudiments, the stimulus to the development of which is the removal of the fully-formed structure. (3) Regeneration involving the general capacity of protoplasm to respond to changes in the surroundings by changes of growth. The most general view is to regard regenerations as special adaptations; and Weismann, following in this matter Arnold Lang, has developed the idea at considerable length, and has found a place for regenerations in his system of the germ-plasm (see HEREDITY) by the conception of the existence of "accessory determinants." Hertwig, on the other hand, attaches great importance to the facts of regeneration as evidence for his view that every cell of a body contains a similar essential plasm. Our knowledge of the facts is not yet sufficiently systematic to allow of useful criticism of these opposing views. (P. C. M.)

Reggio di Calabria, a town and archiepiscopal see of Calabria, Italy, capital of the province of Reggio, stands at the south-west extremity of Italy, on the Straits of Messina, 7 miles south-south-east of Messina in Sicily, and 248 miles from Naples by rail. In 1894 the town suffered from an earthquake, though less severely than in 1783. It possesses an archæological museum, a school of the industrial arts, and statues to Garibaldi and Italy. Ancient Græco-Roman baths have been excavated near the shore. The port has been enlarged and improved since 1896, and a new town hall was built in 1897. The manufacture of bergamot and other essential oils, of olive oil, and of silk, with some printing, are the principal industries. In 1897 its port was cleared by 624 vessels of 433,349 tons. Population (1881), 35,437; (1901), 44,417.

Reggio nell' Emilia, a city and episcopal see of Emilia, Italy, capital of the province of the same name, 38 miles north-west of Bologna by rail. Its public buildings include the church of the Madonna della Ghiara (1597), a Renaissance structure with fine domes, built in the form of a Greek cross; an archæological museum; and an industrial institute, a school of design, and a specialized school of agriculture (1879). Its industries embrace the making of cheese, objects in cement, matches, and brushes, the production of silkworms, and printing. Population (1881), 18,634; (1901), 59,176.

Regina, a town and port of entry of Assiniboia, Canada, and the capital of the North-West Territories, is situated 357 miles (by rail) west of Winnipeg, on Wascana creek and the Canadian Pacific Railway, in 104° 36′ W. and 50° 27′ N., at an altitude of 1885 feet above the sea. It contains the Government buildings and headquarters of the Indian Department and of the North-West Mounted Police. Population (1901), 2645.

Registration of Voters.—Registration was not altogether unknown in Great Britain in connexion with the parliamentary franchise before the Reform Acts of 1832. Thus in the Scottish counties the right to vote depended on the voter's name being upon the roll of freeholders established by an Act of Charles II.; a similar register existed in Ireland of freeholders whose freeholds were under £20 annual value; and in the Universities of Oxford and Cambridge the rolls of members of Convocation and of the Senate were, as they still are, the registers of parliamentary voters. But except in such cases as the above, the right of a voter had to be determined by the returning officer upon the evidence produced before him when the vote was tendered at a poll. This necessarily took time, and the result was that a contested election in a large constituency might last for weeks. The celebrated Westminster election of 1784, in which the poll began on the 1st of April and ended on the 17th of May, may be mentioned as an illustration. Moreover, the decision of the returning officer was not conclusive; the title of every one who claimed to vote was liable to be reconsidered on an election petition, or, in the case of a rejected vote, in an action for damages by the voter against the returning officer. The inconvenience of such a state of things would have been greatly aggravated had the old practice continued after the enlargement of the franchise in 1832. The establishment of a general system of registration was therefore a necessary and important part of the reform then effected. It has enabled an election in the most populous constituency to be completed in a single day. It has also been instrumental in the extinction of the "occasional voter," who formerly gave so much trouble to returning officers and election committees—the person, namely, who acquired a qualifying tenement with the view of using it for a particular election and then disposing of it. The period of qualification now required in all cases, being fixed with reference to the formation of the register, is necessarily so long anterior to any election which it could affect, that the purpose or intention of the voter in acquiring the qualifying tenement has ceased to be material, and is not investigated.

England.—The reform of parliamentary representation in 1832 was followed in 1835 by that of the constitution of municipal corporations, which included the creation of a uniform qualification (now known as the old burgess qualification) for the municipal franchise. In 1888 the municipal franchise was enlarged, and was at the same time extended to the whole country for the formation of constituencies to elect county councils; and in 1894 parochial electors were called into existence for the election of parish councils and for other purposes. Inasmuch as provision was made for the registering of persons entitled to votes for the above purposes, there are now three registers of voters, namely, the parliamentary register, the local government register (*i.e.*, in boroughs under the Municipal Corporation Acts, the burgess rolls, and elsewhere the county registers), and the register of parochial electors. Under the Municipal Corporations Act, 1835, the registration of burgesses, though on similar lines to that of parliamentary voters, was entirely separate from it. Since, however, the qualification for the municipal franchise covered to a great extent the same ground as that for the parliamentary franchise in boroughs which sent members to Parliament, a considerable number of voters in such boroughs were entitled in respect of the same tenement to be upon both parliamentary register and burgess roll. The waste of labour involved in settling their rights twice over was put an end to in 1878, when the system of parliamentary registration was extended to the boroughs in question for municipal purposes, and the lists were directed to be made out in such a shape that the portion common to the two registers could be detached and combined with the portion peculiar to each, so as to form the parliamentary register and the burgess roll respectively. This system of registration was extended to the non-parliamentary boroughs and to the whole country in 1888, the separate municipal registration being completely abolished.

Procedure.

The procedure of parliamentary registration is to be found in its main lines in the Parliamentary Registration Act, 1843, which superseded that provided by the Reform Act of 1832, and has itself been considerably amended by later legislation. The Acts applying and adapting the system to local government and parochial registration are the Parliamentary and Municipal Registration Act, 1878, the County Electors Act, 1888, and the Local Government Act, 1894. Registration is carried out by local machinery, the common-law parish being taken

as the registration unit; and the work of preparing and publishing the lists, which when revised are to form the register, is committed to the overseers. The selection of these officers was no doubt due to their position as the rating authority, and to their consequent opportunities for knowing the ownership and occupation of tenements within their parish. They do not always perform the duties themselves, other persons being empowered to act for them in many parishes by general or local Acts of Parliament; but in all or almost all cases they are entitled to act personally if they think fit, they sign the lists, and the proceedings are conducted in their name.

In order to render intelligible the following summary of the procedure, it will be necessary to divide the voters to be registered into classes based on the nature of their qualification, since the practice differs in regard to each class. The classes are as follows:—(1) Owners, including the old forty-shilling freeholders, and the copyholders, long leaseholders, and others entitled under the Reform Act of 1832 to vote at parliamentary elections for counties; (2) occupiers, including those entitled to (*a*) the £10 occupation qualification, (*b*) the household qualification, and (*c*) the old burgess qualification; (3) lodgers, subdivided into (*a*) old, *i.e.*, those on the previous register for the same lodgings, and (*b*) new; (4) those entitled to reserved rights, *i.e.*, in addition to those (if any still remain) who were entitled to votes before the Reform Act of 1832 in respect of qualifications abolished by that Act, (*a*) freehold and burgage tenants in Bristol, Exeter, Norwich, and Nottingham, and (*b*) liverymen of the City of London and freemen of certain old cities and boroughs, whose right to the parliamentary franchise was permanently retained by the same Act. In regard to these classes it may be said that the general scheme is that owners must make a claim in the first instance before they can get their names upon the register, but that, once entered on the register, the names will be retained from year to year until removed by the revising barrister; that the lists of occupiers and of freehold and burgage tenants are made out afresh every year by the overseers from their own information and inquiries, without any act being required on the part of the voters, who need only make claims in case their names are omitted; that lodgers must make claims every year; and that liverymen and freemen are in the same position as occupiers, except that the lists of liverymen are made out by the clerks of the several companies, and those of freemen by the town clerks, the overseers having nothing to do with these voters, whose qualifications are personal and not locally connected with any parish.

The overseers and other officers concerned are required to perform their duties in connexion with registration in accordance with the instructions and precepts, and to use the notices and forms prescribed by Order in Council from time to time. The Order at present in force is the Registration Order, 1895. It directs the clerk of every county council, on or within seven days before the 15th of April in every year, to send to the overseers of each parish in his county a precept with regard to the registration of ownership electors, and to every parish not within a parliamentary or municipal borough a precept with regard to the registration of occupation electors (which expression for this purpose includes lodgers as well as occupiers proper). The town clerk of every borough, municipal or parliamentary, is to send to the overseers of every parish in his borough a precept with regard to the registration of occupation electors. These precepts are set out in the Registration Order, and those issued by the town clerks differ according as the borough is parliamentary only, or municipal only, or both parliamentary and municipal; in the cases of Bristol, Exeter, Norwich, and Nottingham they contain directions as to freehold and burgage tenants. The duties of the overseers in regard to registration are set out in detail in the precepts. Along with the precepts are forwarded forms of the various lists and notices required to be used, and with the ownership precept a certain number of copies of that portion of the parliamentary register of the county at the time in force which contains the ownership voters for the parish, the register being so printed that the portion relating to each parish can be detached. It is the duty of the overseers to publish on the 20th of June, in manner hereinafter described, the portion of the register so received, together with a notice to owners not already registered to send in claims by the 20th of July. Meanwhile the overseers are making the inquiries necessary for the preparation of the occupier list. For this purpose they may require returns to be furnished by owners of houses let out in separate tenements, and by employers who have servants entitled to the service franchise. The registrars of births, deaths, and marriages are required to furnish the overseers with returns of deaths, and the assessed tax collectors with returns of defaulters; the relieving officers are to give information as to recipients of parochial relief. On or before the 31st of July the overseers are to make out and sign the lists of voters. These are the following: the list of ownership electors, consisting of the portion of the register previously published with a supplemental list of those who have sent in claims by the 20th of July; the occupier list; and the old lodger list, the last being formed from claims sent in by the 25th of July. The overseers do not select the names in the first and last of these lists; they take them as supplied in the register and claims. It is, however, their duty to write "dead" or "objected" in the margin against the names of persons whom they have reason to believe to be dead or not entitled to vote in respect of the qualification described. The ownership and old lodger lists will be divided into two parts, if the register contains names of owners entitled to a parochial vote only, or if claims by owners or old lodgers have been made limited to that franchise. The occupier list contains the names of persons whom the overseers believe to be qualified, and no others, and therefore will be free from marginal objections. Except in the administrative county of London, it is made out in three divisions—division 1 giving the names of occupiers of property qualifying for both parliamentary and local government votes, divisions 2 and 3 those of occupiers of property qualifying only for parliamentary and only for local government votes respectively. It happens so frequently that a tenement, if not of sufficient value to qualify for the £10 occupation franchise (parliamentary and local government), qualifies both for the household franchise (parliamentary) and for the old burgess franchise (local government), that division 1 would in most cases be the whole list, but for two circumstances. The service franchise is a special modification of the household franchise only; and the service occupants, being therefore restricted to the parliamentary vote, form the bulk of division 2; while peers and women, being excluded from the parliamentary vote, are consequently relegated to division 3. In the administrative county of London the local government register, being coextensive with the register of parochial electors, includes the whole of the parliamentary register. The occupier lists are consequently there made out in two divisions only, the names which would elsewhere appear in division 2 being placed in division 1. The lists of freehold and burgage tenants in Bristol, Exeter, Norwich, and Nottingham are to be made out and signed by the same date. The overseers have also to make out and sign a list of persons qualified as occupiers to be elected aldermen or councillors, but as non-residents

disqualified from being on the local government register. By the same date also the clerks of the livery companies are to make out, sign, and deliver to the secondary (who performs in the City of London the registration duties which elsewhere fall on the town clerk) the lists of liverymen entitled as such to the parliamentary vote; and the town clerks are to make out and sign the lists of freemen so entitled in towns where this franchise exists.

On the 1st of August all the above lists are to be published, the livery lists by the secondary, lists of freemen by the town clerks, and the rest by the overseers. In addition the overseers may have to publish a list of persons disqualified by having been found guilty of corrupt or illegal practices; this list they will receive, when it exists, from the clerk of the county council or town clerk with the precept. Publication of lists and notices by overseers is made by affixing copies on the doors of the church and other places of worship of the parish (or, if there be none, in some public or conspicuous situation in the parish), and also, with the exception to be mentioned, in the case of a parish wholly or partly within a municipal borough or urban district, in or near every public or municipal or parochial office and every post and telegraph office in the parish. The exception is that lists and notices relating to ownership electors need not be published at the offices mentioned when the parish is within a parliamentary borough. Publication by the secondary is made by affixing copies outside the Guildhall and Royal Exchange; publication by town clerks is made by affixing copies outside their town hall, or, where there is none, in some public or conspicuous place in their borough. From the 1st to the 20th of August inclusive is allowed for the sending in of claims and objections. Those whose names have been omitted from the occupier or reserved rights lists, or the non-resident list, or whose names, place of abode, or particulars of qualification have been incorrectly stated in such lists, may send in claims to have their names registered; lodgers who are not qualified as old lodgers, or who have omitted to claim as such, may claim as new lodgers; persons whose names are on the corrupt and illegal practices list may claim to have them omitted. Any person whose name is on the list of parliamentary, local government, or parochial electors for the same parliamentary county, administrative county, borough, or parish, may object to names on the same lists. Notices of claim and objection in the case of liverymen and freemen are to be sent to the secondary and town clerk, and in other cases to the overseers; and notices of objection must also in all cases be sent to the person objected to. All notices must be sent in by the 20th of August, and on or before the 25th of August the overseers, secondary, and town clerks are to make out, sign, and publish lists of the claimants and persons objected to. It remains to be added that any person on a list of voters (*i.e.*, on one of the lists published on the 1st of August) may make a declaration before a magistrate or commissioner for oaths correcting the entry relating to him. In the case of ownership electors the correction can only deal with the place of abode; in the case of other lists it extends to all particulars stated, and is useful inasmuch as it enables the revising barrister to make corrections as to the qualification which he could not make in the absence of a declaration. The declarations must be delivered to the clerk of the county council or town clerk on or before the 5th of September.

The next stage is the revision of the lists. For this purpose revising barristers are appointed yearly, for the Middlesex circuit (which includes the whole of the old county of Middlesex and the City of London) by the Lord Chief-Justice, for the other counties and boroughs by the senior judge going the summer assize on the circuits to which they respectively belong. The period within which revision courts can be held is from the 8th of September to the 12th of October, both days inclusive. The clerk of the county council attends the first court held for each parliamentary division of his county, and the town clerk the first court held for his city or borough; and they are respectively to produce all lists, notices, and declarations in their custody, and to answer any questions put to them by the revising barrister. The overseers also attend the courts held for their parish, to produce the rate books, original notices of claim and objection, &c., and to answer questions. The claimants, objectors, and persons objected to appear personally or by representative to support their several contentions. Any person qualified to be an objector may also appear to oppose any claims, upon giving notice to the barrister before such claims are reached. The powers of the revising barrister are as follow:—As regards persons whose names are on the lists of voters published on the 1st of August, he is to expunge the names, whether objected to or not, of those who are dead or subject to personal incapacity, such as infants and aliens, and for parliamentary purposes peers and women; but this class of persons has been held not to include those incapacitated by receipt of parochial relief, whose names therefore cannot be expunged unless objected to. If an entry is imperfect, the name must be removed, unless the particulars necessary for completing it are supplied to the barrister. All names marginally objected to by overseers must be expunged, unless the voters prove to the barrister that they ought to be retained. Objections made by other objectors must be supported by *primâ facie* proof, and if this is not rebutted the name is struck out. Claimants (including owners and old lodgers who have duly claimed, but whose names for whatever cause have been omitted from the lists of voters published on the 1st of August) must be ready to support their claims. The declaration attached to a lodger claim is indeed *primâ facie* proof of the facts stated in it, but other claimants require evidence to make out even a *primâ facie* case, and if they fail to produce it their claims will be disallowed. The barrister is required to correct errors in the lists of voters, and has a discretion to rectify mistakes in claims and objections upon evidence produced to him. But his power in this respect is limited, and in particular he may not correct the description of qualification in a list of voters (except upon the evidence of a declaration made as above mentioned), or in a claim, so as to make it a different qualification from that stated in the list or claim. Lastly, the barrister has to deal with duplicates. A voter is entitled to be on the register once, but not more than once, as a parliamentary voter for each parliamentary county or borough, as a burgess for each municipal borough, as a county elector for each electoral division, and as a parochial elector for each parish in which he holds a qualification. But inasmuch as the overseers of a parish cannot say with certainty what entries relating to any person will appear on the lists of other parishes, nor which of them or of any duplicates on their own lists will be retained on revision, it is their duty to place each name on the lists where it would be if there were no duplicate, leaving it to the revising barrister to deal with the duplicate entries by expunging or transferring them to a separate parochial list, or, in the case of occupiers, to division 2 or 3 of the occupier list, as required. The revising barrister has also, as regards freemen in a divided parliamentary borough, to allot the non-residents equally as nearly as may be among the parliamentary divisions, the residents being placed on the

Revising barristers.

list of the division where they reside. The decision of the revising barrister is final and conclusive on all questions of fact; but an appeal lies from him on questions of law at the instance of any person aggrieved by the removal of his name from a list of voters, by the rejection of his claim or objection, or by the allowance of a claim which he has opposed. Notice of the intention to appeal must be given to the barrister in writing on the day when his decision is given. The barrister may refuse to state a case for appeal; but if he does so without due cause he may be ordered by the High Court to state a case. The appeal is heard by a Divisional Court, from whose decision an appeal lies (by leave either of the Divisional Court or of the Court of Appeal) to the Court of Appeal, whose decision is final.

On the completion of the revision the barrister hands the county and borough lists (every page signed and every alteration initialled by him) to the clerk of the county council and the town clerk respectively, to be printed. It is to be observed that the ownership list is a county list, whether the parish be within a borough or not, and will in all cases be handed to the clerk of the county council. With the following exceptions the revised lists are to be made up and printed by the 20th of December, and come into force as the register for all purposes on the 1st of January. In the boroughs created by the London Government Act, 1899, the whole register is to be made up and printed by the 20th of October, and to come into force for the purpose of borough elections under the Act on the 1st of November. In boroughs subject to the Municipal Corporations Acts, divisions 1 and 3 of the occupiers' list are to be made up and printed by the 20th of October, and come into force for the purpose of municipal and county council elections on the 1st of November. Corrections ordered in consequence of a successful appeal from a revising barrister are to be made by the officers having the custody of the registers, but a pending appeal does not affect any right of voting. The register in its final form will consist of the lists published on the 1st of August as corrected, with the claims which have been allowed on revision incorporated with them. It is printed in such form that each list and each division of a list for every parish can be separated from the rest for the purpose of making up the parliamentary, local government, and parochial registers respectively. The alphabetical order is followed, except in London and some other large towns, where street order is adopted for all except the ownership lists and lists of liverymen and freemen. The parliamentary register for a parliamentary county will consist of the ownership lists for all parishes in the county, and of the lodger lists and divisions 1 and 2 of the occupier lists for parishes within the county and not within a parliamentary borough. The parliamentary register for a parliamentary borough will consist of the lodger lists, of the lists of freehold and burgage tenants (if any), and of divisions 1 and 2 of the occupier lists for all parishes within the borough, and also of the borough lists (if any) of liverymen or freemen. The local government register for an administrative county will consist of divisions 1 and 3 of the occupier lists for all parishes in the county, and the burgess roll for a municipal borough of divisions 1 and 3 of the occupier lists for all parishes in the borough. It will be seen, therefore, that, except in county boroughs, the burgess roll is also a part of the local government register of the administrative county within which the borough is situate. The register of parochial electors consists of the complete set of lists for each parish; but this does not include the lists of liverymen and freemen, which, as has been stated, are not parish lists.

No one whose name is not on the register can vote at an election. The fact that a man's name is on the register is now so far conclusive of his right that the returning officer is bound to receive his vote. Only two questions may be asked of him when he tenders his vote, namely, whether he is the person whose name is on the register, and whether he has voted before at the election. The Reform Act, 1832, allowed him to be asked at parliamentary elections whether he retained the qualification for which he had been registered; but the Registration Act, 1843, disallowed the question, and made the register conclusive as to the retention of the qualification. When, however, a petition is presented against an election, the register, although conclusive as to the retention of the qualification, does not prevent the court from inquiring into the existence of personal incapacities, arising in connexion with the election or otherwise, and striking off on scrutiny the votes of persons subject thereto, *e.g.*, aliens, infants, or in parliamentary elections peers, &c. But this power has been held not to extend to the incapacity arising from receipt of parochial relief, which here, as before the revision court, enjoys an exceptional position.

The expenses incurred by the overseers in the performance of their registration duties are laid before the revising barrister, whose certificate of allowance signed in open court is final and conclusive. One-half of the amount certified to be due is to be paid out of the poor-rate of the parish; the other half in municipal boroughs out of the borough fund, and elsewhere out of the county fund. The expenses of the clerk of the county council, and the expenses of a town clerk in respect of an area not within a municipal borough, are to be laid before the county council, and the expenses of a town clerk in respect of an area within a municipal borough are to be laid before the town council. The amount allowed by the county council is to be paid out of the county fund; and of the amount allowed by the town council one-half is to be paid out of the borough fund, and one-half to be contributed by the several parishes of the borough out of their poor-rates. The fee of the revising barrister (which is to cover all his expenses) is paid by the Treasury; and one-half of the total amount so paid for each circuit is to be apportioned by a certificate of the Treasury among the counties and boroughs of the circuit, and repaid by them to the Exchequer.

The City of London is not within the Municipal Corporations Acts, and is not subject to the general registration law in the formation of its roll of citizens for municipal purposes. But a register of parliamentary, county, and parochial electors is made in the ordinary way. The universities are also exempt from the general law of registration. At Oxford and Cambridge the members of Convocation and the Senate respectively have always formed the parliamentary constituencies; and, as has been already stated, the registers of those members were before 1832, and still are, the parliamentary registers. Similarly, the Reform Act of 1867, which gave parliamentary representation to the University of London, simply enacted that the register of graduates constituting the Convocation should be the parliamentary register of that body.

Scotland.—In Scotland the qualifications for local government and parish electors are the same as those for parliamentary voters, the only difference in the registers being in respect of personal incapacities for the parliamentary franchise, incapacity for the other franchises by reason of non-payment of rates, and duplicates. The principal Act regulating registration in burghs is 19 and 20 Vict. c. 58, amended in some particulars as to dates by 31 and 32 Vict.

c. 48, § 20. County registration, formerly regulated by 24 and 25 Vict. c. 83, has been assimilated to burgh registration by 48 and 49 Vict. c. 3, § 8 (6). The procedure consists, as in England, of the making and publication of lists of voters, the making of claims and objections, and the holding of revision courts; but there are important differences of detail. Though the parish is the registration unit, parochial machinery is not used for the formation of the register. The parliamentary lists for a county are made up yearly by one or more of the assessors of the county, and those for a burgh by one or more of the assessors for the burgh, or by the clerk of the commissioners. They are published on the 15th of September; and claims and objections must be sent in by the 21st and are published on the 25th of the same month. Publication is made in burghs by posting on or near the town hall, or in some other conspicuous place, in counties by posting the part relating to each parish on the parish church door, and in both cases giving notice by newspaper advertisement of a place where the lists may be perused. The revision is conducted by the sheriff, the time within which his courts may be held being from the 25th of September to the 16th of October, both days inclusive. An appeal lies to three judges of the Court of Session, one taken from each division of the Inner House, and one from the Lords Ordinary of the Outer House. The revised lists are delivered in counties to the sheriff clerk, in burghs to the town clerk, or person to whom the registration duties of town clerk are assigned. The register comes into force for all purposes on the 1st of November.

The municipal register of a royal burgh which is coextensive, or of that part of a royal burgh which is coextensive with a parliamentary burgh, consists of the parliamentary register with a supplemental list of women who but for their sex would be qualified for the parliamentary vote. The municipal register for a burgh, or for that part of one which is not within a parliamentary burgh, consists of persons possessed of qualifications within the burgh which, if within a parliamentary burgh, would entitle them, or but for their sex would entitle them, to the parliamentary vote. The register of county electors consists of the parliamentary register for a county with the supplemental list hereafter mentioned; but inasmuch as exemption from or failure to pay the consolidated county rate is a disqualification for the county electors' franchise, the names of persons so disqualified are to be marked with a distinctive mark on the register; as are also the names of persons whose qualifications are situated within a burgh, such marks indicating that the persons to whose names they are attached are not entitled to vote as county electors. Every third year, in preparation for the triennial elections of county and parish councils (casual vacancies being filled up by co-optation), a supplemental list is to be made of peers and women possessed of qualifications which but for their rank and sex would entitle them to parliamentary votes. The register of county electors in a county and the municipal register in a burgh form the registers of parish electors for the parishes comprised in each respectively. Inasmuch, however, as a man is entitled to be registered as a parish elector in every parish where he is qualified, duplicate entries are, when required, to be made in the register, with distinctive marks to all but one, to indicate that they confer the parish vote only. These distinctive marks and those previously mentioned are to be made in the lists by the assessors, subject to revision by the sheriff. The register is conclusive to the same extent as in England, except that the vote of a parish elector who is one year in arrear in payment of a parish rate is not to be received. The clerk of the parish council is to furnish the returning officer one week before an election with the names of persons so in arrear; and the returning officer is to reject their votes except upon the production of a written receipt. The expenses of registration in counties are to be laid before the county councils; and the amount they allow in respect of the parliamentary register is paid out of the county rate, while the additional amount allowed in respect of the county register is paid by a rate levied on lands and heritages which are not within a burgh. In burghs the expenses are laid before the magistrates or commissioners; and the amount allowed is either apportioned by them among the parishes in proportion to their yearly rent or value, or otherwise levied by rate. Provision is made by 31 and 32 Vict. c. 48, §§ 27-41, for the formation of registers of parliamentary electors for the universities. The register for each university is to be made annually by the university registrar, with the assistance of two members of the council, from whose decisions an appeal lies to the university court.

Ireland.—There are no parish councils in Ireland, and no parochial electors. There are therefore but two registers of voters, the parliamentary and the local government registers, the latter of which consists of the former with a local government supplement containing the names of those excluded from the parliamentary register by reason of their being peers or women, and duplicate entries relating to those whose names are registered elsewhere for the same parliamentary constituency. The principal Acts regulating registration are 13 and 14 Vict. c. 69, 31 and 32 Vict. c. 112, 48 and 49 Vict. c. 17, and 61 and 62 Vict. c. 2. The Lord Lieutenant is empowered to make by Order in Council rules for registration, and to prescribe forms; and under this power has made the Registration (Ireland) Rules, 1899, now in force. The registration unit is not the parish, but the district electoral division, except where such division is subdivided into wards, or is partly within and partly without any town or ward of a borough or town, in which cases each ward of the division or part of a division is a separate registration unit.

The procedure is as follows, subject to variation in cases where there are clerks of unions who held office on the 31st of March 1898, and have not agreed to transfer their registration duties. The clerk of the peace sends out on the 1st of June a precept in the form prescribed for county registration to the secretary of the county council and clerks of urban district councils, together with a copy of the existing register for their county or district; and a precept in the form prescribed for borough registration to town clerks of boroughs. As regards registration units not in a parliamentary or municipal borough, the secretary of the county council or clerk of the urban district council is to put marginal objections, "dead" or "objected," where required, to £10 occupiers and householders in the copy of the register, both in the parliamentary list and in the local government supplement. He is also to make out supplemental parliamentary and local government lists of £10 occupiers and householders not on the existing register, and to put marginal objections where required to these. He is to verify on oath before a magistrate the copy of the register and supplemental lists, and to return them to the clerk of the peace by the 8th of July. As regards registration units in a parliamentary borough, but outside a municipal borough, the secretary of the county council or clerk of the urban district council is to make out lists of £10 occupiers and householders with local government supplement, and transmit them to the town clerk of the municipal borough or town. The clerk of the peace is to publish the copy of the register, after himself placing marginal objections where required to voters other than £10 occupiers and householders, and the supplemental lists as received, and also the corrupt and illegal

practices list, if any, on the 22nd of July. On the same day the town clerk will publish the lists received as aforesaid for registration units outside the municipal borough, and the lists, which he will have made out himself for the municipal borough, including the freemen's list and corrupt and illegal practices list. Freemen being entitled to the local government vote will, if resident, be placed on the list of the registration unit where they reside, and will, if non-resident, be allotted by the revising barrister among the registration units of the borough for local government purposes in proportion to the number of electors in each registration unit. Claims are to be sent in to the clerk of the peace and town clerk by the 4th of August, including old lodger claims and, in the case of the clerk of the peace, ownership claims. Lists of claimants with marginal objections, where required, are to be published by the clerk of the peace and town clerk by the 11th of August. Notices of objection to voters or claimants may be given by the 20th of August; and lists of persons objected to are to be published by the clerk of the peace and town clerk by the 24th of the same month. Publication of lists and notices by a clerk of the peace is made by posting copies of those relating to each registration unit outside every court-house, petty sessions court, and other public offices in the unit; publication by a town clerk is made by posting copies outside the town hall, or, if there be none, in some public and conspicuous place in the borough.

Revising barristers are specially appointed for the county and city of Dublin by the Lord Lieutenant; elsewhere the county court judges and chairmen of quarter sessions act as such *ex officio*, assisted, when necessary, by additional barristers appointed by the Lord Lieutenant. The time for the holding of revision courts is from the 8th of September to the 25th of October inclusive. An appeal lies to the Court of Appeal, whose decision is final. The revised lists are handed to the clerk of the peace; they are to be made up by him by the 31st of December, and come into force on the 1st of January. The registration expenses of the clerk of the peace are to be laid before the county council, and the amount allowed is to be levied from the county. The expenses of the town clerk are to be laid before the revising barrister; and the amount allowed by the barrister is to be laid before the county council, who may allow the whole or part of such amount, and levy the sum they allow from the county. In county boroughs the council of the borough acts in the place of the county council. The extra cost, if any, incurred by the Treasury in connexion with revision in consequence of the creation of the local government register, is to be certified by the Treasury, and repaid to the Exchequer by the county councils.

The registrar of the University of Dublin is to make out in December a list of the persons entitled to the parliamentary vote for the university, and to print the same in January, and to publish a copy in the university calendar, or in one or more public journals circulating in Ireland. He is to revise the list annually, and expunge the names of those dead or disqualified; but an elector whose name has been expunged because he was supposed to be dead is entitled, if alive, to have his name immediately restored and to vote at any election. (L. L. S.)

Regla, an important suburb of Havana, opposite the city, on the east side of the bay, where most of the sugar warehouses of the Havana trade are situated, and where outgoing ships are laden. The eastern railways have their termini here. Formerly it was the scene of the Havana bull-fights. The population in 1899 was 11,363.

Reichenbach, a town of Germany, 11 miles by rail south-west of the town and in the circle of Zwickau, kingdom of Saxony. There are a commercial and a weaving school, and a museum; the industries include woollen, cotton, bleaching, cloth-dressing, spinning, wool-carding, and wool-dressing mills, aggregating in all about 150 firms. Population (1885), 18,406; (1900), 24,498.

Reichenberg (Czech, *Liberec*), a town of Bohemia, Austria, near the Saxon and Prussian frontiers, and practically the capital of German Bohemia. After Prague, it is one of the largest and most important centres of trade and industry in the crownland, although within the last decade the population of Pilsen and Aussig show a more rapid increase. Population (1890), 30,890; (1900), 34,204, chiefly German and Catholic (estimated at 5 per cent. Czech, 4 per cent. Protestant, and 3 per cent. Jewish). The garrison has been increased to 1518 men. In 1890 the district within the jurisdiction of the Chamber of Commerce comprised over 370 factories for spinning and weaving of wool, cotton, and linen, besides carpet factories and establishments for the manufacture of carding and other machinery, beer, malt, liqueurs, hosiery, dyeing, &c. The industrial community, including a considerable section of the large manufacturers, has manifested strong German-Nationalist sentiment in the recent phases of the nationality strife in Austria.

Reid, Sir George (1841–——), Scottish artist, was born in Aberdeen. After the usual school education he developed an early passion for drawing, which led to his being apprenticed in 1854 for seven years to Messrs Keith and Gibb, lithographers in Aberdeen. In 1861 Reid took lessons from an itinerant portrait-painter, William Niddrie, who had been a pupil of James Giles, R.S.A., and afterwards entered as a student in the school of the Board of Trustees in Edinburgh. After the usual course of study Reid returned to Aberdeen, to paint landscapes and portraits for any trifling sum which his work could command, gradually gaining the notice of those who recognized his earnestness. The first portrait to attract attention, from its fine quality, was that of George Macdonald, the poet and novelist, now the property of the University of Aberdeen. His early landscapes were conscientiously painted in the open air and on the spot. But Reid soon came to see that such work was inherently false, painted as the picture was day after day under varying conditions of light and shade. Accordingly, in 1865 he proceeded to Utrecht to study under A. Mollinger, whose work he admired, from its unity and simplicity. This change in his method of viewing Nature was looked on as revolutionary by the Royal Scottish Academy, and for some years his work found little favour in that quarter; but other artists gradually adopted the system of tone-studies, which ultimately prevailed. Conscious of imperfect training in drawing, Reid went to Paris in 1868 to study under the accomplished figure-painter Yvon; and, still further to master the mysteries of his art, he worked in 1872 with his friend Josef Israëls at The Hague. From this time forward Reid's success was continuous and marked. He showed his versatility in landscape, as in his "Whins in Bloom," which combined great breadth with fine detail; in flower-pieces, such as his "Roses," which were brilliant in rapid suggestiveness and force; but most of all in his portraits, which are marked by great individuality, and by fine insight into character. His work in black-and-white, his admirable illustrations in brush-work of Edinburgh and its neighbourhood, and also his pen-drawings, about which it has been declared that "his work contains all the subtleties and refinements of a most delicate etching," must also be noted. Elected Associate of the Royal Scottish Academy in 1870, Reid attained the full membership in 1877, and took up his residence in

Edinburgh in 1882. In 1891 he was elected President, receiving also the honour of knighthood, and he was awarded a gold medal at the Paris Exhibition of 1900. For a specimen of his work, see PORTRAITURE.

Reigate, a municipal borough and market town of Surrey, England, in the Reigate parliamentary division, 23 miles south of London, with a station on the South-Eastern Railway. The Free Convalescent Home, removed from Bletchingly, was opened at South Park in 1880; and Brabazon Home, in connexion with the Girls' Friendly Society, in 1885. There is also a technical institute. Population (1881), 18,665; (1901), 25,993.

Reinecke, Carl Heinrich Carsten (1824–——), German composer and pianist, born at Altona, 23rd June 1824, came of musical stock, his father, Peter Reinecke (who was also his teacher), being an admirable musician. At the age of eleven he made his first appearance as pianist, and when scarcely eighteen he went a successful tour through Denmark and Sweden. After a stay in Leipzig, where he studied under Mendelssohn, in the recently founded Conservatorium, and Schumann, Reinecke went on tour with Königslöw and Wasielewski, Schumann's biographer, in North Germany and Denmark. From 1846 to 1848 Reinecke was court pianist to Christian VIII. of Denmark. After resigning this post he went first to Paris, and next to Cologne, as professor in the Conservatorium. From 1854 to 1859 he was music director at Barmen, in the latter year filling this post at Breslau University; in 1860 he became conductor of the famous Leipzig Gewandhaus, a post which (together with that of professor at the Conservatorium) he held with honour and distinction for thirty-five years. During this time Reinecke continually made concert tours to England and elsewhere. His pianoforte playing belonged to a school now almost extinct. Grace and neatness were its characteristics, and at one time Reinecke was probably unrivalled as a Mozart player and an accompanist. His compositions are as unimportant historically as Raff's, and even more numerous. His grand opera *König Manfred*, and the comic opera *Auf hohen Befehl*, were at one time frequently played in Germany; and his cantata *Hakon Jarl* is melodiously beautiful, as are many of his songs; while his Friedensfeier overture was once quite hackneyed. By far his most valuable works are those written for educational purposes. His sonatinas, his "Kindergarten," and much that he has ably edited, will continue to delight generations not yet born.

Reinkens, Joseph Hubert (1821–1896), Old Catholic bishop, was born at Burtscheid, near Aix-la-Chapelle. He was educated at the gymnasium at Aix, and afterwards studied theology at the universities of Bonn and Munich. He was ordained priest in 1848, and in 1849 graduated as doctor in theology with considerable *éclat*. He was soon appointed professor of ecclesiastical history at Breslau, by the influence of the Cardinal Archbishop Diepenbrock. In 1865 he was made rector of Breslau University. He wrote a number of treatises on various subjects during this period, the most noticeable among which were monographs on Clement of Alexandria, Hilary of Poitiers, and Martin of Tours. In consequence of an essay on art, especially in tragedy, after Aristotle, he was made doctor in philosophy in the University of Leipzig. When, in 1870, the question of Papal Infallibility was raised, Reinkens attached himself to the party opposed to the proclamation of the dogma. He had been confirmed in his Liberal sentiments by a visit he had recently paid to Rome. He threw himself vigorously into the controversy, and wrote several pamphlets on Church tradition relative to Infallibility, and on the procedure of the Council. When the dogma of Infallibility was proclaimed, Reinkens joined those who resolved to offer an organized resistance to the decree. The head of this band of influential theologians was Döllinger, and among them were von Schulte, Michelis, Friedrich, Knoodt, Langen, and Weber. Reinkens was one of those who signed the celebrated Declaration of Nuremberg in 1871. It was further resolved to appeal to other Episcopal bodies; and at the Bonn conferences with Orientals and Anglicans, organized by Döllinger in 1874 and 1875, Reinkens was a conspicuous figure. In the meantime the question had to be decided whether the Old Catholics should or should not definitely separate themselves from the Church of Rome. The bishops of the so-called Jansenist Church in Holland, which had existed independently of Rome for about two centuries, and possessed an incontestably canonical Episcopate, had promised to convey a valid succession according to the customs of the Western Church. Döllinger objected; and though he afterwards admitted that his objections were ill-founded, his dissent prevented all but a small band of eminent theologians and a few enthusiastic laymen from joining the new Church. It was nevertheless constituted, and Reinkens was chosen bishop of the Old Catholics in Germany at an enthusiastic meeting at Cologne in 1873. On the 11th August of the same year he was consecrated to the Episcopate by Dr Heykamp, bishop of Deventer, in Holland, Archbishop Loos of Utrecht, who had promised to consecrate the bishop if elected by the German Old Catholics, having been removed by death on the very day of Reinkens's election to the Episcopate. Reinkens devoted himself to his office of superintending the infant Church with the utmost solicitude, as the number of his *Hirtenbriefe* and the variety of their subjects prove. Nor did his activity as a theologian cease. He wrote a number of theological works after his consecration, but none of them so important as his treatise on Cyprian and the Unity of the Church, which he wrote in the year of his consecration. The chief act of his episcopal career was his consecration in 1876 of Dr Edward Herzog to preside as bishop over the Old Catholic Church in Switzerland. He would have performed the same office for the Old Catholics in Austria, but the Austrian Government interfered and refused its consent. In 1881 Reinkens visited England, and received Holy Communion more than once with bishops, clergy, and laity of the Church of England. Almost his last important public act was the publication, in conjunction with Professor Friedrich, of a defence of the validity of Anglican orders against his co-religionists, the Old Catholics of Holland, who had distributed an attack on their validity among the clergy and theologians present at the Old Catholic Congress at Rotterdam in 1894. Reinkens was gentle and inoffensive in disposition; and if he was unable to command much support for the Church over which he presided, he won for himself great respect and affection among the German people. This was manifested at his funeral, when a great and sympathetic crowd lined the streets through which the *cortège* had to pass, and wreaths from the sons of the German emperor were laid upon the coffin. He died at Bonn on 4th January 1896. (J. J. L*.)

Remedios, a large town of Santa Clara province, Cuba. The population in 1899 was 6633.

Remscheid, a town of Prussia, Rhine province, 6 miles by rail south from Barmen, a centre for the manufacture of cutlery and steel and iron wares. The municipal area was enlarged in 1893. Population (1885), 33,986; (1900), 58,108.

Renaix, a town of Belgium, in the province of East

Flanders, 25 miles south of Ghent, on a network of railways. It has dye-works, bleaching-fields, and manufactories for cotton and woollen goods. Population (communal) (1880), 14,370; (1900), 19,936.

Renan, Ernest (1823–1892), the celebrated French thinker and writer, was born on the 28th of February 1823 in the town of Tréguier, situated in the department of the Côtes-du-Nord, which occupies the north-west of the ancient province of Brittany. His father's people were of the fisher-clan of Renans or Ronans; his grandfather, having made a small fortune by his fishing smack, bought a house at Tréguier and settled there, and this man's son, captain of a small cutter and an ardent Republican, married the daughter of Royalist trading-folk from the neighbouring town of Lannion. All his life long Renan's mind was divided between his father's and his mother's political beliefs. His father died when the child was five years old. His sister Henriette, twelve years older than Ernest, a girl of remarkable character, was henceforth morally the head of the household. She determined to pay her father's debts, to help her mother, and to educate her little brother. Having in vain attempted to keep a school for girls at Tréguier, she left her native place and went to Paris as teacher in a young ladies' boarding-school. Ernest meanwhile was educated in the ecclesiastical seminary of his native place. His family still preserve his good-conduct notes for this period: "Docile, patient, diligent, painstaking, thorough," are adjectives which occur often. We do not hear that he was brilliant or clever, but then the priests cared little for such qualities; occasionally they complain that "Ernest Renan is inattentive during service in church." While the priests were grounding Renan in mathematics and Latin, and teaching him the value of disinterestedness and duty, his mother, with her fund of myth and local traditions, completed his education at home. Very early in life the future historian of religions learned how the unexplained becomes the supernatural in a rustic imagination, and how a fact becomes a faith. Madame Renan *mère*, a lively little gipsy of a woman, was only half a Breton. Her paternal ancestors came from Bordeaux, and Renan used to say that in his own nature the Gascon and the Breton were constantly at odds.

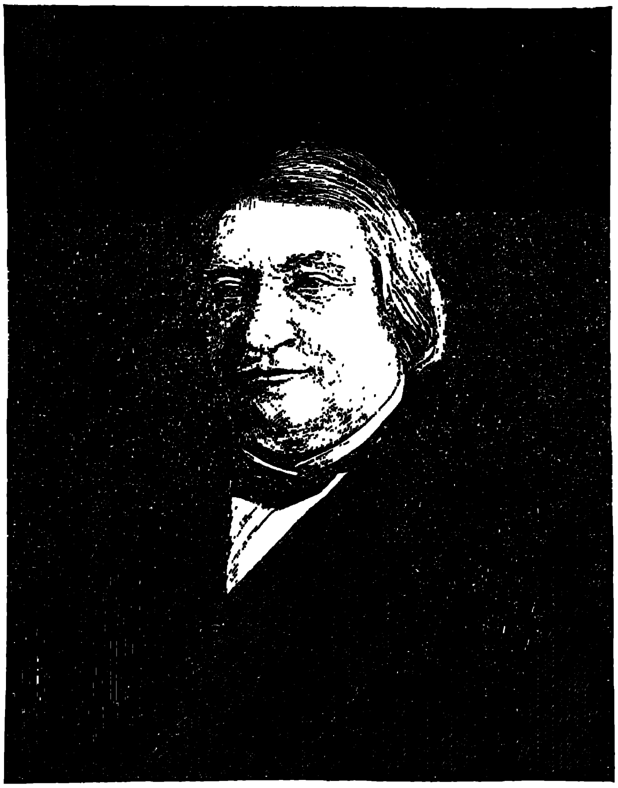
In the summer of 1838 Renan carried off all the prizes at the college of Tréguier. His sister in Paris told the doctor of the school in which she taught about the marvellous success of her brother, and he carried the news to M. Dupanloup, then engaged in organizing the ecclesiastical college of St Nicholas du Chardonnet, a school in which the young Catholic nobility and the most gifted pupils of the Catholic seminaries were to be educated together, with a view to cementing the bond between the aristocracy and the priesthood. When M. Dupanloup heard of the new Breton prodigy, he sent for him at once. Renan was fifteen and a half. He had never been outside his Breton province. "What I saw in Paris was as strange to me as if I had been sent into the wilds of Tahiti or Timbuctoo." The breath of the boulevards penetrated through a thousand fissures into the closed circle of the Parisian seminary, where the students discussed with passion the rising glories of Lamartine, Victor Hugo, and Michelet. "I learned with stupor that knowledge was not a privilege of the Church . . . I awoke to the meaning of the words talent, fame, celebrity." Above all, religion seemed to him a wholly different thing in Tréguier and in Paris. The superficial, brilliant, pseudo-scientific Catholicism of the capital did not satisfy the new recruit, who had accepted the austere and primitive faith of his Breton masters.

In 1840 Renan left St Nicholas to study philosophy at the seminary of Issy, in the suburbs of Paris. He entered with a passion for Catholic scholasticism. The rhetoric of St Nicholas had wearied him, and his serious intelligence hoped to satisfy itself with the vast and solid material of Catholic theology. Reid and Malebranche first attracted him among the philosophers, and after these he opened the tomes of Hegel, Kant, and Herder: "I studied the Germans, and I thought I entered a temple." But it was not that temple of which Issy is a portal. Renan began to perceive the essential contradiction between the metaphysics which he studied and the faith that he professed, but a curious appetite for truths that can be verified restrained his scepticism. "Philosophy excites and only half satisfies the appetite for truth; I am eager for mathematics," he wrote to his sister Henriette, his confidante, his guide, and friend. The letters had far to go. Bent on her self-imposed charges, Henriette had accepted in the family of Count Zamoyski an engagement more lucrative than her place as under-mistress in a Paris boarding-school. From her Polish steppes she exercised the strongest influence over her distant brother. All that Jacqueline Pascal was to the great French reformer Henriette was to Ernest Renan, and her recently published letters reveal a mind almost equal, a moral nature superior, to his own. It was not mathematics but philology which was to settle the gathering doubts of Ernest Renan. His course completed at Issy, he entered the great college of St Sulpice in order to take his degree in philology prior to entering the Church. And here he began the study of Hebrew. His mind, hitherto nourished on dogmas and ideas, on views and opinions, was famished for reality and alert in detecting the importance of a fact. He was already prompt to accept the proofs of experience as the sole authentic proofs. He saw that the second part of Isaiah differed from the first not only in style but in date; that the grammar and the history of the Pentateuch are posterior to the time of Moses; that the book of Daniel is clearly apocryphal. It followed from his training that, if you admit one error in a revealed text, you incriminate the whole. Secretly, Renan felt himself cut off from the communion of saints, and yet with his whole heart he desired to live the life of a Catholic priest. "The priest lives for his fellows, to teach them and to counsel them. He is a man of books; he lives the contemplative life, and yet he is a brother unto his brethren . . . I am not born for a life of action; a merely private life would seem to me a sort of selfishness . . . I am only fit for *one* sort of life." Hence a bitter struggle between vocation and conviction; owing to Henriette, conviction gained the day. In October 1845 Renan left the seminary of St Sulpice for Stavistas, a lay college of the Oratorians. Finding himself even there too much under the domination of the Church, a few weeks later, most reluctantly, he broke the last tie which bound him to the religious life and entered M. Crouzet's school for boys as a pupil teacher—or, rather, as usher—receiving his board and his room in return for his supervision of the evening class.

It is always dangerous to educate a really great mind in only one order of truth; so soon as it perceives the hidden half of the world, it will realize and even magnify its importance, embracing it with the ardour of a spiritual conversion. Thus Pascal, trained by a set of savants to observe, to calculate, to reason, to concern himself solely with experiments and mechanical inventions, was to become the tormented enthusiast of the religious life. Renan, brought up by priests in a world ruled by authority and curious only of feeling and opinion, was to accept the scientific ideal with the same extraordinary expansion of all his faculties. He was henceforth and for ever ravished by the splendour of the cosmos. Quite at the end of his life he wrote of Amiel, "The man who has time to keep a private diary has

never understood the immensity of the universe." The magnificent certitudes of physical and natural science were revealed to Renan in 1846 by the great chemist Marcellin Berthelot, then a boy of eighteen, his pupil at M. Crouzet's school. To the day of Renan's death their friendship continued. "It consisted in what we learned together." M. Crouzet's usher was occupied only in the evenings. In the daytime Renan continued his researches in Semitic philology. In 1847, an obscure young man of four-and-twenty, he obtained the Prix Volney—one of the principal distinctions awarded by the Academy of Inscriptions—for the manuscript of his "General History of Semitic Languages." In 1847 he took his degree as Agrégé de Philosophie; that is to say, fellow of the university, and was offered a place as master in the lycée of Vendôme. In 1848 a small temporary appointment to the lycée of Versailles permitted him to return to the capital and resume his studies.

The revolution of 1848 aroused in Renan that side of him which loved the priesthood because "the priest lives for his fellows." For three years the problems of faith and the glories of science had filled his mind and soul, to the exclusion of this sense of fraternity, which was, none the less, fundamental, and was yet to inspire some of his most beautiful pages. Among the gun-smoke and the fusillades of 1848 Renan for the first time confronted the problems of Democracy. The result was an immense volume, *The Future of Science*, which was to remain in manuscript until 1890. *L'Avenir de la Science* is an attempt to conciliate the privileges of a necessary *élite* with the diffusion of the greatest good of the greatest number. This difficulty was to haunt Ernest Renan throughout his life. By the time he had finished his elaborate scheme for regenerating society by means of a devoted aristocracy of knowledge, and the diffusion of culture, the year 1848 was past and gone, and with it his fever of Democracy. In 1849 the French Government sent the young scholar to Italy on a scientific mission. He remained eight months abroad, during which he forgot his anxiety about the toilers' lot. Hitherto he had known nothing of art. In Italy the artist in him awoke, and easily triumphed over the savant and the reformer. On his return to Paris Renan chose a small flat near the Val-de-grace, and went to live there with his sister Henriette, his devoted secretary. A small post at the National Library, together with his sister's savings, henceforth furnished him with the means of livelihood. In the evenings he wrote for the *Revue des Deux Mondes* and the *Débats* those exquisite essays, some of the most perfect he was to produce, which were to appear in 1857 and 1859 under the titles *Études d'Histoire Religieuse* and *Essais de Morale et de Critique*. Already in 1852 his book on *Averroès* had brought him not only his doctor's degree, but his first reputation as a thinker. In his two volumes of essays Renan shows himself a Liberal, but no longer a Democrat. Nothing, according to his philosophy, is less important than prosperity. The greatest good of the greatest number is a theory as dangerous as it is illusory. Man is not born to be prosperous, but to realize, in a little vanguard of chosen spirits, an ideal superior to the ideal of yesterday. Only the few can attain a complete development. The bulk of humanity lives by proxy; it is the enormous useless residue from which is distilled that small drop of exquisite aroma—the *élite*. Yet there is a solidarity between the chosen few and the masses which produce them; each has a duty to the other. The acceptance of this duty is the only foundation for a moral and just society. The aristocratic idea has seldom been better stated.



Ernest Renan.

(*From a photograph by A. Liébert, Paris.*)

The success of the *Études d'Histoire Religieuse* and the *Essais de Morale* had made the name of Renan known to a cultivated public. While Mademoiselle Renan remained shut up at home copying her brother's manuscripts or compiling material for his work, the young philosopher began to frequent more than one Parisian *salon*, and especially the studio of Ary Scheffer, at that time a noted social centre. In 1856 he proposed to marry Mademoiselle Cornélie Scheffer, the niece and adopted daughter of the great Dutch painter. Not without a struggle did the devoted but jealous Henriette resign her claim to be her brother's sole companion. At last she consented not only to the marriage, but to make her home with the young couple, whose housekeeping depended on the sum that Mademoiselle Renan could contribute. The history of this humble romance has been told by Ernest Renan, with rare tenderness and beauty, in the memorial essay which he wrote some six years later, entitled *Ma Sœur Henriette*. His marriage brought much brightness into his life, a rare naturalness and piquancy into his style, and a greater attention to the picturesque, as if at last he dared to be altogether himself, even at the expense of a certain noble simplicity. He did not forsake his studies in Semitic philology, and in 1859 appeared his translation of the *Book of Job* with an introductory essay, followed in 1859 by the *Song of Songs*.

Renan was now a candidate for the chair of Hebrew and Chaldaic languages at the Collège de France, a chair which he had consistently desired since first he studied Hebrew at the seminary of St Sulpice. The death of the famous scholar Quatremère had left this post vacant in 1857. No one in France save Renan was capable of filling it. The Catholic party, upheld by the empress, would not appoint an unfrocked seminarist, a notorious heretic, to what is, in point of fact, a chair of Biblical exegesis. Yet the emperor, ever anxious to stand well with men of letters and men of science, wished to conciliate Ernest Renan. He offered to send the young scholar on an archæological mission to Phœnicia. Renan

immediately accepted. Leaving his wife at home with their baby son, Renan left France, accompanied by his sister, in the summer of 1860. Madame Renan joined them in January 1861, returning to France in the course of July. Her husband and her sister-in-law would have done well to accompany her. But the mission proved fruitful in Phœnician inscriptions which Renan was to publish in his *Mission de Phénicie*. They form the base of that *Corpus Inscriptionum Semiticarum* on which, a little perversely, he used in later years to declare that he founded his claim to remembrance. He wished to complete his exploration of the upper range of Lebanon; he remained, therefore, with Henriette to affront the dangerous miasma of a Syrian autumn. At Amschit, near Byblos, Henriette Renan died of intermittent fever on the 24th September 1861. Her brother, himself at death's door, was carried unconscious on board a ship waiting in harbour and bound for France. The sea air revived him, but he reached France a broken man apparently in heart and health. Fortunately, he had more than one great project which attached him to life. His sister in her last days had entreated him not to give up his candidature for the chair of Hebrew, and on the 11th of January 1862 the Minister of Public Instruction ratified Renan's election to the post. But the scandal of his opening lecture, in which, amid the applause of the students, Renan declared Jesus Christ "an incomparable Man," alarmed the Catholic party. Renan's lectures were pronounced a disturbance of the public peace, and the young professor was forthwith suspended from his functions. On the 2nd of June 1864, on opening the morning newspaper, Renan saw that he had been transferred from the chair of Hebrew at the College of France to the post of sub-librarian at the National Library. The fund of combativeness, which even the most detached philosopher hides in the bottom of his heart, seethed within him at this high-handed proceeding. He wrote to the Minister of Public Instruction: "Pecunia tua tecum sit!" He refused the new position, was officially deprived of his chair, and henceforth depended for his daily bread solely upon his pen.

Henriette had told him not to abandon the chair of Hebrew. She had also said, "Write the life of Jesus." They had, in fact, begun it together in their Syrian retreat, she copying the pages as fast as her brother wrote them, with a New Testament and a *Josephus* for all his library. The book bears the mark of its origin — it is filled with the living, vibrating atmosphere of the East. It is the work of a man familiar with the Bible and theology, and no less acquainted with the inscriptions, monuments, types, and landscapes of Syria; it is, above all, the work of a man who has sounded the human heart. But it is scarcely the work of a great scholar: Renan's debt to the school of Tübingen has certainly been exaggerated, in so far at least as regards the *Life of Jesus*. The book appeared on the 23rd June 1863; before November sixty thousand copies of it were in circulation. There was no longer any doubt as to Ernest Renan's future. The professor had become a great writer, the philologist was seen to be a genius. But Renan still used his literary gifts to pursue a scientific ideal. In the days when he had composed his huge, immature treatise on the *Future of Science*, he had written: "I envy the man who shall evoke from the past the origins of Christianity. Such a writer would compose the most important book of the century." He set to work to realize this project, and produced the *Apostles* in 1866, and *St Paul* in 1869, after having visited Asia Minor with his wife, where he studied the scenes of the labours of St Paul as minutely as in 1861 he had observed the material surroundings of the life of Jesus.

Renan was not only a scholar. In *St Paul*, as in the *Apostles*, he shows his deep concern with the larger social life, his sense of fraternity, and a revival of the Democratic sentiment which had inspired *L'Avenir de la Science*. In 1869 he presented himself as the candidate of the Liberal opposition at the parliamentary election for Meaux. While his temper had become less aristocratic, his Liberalism had grown more tolerant. On the eve of its dissolution Renan was half prepared to accept the Empire, and, had he been elected to the Chamber of Deputies, he would have joined the group of *l'Empire Libéral*. But he was not elected. A year later war was declared with Germany, the Empire fell, and Napoleon III. went out into exile. The Franco-German war was to be a turning-point in Renan's history. Germany had always been to him, as he had exclaimed at St Sulpice, a sanctuary, "un temple," the asylum of thought and disinterested science. Now he saw the land of his ideal destroy and ruin the land of his birth; he beheld the German no longer as a priest, but as a brutal and wanton invader. With a great revulsion his heart turned to France. In his noble and thoughtful work, *La Réforme Intellectuelle et Morale* (1871), he endeavoured at least to bind her wounds, to raise her head, to safeguard her future. Yet, in spite of himself, he was still under the influence of Germany. The ideal and the discipline which he proposed to his defeated and mangled country were the ideal and the discipline of her conqueror —a feudal society, a monarchical government, a France directed by a superior class, an *élite*, which the rest of the nation exists merely to support and nourish; an ideal of honour and duty imposed by a chosen few on the recalcitrant and subject multitude. The savage and ignorant errors of the Commune confirmed Renan in this reaction. At the same time the note of irony, always perceptible in his work, grows more bitter, more concentrated, more brilliant. His *Dialogues Philosophiques*, written in 1871, his *Ecclesiastes* (1882), and his *Antichrist* (1876) (the fourth volume of the *Origins of Christianity*, dealing with the reign of Nero), are incomparable in their literary genius, but they are examples of a disenchanted and sceptical temper. He had vainly tried to make his country follow his precepts. He resigned himself to watch her drift her own way, probably, as it seemed to him, towards perdition. The progress of events showed him, on the contrary, a France which every day left a little stronger, and he aroused himself from his disbelieving, disillusioned mood, and observed with genuine interest the struggle for justice and liberty of a Democratic society. For his mind was the broadest of the age, incapable of blindly taking a side, of setting a limit to the laws of reason. And when Truth spoke from the mouth of an opponent he was ever ready with an unqualified assent. The fifth and sixth volumes of the *Origins of Christianity* (the *Christian Church* and *Marcus Aurelius*) show us a Renan reconciled with Democracy, confident in the gradual ascent of man, aware that the greatest catastrophes do not really interrupt the sure if imperceptible progress of the world—reconciled also in some measure, if not with the truths, at least with the moral beauties of Catholicism and with the remembrance of his pious youth.

On the threshold of old age, the philosopher turned and cast a last long lingering glance at the days of his childhood. He was nearly sixty when, in 1883, he published those *Souvenirs d'Enfance et de Jeunesse*, which, after the *Life of Jesus*, are the work by which he is chiefly known. They took the world by storm. They possess that lyric note of personal utterance which the public prizes in a man already famous. They showed the *blasé* modern reader that a world no less poetic, no less primitive than that of the *Origins of Christianity* exists, or

still existed within living memory, on the north-western coast of France. They have the Celtic magic of ancient romance and the simplicity, the naturalness, the accent of veracity which the 19th century prized so highly. They reflect the picturesque and emotional side of Renan, the easiest to understand in that mind of many facets. But his *Ecclesiastes*, published a few months earlier, his *Drames Philosophiques* collected in 1888, give a more adequate image of his fastidious, subtle, critical, most disenchanted, yet not unhopeful spirit. These books are often bitter and melancholy, yet not destitute of traces of optimism. They show the attitude towards uncultured Socialism of a philosopher Liberal by conviction, by temperament an aristocrat. We learn in them how Caliban (Democracy), the mindless brute, educated to his own responsibility, makes after all an adequate ruler; how Prospero (the aristocratic principle, or, if we will, the mind) accepts his dethronement for the sake of greater liberty in the intellectual world, since Caliban proves an effective policeman, and leaves his superiors a free hand in the laboratory; how Ariel (the religious principle) acquires a firmer hold on life, and no longer gives up the ghost at the faintest hint of change. Indeed, Ariel flourishes in the service of Prospero under the external government of the many-headed brute. For the one thing needful is not destined to succumb. Religion and knowledge are as imperishable as the world they dignify. Thus out of the depths rises unvanquished the essential idealism of Ernest Renan.

Renan was a great worker. At sixty years of age, having finished the *Origins of Christianity*, he began his *History of Israel*, based on a lifelong study of the Old Testament and on the *Corpus Inscriptionum Semiticarum*, published by the Académie des Inscriptions under Renan's direction from the year 1881 till the end of his life. The first volume of the *History of Israel* appeared in 1887, the third and finest volume in 1891, the last two only after the historian's decease. As a history of facts and theories the book has many faults; as an essay on the evolution of the religious idea, it is (despite some passages of frivolity, irony, or incoherence) of extraordinary importance; as a reflection of the mind of Ernest Renan it is the most lifelike of images. In a volume of collected essays, *Feuilles Détachées*, published also in 1891, we find the same mental attitude, an affirmation of the necessity of piety independent of dogma: "the most logical attitude of the thinker towards religion is to behave as though religion were true." Renan had never been strong, and the last years of his life were much chequered by rheumatism, which gradually affected the structure of the heart. On the 12th of October 1892 he died after a few days' illness. "I have done my work," he said to Madame Renan; "I die happy." Dead, he continued to delight his readers. Two volumes of the *History of Israel*, his correspondence with his sister Henriette, his *Letters to M. Berthelot*, and the *History of the Religious Policy of Philippe-le-Bel*, which he wrote in the years immediately before his marriage, all appeared during the last eight years of the 19th century. (A. M. F. D.)

Renfrew, a royal and parliamentary burgh (Kilmarnock group) and the county town of Renfrewshire, near the Clyde, about 6 miles west of Glasgow by road. A large dock is about to be constructed by the Clyde Trust at a cost of £335,000. Two engineering works, cabinet-making factories, and large bolt and rivet undertakings are new industrial features. The construction of dredgers and floating docks is a speciality connected with the staple industry, shipbuilding. The school board manages a grammar school, and has recently built a new elementary school. Population (1881), 4825; (1901), 9297.

Renfrewshire, a maritime county of west Scotland, is bounded N. by the Clyde, N.E. by Dumbartonshire and Lanarkshire, E. by Lanarkshire, S. by Ayrshire, and W. by the Firth of Clyde.

Area and Population.—In 1891 the Renfrewshire part of the city of Glasgow was transferred to the county of Lanark, as was the Renfrewshire police burgh of Kinning Park; the whole of the parish of Cathcart was placed in Renfrewshire, and the whole parish of East Kilbride in Lanarkshire; while the parishes of Beith and Dunlop, which had been previously divided between Ayrshire and Renfrewshire, were placed wholly in the former county. According to the latest official estimate, the area of the county (foreshore excluded) is 155,965 acres, or about 244 square miles. The population was, in 1881, 263,374; in 1891, 290,798; in 1891, on the above area, 230,812, of whom 110,520 were males and 120,292 females; in 1901, 268,934. On the old area, taking land only (156,785 acres, or 245 square miles), the number of persons to the square mile in 1891 was 1187, and the number of acres to the person 0·5. In the registration county the population increased between 1881 and 1891 by 8·7 per cent. Between 1881 and 1891 the excess of births over deaths was 31,459, and the increase of the resident population 19,571. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Per cent. of Illegitimate.
1880	5239	1636	7730	6·2
1890	4861	1778	7842	5·08
1899	5291	2010	8548	4·1

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate	34·64	34·57	32·18	31·92	32·68
Death-rate	23·48	21·21	19·94	19·99	20·22
Marriage-rate	7·33	7·31	7·29	7·05	7·68

At the census of 1891 there were 6114 Gaelic-speaking persons in the county, of whom 51 spoke Gaelic alone, and 2411 foreigners. Valuation in 1889–90, £783,051; 1899–1900, £612,633.

Administration.—Since 1885 the county has returned two members to Parliament, one for the East and the other for the West division of the shire. Paisley (79,355), Greenock (67,645), Port-Glasgow (16,840), and Renfrew (9297) are all parliamentary burghs, Paisley and Greenock having a member each, and the other two belonging to the Kilmarnock group. Renfrew, the county town, is the only royal burgh. Police burghs are Barrhead (9855), Pollokshaws (11,169), Gourock (5244), and Johnstone (10,502). There are 16 civil parishes, and the number of paupers and dependants in September 1899 was 5386; there are poor-houses at Greenock and Paisley. Renfrewshire forms a sheriffdom with Bute, and there is a resident sheriff-substitute at Paisley and one at Greenock.

Education.—Twenty-three school boards manage 81 schools, which had an average attendance of 34,638 in 1898–99, while 22 voluntary schools (17 Roman Catholic and 2 Episcopal) had 6395. There is an academy at Greenock, and a grammar school and a technical school at Paisley; five other schools in the county earned grants in 1898 for giving higher education; while the county secondary committee makes provision also for the free education of Renfrewshire children in Glasgow high schools and the Spier School at Beith. The Paisley Technical School and the Glasgow and West of Scotland Technical College are subsidized out of the residue grant, part of which goes also to defraying the travelling expenses of students and to supporting science and art and technological classes in the burghs and throughout the county.

Agriculture.—The percentage of the area under cultivation was, in 1898, 59 per cent. Arable farming predominates, but dairying grows with the increasing town populations in and adjoining the county. The following table gives the principal acreages at intervals from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	93,786	17,477	8095	17,332	50,355	527
1885	95,529	16,806	6670	23,573	48,268	212
1890	96,247	15,573	6015	29,501	44,986	102
1895	93,907	14,078	5951	21,437	52,216	134
1899	92,695	13,322	5858	24,773	48,551	90

The table in the next column gives particulars of the live stock during the same years.

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	3330	24,677	14,945	35,436	1192
1885	3296	27,619	16,131	32,432	1815
1890	3470	27,878	17,247	36,667	1541
1895	3516	26,125	16,808	38,370	1584
1899	3314	26,813	17,452	42,584	1458

There were 6661 acres under wood in 1895. Of the 1096 holdings in 1895, the date of the last return, the average size was 86 acres. The percentage under 5 acres was 12·13, between 5 and 50 acres 27·92, and over 50 acres 59·95. The number of farms between 50 and 100 acres was 295, between 100 and 300, 342, between 300 and 500, 14 only, and there were 6 over 500.

Industries and Trade.—Industries have advanced generally in importance throughout the county, but no change has taken place in their fundamental character. For details see the separate articles on Johnstone, Pollokshaws, Barrhead, Kilbarchan, Paisley, Greenock, and Renfrew. The following table shows the output of coal, ironstone, fireclay, and sandstone in 1890 and 1899:—

Year.	Coal.		Ironstone.		Fireclay.		Sandstone.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	58,351	£16,693	162,561	£89,409	37,591	£7,048	..	..
1899	12,491	£4,424	162,755	£77,309	76,999	£10,625	73,112	£15,010

40,757 tons of limestone valued at £4345 were also raised in 1899. It is impossible to disentangle the figures relating to oil shale from the confusion of the mining inspectors' reports, but the output has certainly fallen off since 1885. In 1891, 50,388 men and 24,391 women were engaged in industrial handicrafts or were dealers in manufactured substances. Of these, 7339 men and 15,992 women were connected with the manufacture of textiles, 5471 men with ships, 5128 men with machines and implements, and 8219 with minerals. Commerce engaged the attention of 10,984 men and 484 women. About 22 miles were added to the railway mileage of the county in the last quarter of the 19th century, and considerable further extensions are now in progress.

AUTHORITIES.—WILSON. *General View of the Agriculture of Renfrewshire.* 1812.—*Archæological and Historical Collections of the County of Renfrew.* Paisley, 1885.—CRAIG. *Historical Notes on Paisley.* Paisley, 1881.—W. HECTOR. *Vanduara.* Paisley, 1881; *Lichens from an Old Abbey.* Paisley, 1876.—GILMOUR. *Paisley Weavers of Other Days.* Paisley, 1879.—D. CAMPBELL. *Historical Sketches of the Town and Harbours of Greenock.* 1879–1881; *Old Greenock.* Greenock, 1888.—A. H. MILLAR. *Castles and Mansions of Renfrew.* Glasgow, 1889.—*Harp of Renfrewshire.* Paisley, 1872–73.—P. A. RAMSAY. *View of Renfrewshire.* Edinburgh, 1839. (W. WA.)

Rennes, chief town of department Ille-et-Vilaine, France, and an important railway junction, 232 miles west-south-west of Paris. It is the seat of a Court of Appeal for the five Breton departments. The second trial of Captain Dreyfus took place here. A preparatory school of medicine and pharmacy, in connexion with the university academy, has been reorganized, and there are a national school of agriculture and a school of dairying. A statue of Bastard, former mayor and local benefactor, stands in front of the Chamber of Commerce, a handsome modern structure in the Renaissance style. Population (1881), 47,774; (1896), 57,249.

Renouf, Sir Peter Le Page (1822–1897), Egyptologist, was born in Guernsey, 23rd August 1822. He was educated at Elizabeth College in his native island, and proceeded thence to Oxford, which, upon his becoming a Roman Catholic, under the influence of Dr Newman, he quitted without taking a degree. Like many other Anglican converts, he proved a thorn in the side of the Ultramontane party in the Roman Church, though he did not, like some of them, return to the communion of the Church of England. He opposed the promulgation of the dogma of Papal Infallibility, and his treatise (1868) upon the condemnation of Pope Honorius for heresy by the Council of Constantinople in A.D. 680 had the distinction of being placed upon the index of prohibited books. Previously to this stirring episode in his career he had been from 1855 to 1864 professor of ancient history and Oriental languages in the Roman Catholic university which Newman vainly strove to establish in Dublin, and during part of this period edited the *Atlantis* and the *Home and Foreign Review*, which latter periodical had to be discontinued on account of the hostility of the Roman Catholic hierarchy. In 1864 he was appointed a Government inspector of schools, which position he held until 1886, when his growing celebrity as an Egyptologist procured him the appointment of Keeper of Oriental Antiquities in the British Museum, in succession to Dr Samuel Birch. He was also elected in 1887 president of the Society of Biblical Archæology, to whose *Proceedings* he was a constant contributor. The most important of his numerous and highly valued contributions to Egyptology are his Hibbert lectures on the Religion of the Egyptians, delivered in 1879; and the translation of *The Book of the Dead*, with an ample commentary, which was published in the transactions of the society over which he presided. He retired from the Museum under the superannuation rule in 1891, and died in London on 14th October 1897. He had been knighted the year before his death. He married in 1857 Ludovica von Brentano, member of a well-known German literary family. (R. G.)

Renouvier, Charles Bernard (1818——), French philosopher, was born at Montpellier, 1st January 1818, and educated in Paris at the École Polytechnique. In early life he took much interest in politics, and the approval extended by Hippolyte Carnot to his *Manuel républicain de l'homme et du citoyen* (1848) was the occasion of that minister's fall. He has never held public employment, but has spent his life writing, retired from the world. His chief works are: *Essais de critique générale*, 4 parts (1854–64), *La science de la morale*, 2 vols. (1869), *Uchronie* (1876), *Esquisse d'une classification systématique des doctrines philosophiques*, 2 vols. (1885–86), *La philosophie analytique de l'histoire*, 4 vols. (1896–97), *Histoire et solution des problèmes métaphysiques* (1901). Renouvier has been the first Frenchman since Malebranche to formulate a complete idealistic system, and he has had a vast influence on the development of French thought in the past century. His system is based on Kant's, as his chosen term *Néo-criticisme* indicates; but it is a transformation rather than a continuation of Kantianism. The two leading ideas discernible in it are a dislike to the Unknowable in all its forms, and a reliance on the validity of our personal experience. The former accounts for his decided acceptance of Kant's phenomenalism, combined with an equally decided rejection of the thing in itself. It accounts, too, for his strenuous polemic on the one hand against a Substantial Soul, a Buddhistic Absolute, an Infinite Spiritual Substance; on the other hand against the no less mysterious material or dynamic substratum by which naturalistic Monism explains the world. He holds that nothing exists except presentations, which are not merely sensational, and have an objective aspect no less than a subjective. To explain the formal organization of our experience he adopts a modified version of the Kantian categories. The insistence on the validity of personal experience leads Renouvier to a yet more important divergence from Kant in his treatment of volition. Liberty, he says, in a much wider sense than Kant, is man's fundamental characteristic. Human freedom acts in the phenomenal, not in an imaginary noumenal sphere. Belief is not intellectual merely, but is determined by an act of will affirming what we hold to be morally good. In his religious views Renouvier makes a considerable approximation to Leibnitz. He holds that we are ration-

ally justified in affirming human immortality and the existence of a finite God who is to be a constitutional ruler, but not a despot, over the souls of men. He would, however, regard atheism as preferable to a belief in an infinite Deity.

Rensselaer, formerly known as Greenbush and sometimes as East Albany, a city of Rensselaer county, New York, U.S.A. It is on the Hudson river, opposite Albany, with which it is connected by bridges, and on the New York Central and Hudson River and the Boston and Albany railways. Population (1880), 3295; (1890), 7301; (1900), 7466, of whom 1089 were foreign-born.

Renton, a manufacturing town of Dumbartonshire, Scotland, on the river Leven, 2¼ miles north by west of Dumbarton by rail. It is the centre of the Turkey-red dyeing industry, and calico-printing and bleaching are also carried on. A parish church stands on the site of Dalquhurn House, the birthplace of Tobias Smollett, to whom there is a monument (1775). There is a drill hall and a Jubilee Victoria Institute, with library and recreation rooms. Population (1881), 4319; (1901), 5227.

REPRODUCTION.

IN recent embryological work no idea has been more prominent than that of *germinal continuity*. From one point of view it may be said that multicellular organisms give rise by a process of division to macrogametes or ova, and to microgametes or spermatozoa; that these unite in fertilization to form a new individuality, and that after a period of development this again produces gametes. But, from another point of view, it may be said with equal accuracy that the fertilized ovum gives rise in development to two sets of elements—to the somatic cells which become differentiated into the various tissues of the body, and to a lineage of non-specialized germ-cells, some of which will eventually be separated off to begin a new generation. This lineage of germ-cells is often distinguishable from the somatic cells at an early stage in development, *e.g.*, in some leeches; *Sagitta;* some Nematodes; many Polyzoa; *Moina;* some Cladocera and other Crustaceans; *Chironomus*, *Platygaster*, and some other insects; Phalangidæ among Arachnids, and the Teleostean fish *Micrometrus aggregatus*. Perhaps the most striking instance of early differentiation of germ-cells is that of *Ascaris megalocephala*, described by Boveri (1887, 1891), where from the two-celled stage onwards the germ-cell lineage is distinguishable from the somatic cell lineage by the greater size and richness of the chromatin, and (for a time) by a difference in the process of mitosis. By a process of chromatin elimination, repeated through five or six successive divisions, the somatic cells come to contain a reduced quota of chromatin, while the germ-cells retain the whole amount. More instances of this sort might make it possible to give a precise statement of the relation between germ-cells and somatic cells, but at present only a general contrast is permissible. The somatic cells differentiate in manifold variety, most of them losing all likeness to the fertilized ovum or to its immediate descendants, the blastomeres, though in many cases some retain a power of helping one another to regenerate lost parts or even an entire organism. The germ-cells, on the other hand, are not implicated in building up the body, but remain virtually unchanged, preserving the original organization or "protoplasmic tradition" intact. As the sex-cells in an offspring are thus genetically continuous with the parental sex-cells which gave rise to it, they will in turn develop into organisms like the parents—a conception fundamental to an understanding of inheritance and development. The idea of germinal continuity was expressed by Owen, Haeckel, Rauber, Jaeger, Nussbaum, Brooks, and Galton, but it has been most clearly stated and consistently worked out by Weismann, who has, moreover, adjusted it to meet an obvious difficulty. In many forms, especially among plants, it is only after the differentiation of the body is relatively far advanced that the future reproductive cells are recognizable as such, and thus we have to pass from cases where germ-*cells* form a demonstrable continuous lineage with the fertilized ovum, to the theory of a continuous germ-*plasm*. Weismann assumes that "in each development a portion of the specific germ-plasm, which the parental ovum contains, is not used up in the formation of the offspring, but is reserved unchanged for the formation of the germinal cells of the following generation." This germ-plasm, of definite chemical and special molecular constitution, is supposed to have its seat in the nucleus, and to have great powers of persistence and growth. Part of it is distributed throughout the "body," and may be the material condition of asexual multiplication and regeneration, as well as the determinant of differentiation; but part of it continues with approximately intact stability to form the reproductive cells of the body.

Correlation.—While it may be admitted that the body is the bearer rather than the producer of the germ-cells, it must also be allowed that these cannot lead a charmed life, uninfluenced by somatic accidents and incidents. Vascular and other fluids form a common medium for all parts of the system; the gonads of animals are often under nervous control; alteration of diet may alter reproductivity and even sex; various poisons and the like are known to affect not only the whole bodily system, but the germ-cells as well. Even Weismann, the most prominent upholder of the distinction between soma and germ-cells, finds one of the chief sources of congenital variation in the nutritive stimuli exerted on the germ-plasm by the varying state of the body. On the other hand, many instances are known, if not understood, of correlations between the reproductive system and bodily organs. Thus Rörig (1899) shows that a diseased state of the ovaries in a female deer is correlated with the development of antlers, that atrophy of the testes is always followed by a peculiar growth of antlers, that castration of a young male always inhibits the development of antlers, and so on. Sellheim (1898, 1899) has described some of the numerous somatic changes which follow castration in various animals, one of the most frequent in both sexes being a prolongation of the period of bone-growth. When young cocks are castrated, the whole body is affected; the larynx is intermediate in size between that of cock and hen, the syrinx is weakly developed, the brain and heart are light in weight, fat accumulates in the subcutaneous and subserous connective tissue, and the skeleton shows many abnormalities. From ancient times a correlation between the gonads and the state of various parts of the body—even of the nose—has been recognized in man, and many instances suggest that while the germ-cells are in a sense apart from the general bodily system, an even greater fact is the unity of the organism.

Galton's Law.—Beside the idea of germinal continuity we may rank another generalization of great importance,

namely, Galton's law of ancestral inheritance, based partly on studies in the inheritance of human qualities, and partly on a series of observations on basset hounds. There is a sense in which we may think of an inheritance as dual—half derived from the father and half from the mother—but the heritable material of each parent was also dual, being derived from the grandparents, and Galton's law expresses this conception of inheritance as necessarily multiple. "The two parents between them contribute *on the average* one-half of each inherited faculty, each of them contributing one-quarter of it. The four grandparents contribute between them one-quarter, or each of them one-sixteenth; and so on, the sum of the series $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+$ &c., being equal to 1, as it should be. It is a property of this infinite series that each term is equal to the sum of all those that follow: thus $\frac{1}{2}=\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+$ &c.; $\frac{1}{4}=\frac{1}{8}+\frac{1}{16}+$ &c.; and so on. The prepotencies or subpotencies of particular ancestors, in any given pedigree, are eliminated by a law that deals only with *average* contributions; and the varying prepotencies of sex, in respect to different qualities, are also presumably eliminated." It is highly probable, as Karl Pearson says, that the above simple descriptive statement brings into focus all the complex lines of hereditary influence.

Sexual Differentiation.—Numerous facts point to the conclusion that maleness and femaleness may be regarded as expressing metabolic alternatives open to the germ-cell in its development, and that the bias in one direction or the other is largely due to environmental stimuli. In illustration we may recall the very diverse sexual conditions—hermaphrodite, male, female, parthenogenetic, asexual, &c.—observed in the simple multicellular organism *Volvox*, which has been described as furnishing an epitome of the evolution of sex. According to Cuénot, the little starfish *Asterina gibbosa* is in certain localities first male for a variable period, and then female, while in other localities permanent males, females, and hermaphrodites seem to occur. According to W. M. Wheeler's interpretation, *Myzostoma glabrum* has a functional male phase, succeeded by a functional hermaphrodite phase, and that again by a functional female phase during which the testes disappear, while in other species the hermaphrodite period may be almost or wholly suppressed. In plants, in particular, it seems that environmental conditions are often effective in changing a hermaphrodite into a unisexual condition. Very striking both in their results and in the carefulness of method are the experiments of Klebs, which show that environmental changes will determine in various Algæ and Fungi the occurrence of sexual or of asexual reproduction, or will cause a normally hermaphrodite form to become unisexual. It need hardly be pointed out that the view which regards sexual dimorphism as expressing two opposed metabolic diatheses is complementary, not antagonistic, to that which points out how the dimorphism is adaptive to securing cross-fertilization and other advantages.

Oogenesis.—It is convenient to distinguish in the history of both ova and spermatozoa three periods: (*a*) of multiplication, (*b*) of growth, and (*c*) of maturation. During the growth-period in a number of cases there occurs what may be called a struggle for existence among potential germ-cells. Thus among the numerous possible ova in the ovary of *Hydra* there is usually but one survivor, which has grown strong at the expense of its neighbours, and almost the same thing is known in *Tubularia* and in some other cases. Immature ova of sea-urchins have been seen engulfing others, and even spermatozoa (without resulting fertilization), *i.e.*, exhibiting phagocytosis. Many potential ova are often used up to form follicular or other investments for the few which succeed. It may sometimes be that the elimination process, both among young ova and among spermatozoa, is discriminative, *i.e.*, that the survivors survive in virtue of particular fitness; if so, the process may be of racial importance. This extension of the conception of the struggle for existence to the germ-cells may suggest the further extension expressed in Weismann's daring hypothesis of "germinal selection," which supposes the occurrence of an intimate competition among the hereditary units within the germ-cell.

Spermatogenesis.—Recent researches on spermatogenesis have not greatly altered the state of knowledge outlined in the article REPRODUCTION in the ninth edition of the *Encyclopædia Britannica*, but it may be noted that although the parallelism between spermatogenesis and oogenesis suggested in the previous article does not seem to have been accepted, a deeper parallelism has been established (see *infra*); that there is often in the testes of higher animals, as in the ovaries, a division of labour between the germ-cells proper and associated nutritive cells; that the middle piece of the spermatozoon bears a centrosome which plays an important rôle in the division which follows fertilization; that the locomotor tail has often a fibrillated structure which suggests an analogy with a muscle-fibre; that in various Cycads the male nuclei issue from the pollen tube as motile spermatozoa, whose occurrence removes one of the distinctions between flowering plants and Cryptogams; that there is sometimes dimorphism of spermatozoa, *e.g.*, in water-beetles, which suggests another parallel between spermatogenesis and oogenesis (cf. the familiar dimorphism of the ova of Rotifers, &c.).

Reducing Divisions.—Since van Beneden discovered that each of the two nuclei which unite in fertilization contains one-half of the number of chromosomes characteristic of the somatic cells, though the nuclei of the earlier stages of the germ-cells have the same number as the somatic cells, it has been plain that a reducing process must occur at some phase, and there is now general agreement that the reduction takes place in the last two cell-divisions by which the definitive germ-cells arise, namely, when the ovarian ovum gives rise to the mature ovum and two or three polar bodies, and when a spermatocyte divides into four spermatids or young spermatozoa. The parallelism in the two cases is very striking, but as O. Hertwig says, "while in the latter case the products of the division are all used as functional spermatozoa, in the former case one of the products of the egg-mother-cell becomes the egg, appropriating to itself the entire mass of the yolk at the cost of the others, which persist in rudimentary form as polar bodies." The hypothesis of Minot, adopted also by van Beneden, that each germ-cell is originally hermaphrodite, and that the maturation processes imply the removal of male qualities from the ovum and of female qualities from the spermatozoon, has been abandoned; and the reducing divisions are recognized as securing a constancy in the number of chromosomes characteristic of each species, for without some such preliminary reduction the number would obviously be doubled at each fertilization. That a reduction does really occur in both plants and animals seems now incontrovertible, but as to the precise manner of the reduction the results are at present too discrepant to admit of any brief statement. It should be noted, however, that in some parthenogenetic ova, *e.g.*, of Aphides, only one polar body is formed and no reduction in number is effected, while in other parthenogenetic ova, *e.g.*, those eggs of bees which develop into drones, two are formed—a strange fact, in part at least explained by Brauer, who showed that in the parthenogenetic ova of *Artemia* both types occur, but that when two polar bodies are formed the second remains in the egg and behaves practically like a sperm-nucleus.

Fertilization.—Recent work has forcibly suggested that there are in fertilization two more or less distinct processes—on the one hand, the process by which the gametes, bearing the hereditary characters, unite to form the beginning of a new individuality; on the other hand, the process by which the microgamete supplies some stimulus prompting the ovum to divide. The first aspect is that of amphimixis, believed by many to be of importance in initiating—and, it may be, also in checking—variation, but in any case implying the union of the hereditary qualities contained in the two gametes. The second aspect is that of mitotic stimulus, believed by some to be afforded by an enzyme—for which the name of ovulase has been suggested—and by others to be localized in the sperm-centrosome. It is seen in many cases that equivalent numbers of chromosomes are contributed by the two nuclei; it is evident that the ovum contributes by far the larger quantity of cytoplasm; it seems to have been securely demonstrated in some cases that "from the

father comes the stimulus inducing the organization of the machinery of mitotic division by which the egg splits up into the elements of the tissues, and by which each of these elements receives its quota of the common heritage of chromatin." While the ovum centrosome of many animals seems to disappear, that introduced by the spermatozoon divides into two, and around each a system of rays develops. They migrate to opposite sides of the segmentation nucleus, and between them there appears the spindle of the first cleavage. It may be hasty to call them 'kinetic centres,' but they seem to have an important rôle in the division-process. "Huxley hit the mark two score years ago when he compared the organism to a web of which the warp is derived from the female and the woof from the male. Our principal advance upon this view is the knowledge that this web is probably to be sought in the chromatic substance of the nuclei; and perhaps we shall not push the figure too far if we compare the amphiaster to the loom on which the fabric is woven" (Wilson, 1900, p. 231).

The experiments of Maupas on ciliated Infusorians, where an elaborate nuclear reduction is followed by an intimate nuclear amphimixis, seemed to show that conjugation is not effective between the members of an isolated colony all descended by successive fissions from one form, and that after a large number of generations senile degeneracy sets in, and leads to the extinction of the colony unless it be checked in time by the removal of some members to the vicinity of unrelated forms with which they may conjugate. This suggests the view that amphimixis is necessary to sustain the standard of vitality in a stock, but while some believe that there is a primary need for this "rejuvenescence" (a view which is certainly not supported by the entire absence of any amphimixis in forms like Bacteria, nor by persistently parthenogenetic forms, like many Rotifers), others hold that the dimorphism and mutual dependence of the germ-cells is only an elaborate adaptation to secure the origin or multiplication of variations (a view which has found its most thoroughgoing exponent in Weismann). That Maupas's undoubtedly careful work requires confirmation may be inferred from the experiments of Joukowsky (1898), which suggest that degeneracy depends not merely on the number of asexual generations, but on the rapidity of their succession; in *Pleurotricha lanceolata* over 458 generations were observed without the occurrence of degeneracy; after five months' culture a colony of *Paramœcium caudatum* showed no nuclear senility, but only a marked reduction of cilia and consequent sluggishness; in *P. putrinum* effective conjugation between the descendants of one individual was observed, but the author admits the probability that this has its limits.

A remarkable experiment made by Boveri (1889, 1895) cannot be overlooked, though it is still in some respects unsatisfactory, as Seeliger and Morgan have pointed out. Following a method used by the Hertwigs, Boveri subjected Echinoid eggs to shaking, and obtained enucleated fragments. He showed that these were capable of fertilization, and that they gave rise to dwarf larvæ, which were normal except in size and in having only half the usual number of chromosomes in their cells. Boveri went on to fertilize enucleated ovum-fragments of *Sphærechinus granularis* with spermatozoa of *Echinus microtuberculatus*, and obtained in a few cases dwarf larvæ showing purely paternal characteristics. From this he drew the conclusion that it is the nucleus, not the cytoplasm, which forms the material basis of inheritance; and there are many facts, *e.g.*, the history of the chromosomes in maturation, which point in the same direction. It should be borne in mind, however, that as the life of the cell probably depends on the complex interaction of various materials more or less localized in different parts of the unit-area, since the nucleus cannot live for more than a short time without the cytoplasm as its agent, nor the cytoplasm without the nucleus as its trophic or formative centre, it may be misleading to seek too hastily for a definite localization of functions—to attempt, for instance, to abstract the ovum-cytoplasm altogether from any share in bearing the burden of inheritance. In Boveri's experiment it may have been that the hereditary qualities of the sperm proved themselves prepotent over the hereditary qualities of the ovum-cytoplasm, weakened as these might well be by enucleation. In 1899 Delage succeeded in fertilizing non-nucleated fragments of the ova of *Echinus*, *Dentalium*, and *Lanice conchilega*, and reared Pluteus, Veliger, and Trochosphere larvæ respectively. Three larvæ were reared from one ovum of a sea-urchin—from one nucleated and two non-nucleated portions—and in one case a normal blastula was obtained from a $\frac{1}{37}$th ovum-fragment. He showed, moreover, that an egg-fragment of *Echinus* without any chromosomes gave rise after fertilization by a spermatozoon with nine chromosomes to a larva whose cells had the normal number of eighteen chromosomes; which led him to infer that the number of chromosomes is a property of the cellular organization, and not dependent on the persistent individuality believed by most to be characteristic of the chromosomes. The experiments will require confirmation and extension, but unless the cutting operation caused an escape of nucleoplasm into the cytoplasm fragments (which Delage does not believe to have been possible), it is difficult to avoid the conclusion that fertilization may be effective without any fusion of nuclei. In connexion with these remarkable phenomena of "merogonic" fertilization and development, it is perhaps appropriate to recall the observations of Marchal on *Encyrtus fuscicollis*, where the ovum gives rise not to one embryo, but to "a legion of small morulæ," forming a chain of 50–100 embryos. Even more striking, however, are the experiments of Loeb (1899) on the artificial production of normal larvæ (plutei) from the unfertilized eggs of the sea-urchin. He found that this may be effected by placing the unfertilized eggs for about two hours in sea-water to which a dilute solution of magnesium chloride has been added in certain proportions. "When brought back into normal sea-water the eggs began to segment and form blastulæ, gastrulæ, and plutei, which were normal in every respect. The only difference was that fewer eggs developed, and that their development was slower than in the case of the normal development of fertilized eggs." The precise nature of the physical, or chemical and physical, stimulus in this and in other cases of "artificial parthenogenesis" remains uncertain.

Cleavage.—Many hundreds of researches within the last few years have had for their subject the cleavage or segmentation which follows fertilization, but we cannot do more than refer to one general result which seems to be true of most cases of indirect cell-division. The chromatin nuclear material is disposed in a number of segments or chromosomes (whose number is practically constant for each species); each of these chromosomes is split lengthwise during the division process, and the two halves are borne in opposite directions to the two poles, there to form, or to help to form, the daughter-nuclei. As a chromosome is built up of a single series of chromatin-granules, each of which is cleft by the longitudinal splitting, each daughter-nucleus has a contribution from each chromatin-granule. In the movement towards the poles the system of spindle-fibres which radiate from the centrosomes appears to play a part, but whether they push or pull or act in some more subtle way remains uncertain; nor is it known what precise part is played by the astral rays which surround the centrosome but are quite distinct from the spindle-fibres. What is certain is, that the result of the mitotic process is to divide the chromatin substance with exact equality, so that, in the case of a segmenting ovum, each daughter-nucleus is half maternal and half paternal in its composition—a discovery of much interest in connexion with inheritance. Our understanding of the different forms of ovum segmentation advances very slowly, for though some useful "laws" have been stated—*e.g.*, that each new plane of division tends to intersect the preceding plane at right angles (Sachs), or that the axis of the mitotic figure typically lies in the longest axis of the protoplasmic mass, so that the division tends to cut this axis at right angles (Hertwig)—these are only preliminary descriptive formulæ. It is possible that the experiments of Driesch and others, who have observed the cleavage of eggs under the pressure of glass plates, may be of service in enabling us to eliminate the mechanical factors. The associated problem of the relation of the early cleavages to the axes of the future embryo is not less difficult. It is indeed a familiar fact that the ovum may show polar differentiation and bilateral symmetry, and that in some cases, *e.g.*, frog and Tunicate, the first cleavage plane coincides with the median plane of the adult body. On the other hand, the first cleavage sometimes corresponds approximately to the transverse plane of the body (newt); or separates an ectoderm cell from an endoderm cell; or separates a germ-

cell from a somatic cell (*Ascaris*), and so on; so that what it does admits of no general statement. Moreover, the orientation of the ovum may be entirely altered, as in the frog, by artificial conditions, without the normality of the resulting embryo being affected; and a minute ovum-fragment, as in sea-urchins, may give rise to a complete larva; so that there are strong reasons for the view that the egg-cytoplasm is at first isotropous or indifferent, and that its polarity or anisotropy is secondarily acquired, sometimes earlier, sometimes later, and in very varied degrees.

Experimental Embryology.—Particularly significant of recent embryological work has been the frequent recourse to experiment, and within a few years a large literature has grown, with its centre in Roux's *Archiv für Entwicklungsmechanik.* Artificial isolation of blastomeres by cutting or shaking apart; subjection of the developing ova to peculiar conditions of pressure; modifications of temperature, illumination, &c.; and alterations in the chemical character of the medium, have been the four most frequent lines of experiment. The main aim has been to analyse the immediate factors in development, and while it is too soon to estimate the value of the results, some illustrations may be given.

Isolation of Blastomeres.—As long ago as 1869 Haeckel divided the blastulæ or morulæ of Siphonophora with a fine needle into two, three, or four pieces, and observed that each developed into a complete larva. This was one of the first experiments along a line which many investigators followed during the last decade of the 19th century. In 1877 Chun made, though he does not appear to have published, the observation that when the first two blastomeres of a Ctenophore ovum were shaken apart, each formed a half-larva, with four ciliated ridges, four meridional vessels, and one tentacle; moreover, each became sexual, and the half which was wanting was eventually regenerated. The ova of frog, newt, fishes, lancelet, ascidian, mollusc, sea-urchin, medusa, &c., have been made the subjects of similar experiments, in which blastomeres are isolated by shaking the segmenting ovum until separation occurs, or by actually cutting off or puncturing a portion so as to destroy its power of development. By shaking the water in which the two-cell stages of the segmenting ova of *Amphioxus* floated, E. B. Wilson produced from the separated halves two independent twins of half the normal size, each of the isolated cells segmenting like an intact ovum, and giving origin, through blastula and gastrula stages, to a half-sized metameric larva. When incomplete separation was effected by the shaking, double embryos—like Siamese twins—resulted, and formed shortlived segmented larvæ. Complete isolation of the first four blastomeres resulted in four dwarf blastulæ, gastrulæ, and oval larvæ; separation into two pairs of cells yielded two half-sized larvæ; incomplete separation resulted in (*a*) double embryos, (*b*) triple embryos—one twice the size of the others—or (*c*) quadruple embryos, each a quarter size. An isolated blastomere from the eight-cell stage proceeded to segment, but did not reach the gastrula stage.

Numerous experiments on the developing egg of the frog by Roux, Hertwig, Schultze, Morgan, Endres, Walter, Wetzel, and others have after no little controversy made one interesting result clear, that one of the first two blastomeres may develop into a half-embryo, or into a half-sized whole embryo, according to the conditions of the experiment. "So long as the first two blastomeres remain in contact without any disturbance of the cell-contents, each blastomere develops its half of the body. On the other hand, if the protoplasm is disturbed by reversing the position of the egg after the first cleavage, there generally results a whole embryo from each blastomere" (Morgan, 1897, p. 131). Thus we may place the behaviour of the frog's ovum intermediate between that of the Ctenophor (where an isolated blastomere forms a half-embryo) and that of the lancelet (where an isolated blastomere forms a whole embryo of small size).

Pressure Experiments.—By causing a developing ovum (*e.g.*, of frog) to segment between parallel glass plates, or in a glass tube of smaller calibre than the diameter of the egg, this general result has been established, that the distribution of the nuclei may be entirely different from that in normal conditions, and yet normal embryos result. It seems difficult to avoid the conclusion that the sequence of the early nuclear divisions has no necessary relation to the subsequent formation of the embryo, and that the nuclei in these early stages are all equivalent (Morgan, 1897, chap. x.). O. Hertwig (1898) found that when centrifugal force was exerted in a certain degree on the eggs of *Rana esculenta*, it produced a more marked separation of the lighter and heavier substances, in consequence of which the cleavage was restricted to the upper or "animal half" of the ovum. Indeed, a meroblastic type was closely approached, for an undivided yolk-containing portion occupied from one-half to two-thirds of the egg, the remainder was formed by a blastoderm with a blastocoel, and the resemblance was heightened by the formation of a special layer of merocytes—a yolk-syncytium—beneath the blastoderm. But here again, if removed in due time from the disturbing influences, the eggs gave rise to embryos with the normal equipment of organs.

Influence of Temperature.—Numerous experiments have also been made on the influence of temperature on developing ova, but few of the results are at present intelligible. Thus Driesch, prompted by Vejdovsky's note that the eggs of the earthworm, *Allolobophora trapezoides*, most frequently form twin-embryos in warm weather, tried the effect of warming the developing ova of *Sphærechinus granularis*, with the result that in some cases almost all of them formed distinct twin blastulæ, gastrulæ, and even plutei. Similarly, prompted by Selenka's observation that increased temperature produced deviations from the normal cleavage in marine Planarians, Driesch experimented and found that increase of temperature wholly or partially inhibited the formation of the smaller cells or micromeres, and otherwise disturbed the segmentation, without, however, in the end affecting the normality of the result. Again, he found that when the blastulæ of *Sphærechinus granularis*, about twenty-six hours after fertilization, were kept on a stove heated to about 30° C., the great majority showed in about eighteen hours the exogastrula state; *i.e.*, the growing zone at the so-called vegetative pole, which is normally invaginated to form the archenteron, bulged outwards instead of inwards, the final result being shrivelled, gutless, or anenteric larvæ, which survived for a week.

Chemical Reagents.—Another series of studies in experimental embryology is concerned with the influence of chemical reagents upon the developing ova. Thus Curt Herbst has observed the results of placing the eggs of sea-urchins (*Sphærechinus granularis*) in sea-water to which a little lithium chloride has been added, in the proportion of 2·5 cubic centimetres of 3·7 per cent. aqueous solution to 97·5 cubic centimetres of sea-water. In this the fertilized ovum segments into an elongated blastula which becomes constricted into two vesicles, one thick-walled (the archenteric portion), the other thin-walled (the gastrula wall); the thick-walled portion, which should normally be invaginated to form the endoderm, grows out of proportion to what is normally the ectoderm-forming area, and the series ends in a form (holo-entoblastic) in which the thin-walled vesicle or ectodermic area has wholly disappeared. If rather less lithium is used, the type of larva which results is somewhat different, though the two are connected by transitional forms; it is an exogastrula, in which, as the name suggests, the endoderm is evaginate instead of invaginate.

Development.—More clearly than even a dozen years ago we now recognize that the germ-cells, and especially their nuclei, form the material basis of inheritance; that there is genetic continuity between the germ-cells of the parents and those of their offspring; that fertilization implies a union of two individualities condensed for the time being into minute cells; that paternal and maternal characteristics are distributed in exact equality by the nuclear or cellular divisions which constitute the mode of all development; and so on. On the other hand, we have still to confess our entire inability to solve the old problems: How are the specific characters potentially contained within the germ-cells, and by what mechanism do they attain expression in development?

Germinal Areas.—On one view it is supposed that the germ-cell has an architectural organization predetermined before development begins, and that development is in part a "histogenetic sundering" of the pre-existing germinal localization. Some authorities, *e.g.*, Ray Lankester and Whitman, Flemming and van Beneden, have suggested that the predetermination is expressed in the organization of the egg-cytoplasm—the essential idea of the theory of "organogenetic germinal areas" which His elaborated in 1874. This theory may be supported by Roux's experiments on the frog ovum, where, after one of the first two blastomeres had been punctured, the intact half developed into a one-sided embryo; and it may be opposed by Wilson's experiments on the lancelet ovum, where an isolated blastomere of the four-cell stage still formed a complete embryo. It may be supported by the experiments of Morgan and Driesch on Ctenophor ova, where a defect in the cytoplasm is often followed by a modified cleavage and a defective embryo, even when the whole of the nuclear material is intact; and it may be opposed by Delage's experiments on the ova of sea-urchins, &c., where a small (and non-nucleated) fragment of

an egg may be fertilized and give rise to a complete larva. In fact, the experimental results do not as yet settle the question.

Idioplasm.—Supplementary, rather than opposed, to the idea of germinal localization is that of a specific idioplasm, a complex substance which in its molecular organization and in the metabolism which it induces is different for each species. The idea of an idioplasm was first elaborated by Nägeli (1884), who did not concern himself, however, with its particular localization in the germ-cell; this further step was taken by Hertwig, Strasburger, Kölliker, and Weismann, who, from the importance of the nucleus in metabolism, in the regeneration of Protozoon fragments, in maturation, in fertilization, and in cleavage, argued that it—and even more definitely its chromatin—must be the bearer of the idioplasm. On this view the locality of the pre-established organization is shifted from the cytoplasm to the nucleus, though it may still be admitted that in certain cases a cytoplasmic predetermination arises as a secondary result of idioplasmic influence.

Starting from the assumption that the idioplasm of the germ-nuclei was a complex aggregate of different kinds of granules—the material expressions of different sets of qualities—Roux invented the hypothesis of two kinds of nuclear-division, quantitative and qualitative. The former results in equivalent, the latter in dissimilar nuclei; the former is an integral, the latter a differential division. It is the latter mode which is supposed to be characteristic of the early stages of development during which the different components or qualities of the idioplasm are distributed among the blastomeres, each of which, though not independent of its neighbours, is regarded as endowed with a power of "self-differentiation" due to its specific share of the idioplasm.

Similarly, Weismann in his "Germ-Plasm" and elsewhere has elaborated a theory of development which, while confessedly hypothetical, is remarkable in its logical completeness. He supposes the idioplasm or germ-plasm to be built up of numerous different components or "biophores" corresponding to the characteristics of the adult; the biophores are aggregated in groups or "determinants"; the determinants are grouped in "ids"—the chromatin granules; and the "ids" in "idants"—the chromosomes. In the early stages of development there is by differential division a distribution of the components of the germ-plasm. "Ontogeny depends on a gradual process of disintegration of the id of the germ-plasm, which splits into smaller and smaller groups of determinants," till finally only one kind of determinant remains in each cell, there breaking up into its constituent biophores which give the cell its inherited specific character. But while this is going on, there is also a process of quantitative division, which gives rise to the lineage of future germ-cells. The theory of development here outlined has been criticized from many sides. It has often been pointed out that there are no visible phenomena of nuclear division which suggest that the partition may be qualitative; on the contrary, that the whole elaborate process of mitosis seems adapted to secure the equivalence of the two daughter-nuclei. That the division may be differential or qualitative must, of course, be admitted, though we cannot prove it. It is perhaps more to the point to inquire whether the hypothesis fits the known facts, and critics bring forward some of the results of experimental embryology, especially where one of the first two or first four blastomeres is seen to form a normal embryo, or where under artificial conditions (of pressure, &c.) certain cells develop into tissues which in normal conditions are formed by quite different cells. To explain these and other difficulties, *e.g.*, in regenerative phenomena, various ingenious sub-hypotheses have had to be invented.

Without abandoning the position to which almost all modern embryological work has led up, that the essential intrinsic factor in development is the pre-established and inherited organization of the germ-plasm, and without attempting to deny that the nuclear substance may be gradually specialized as differentiation proceeds, it is possible (as Hertwig, Driesch, Morgan, Wilson, and others have shown) to consider the facts of development in a manner somewhat different from that suggested by Roux and Weismann. We may suppose that from the youngest ovarian ovum onwards the nucleus exerts a "control" upon the surrounding cytoplasm, whether by the migration of "pangens" (De Vries, Hertwig), or of specific "formative substances" (Sachs, Loeb), or of enzymes (Driesch), or by a propagation of molecular movements (Nägeli). We may suppose that in some way—varying greatly in degree in different cases—the nucleus prepares in the cytoplasm a framework for its future operations. This may be so slightly pre-established that from a minute fragment of the egg a complete larva may be reared (Echinoid, &c.), or so well established that if a part of the unsegmented egg is removed the remainder forms a defective larva (Ctenophore). When division occurs, the daughter-nuclei, though equivalent, find themselves in a not wholly isotropic medium, and this incites further differentiation, both in the nuclear material and in its cytoplasmic sphere of influence. If the initial cytoplasmic differentiation was slight, the first steps in differentation will be correspondingly slight, and in these cases the isolated blastomeres may still form complete embryos. If the initial cytoplasmic differentiation was more pronounced, the isolated blastomere may not be able to do more than form a partial embryo; the setting of the cytoplasmic mosaic may be too strong to be overcome even by the completely equipped blastomere-nucleus. Thus we reach the idea expressed, for instance, by Driesch: "The relative position of a blastomere in the whole determines in general what develops from it; if its position be changed, it gives rise to something different; in other words, its prospective value is a function of its position." But the "position" is more than merely topographical; it means, as Wilson says, "the physiological relation of the blastomere to the inherited organization of which it formed a part." But even when we recognize the importance of the initial inherited organization, of the influence of segment upon segment as development proceeds, and of the normal environmental stimuli, we have still to confess that the problem of development remains unsolved.

The Recapitulation Doctrine.—The generalization that the individual development or ontogeny of an organism tends to be a recapitulation of the racial evolution or phylogeny is no longer accepted so readily as it was twenty years ago. Many facts have shown that this luminous idea which has certainly guided research may also mislead. Precise embryological investigation has given prominence to the fact—which von Baer himself clearly recognized—that while there is a parallelism between the stages of organogenesis in the individual and the grades exhibited in phylogeny, or in presumed phylogeny, yet there are individual characteristics present from the first. There is a parallelism between the stages of organogenesis in the frog and grades of structure exhibited in fishes, but no one can accurately call the larval frog at any stage piscine; it is an amphibian from first to last. There is a parallelism between the stages in the development of the lens in a higher mammal and grades of lens-structure exhibited in lower Vertebrates, but the rudiment of the lens in the dog is from the first specifically a dog's lens, and nothing else, as Rabl (1899) has shown in detail. In short, the idea of ontogenetic and phylogenetic parallelism must be corrected by the conception that the organism develops as a specific unity.

Regeneration.—Within recent years our knowledge of the occurrence of regeneration and of the internal processes involved has been greatly increased; our understanding of the facts, however, lags far behind. What Réaumur, Lessona, and Darwin suggested, that regeneration is especially characteristic of those organisms and of those parts of organisms which are or have been in the course of nature most liable to breakage or other non-fatal injury, has been especially elaborated by Weismann, who is the chief exponent of the view that regeneration is an adaptive phenomenon, "that the regenerative power of a part is to be considered, not as a direct and necessary expression of the nature of the organism, but rather as a capability which, though it may be absent, is found wherever it is necessary in the interests of species-preservation. The capability of a part for regeneration depends on whether the part was frequently liable to be lost in the ordinary course of life, and also on its relative biological importance for the animal." That internal organs, which are but slightly subject to non-fatal injury, should show little regenerative capacity; that the weak limbs of *Siren* and *Proteus* should not be replaced, though the gills are, and though the strong limbs of *Triton* are; that there should be special regenerative capacity when the leg of an insect is excised at the point where breakage is most apt to occur in the struggles of moulting or ecdysis; that it should be possible to find in the conditions of life some good reason why the beaks of certain birds, *e.g.*, storks, or the eyes of certain animals, *e.g.*, newts, should be readily regenerated; that regeneration should be so common in animals like branching polypes, elongated worms, starfishes, and arthropods;—these are illustrations of the evidence which has led many to regard the occurrence of regeneration as the

adaptive result of natural selection, and not simply as an expression of the primary reproductive capacity of cells. On the other hand, it is pointed out that in some cases there is no definite relation between the regeneration of a part and its liability to injury. Thus, in opposition to Weismann's interpretation, T. H. Morgan has pointed out that the small fourth and fifth thoracic limbs of a hermit-crab, which do not seem to be often (if ever) injured, regenerate readily, that the terminal abdominal appendages, which are entirely protected, likewise regenerate quickly and normally. Or, again, it seems almost impossible that a hermit-crab's walking-leg should under ordinary conditions of life be broken off proximal to the basal "breaking-joint" (between the fifth and sixth segments), where the leg, if injured, is usually thrown off; yet if it be cut off proximal to that joint there is regeneration. Under ordinary circumstances, if a leg is injured distal to the "breaking-joint," the leg is thrown off at the joint; yet regeneration was observed from the cut end of a limb artificially excised outside the breaking-joint. Such facts seem to the observer to show that there is no relation between the regeneration of the leg and its liability to injury. Thus the case for and against the interpretation of regenerative phenomena as adaptive in their occurrence must remain *sub judice* until a large number of instances have been carefully studied. It has also been urged against Weismann's position that the result of regenerative growth is sometimes non-adaptive, as in the instance of a posterior half of an earthworm, observed by Spallanzani (1768), by Morgan (1899), in which the new part was a tail, not a head—the result being a worm with two tails turned in opposite directions. But unless there were many instances of this kind there is no argument, since no one supposes that adaptations are perfect. Two other interesting questions rise out of the study of regeneration: (*a*) How far there is similarity between the regenerative growth and the process of normal development, a question to which opposite answers have been given in different cases and by different observers in the same case; (*b*) how far it is possible at present to form any scientific conception of the manner in which the potentiality of regeneration is distributed and localized within the organism, and kept latent until specific stimuli liberate it. But neither of these questions will at present admit of brief discussion.

Alternation of Generations.—The distinction which Celakowsky introduced in 1868 between two kinds of alternation of generations has been much discussed. Homologous alternation is illustrated by many Algæ and Fungi where offspring of similar appearance are produced in two different ways, either vegetatively or sexually; antithetic alternation is best illustrated by Bryophytes and Pteridophytes where there is a regular alternation between a vegetative sporophyte and a sexual gametophyte which differ entirely in their structure. But there is difference of opinion as to the value of this distinction, or, if it be admitted, as to its applicability to particular cases. Apart from this, it is interesting to note that in many cases the number of chromosomes in the dividing nucleus of the sporophyte is twice that which occurs in the gametophyte. Here too may be noticed the subtle theory of Beard (1896), which suggests that there is a disguised alternation of generations in Vertebrate animals, just as there is in flowering plants. In several Invertebrates, *e.g.*, Echinoderms and *Phoronis*, the egg gives rise to a larva which does not directly develop into the definitive organism, but serves as the foundation on which the development recommences, as it were, on a new tack; similarly Beard maintains that in Vertebrates, whether skate or chick, there are traces of an asexual larval stage, on the top of which the embryo proper develops. At the "critical stage," when the embryo begins to put on its generic and specific characters, it also sets about the task of suppressing the larval foundation.

In-breeding and Crossing.—In regard to close in-breeding there is still much need of experiment, but it seems certain that in many cases with a healthy stock this may go far without disadvantageous results. It seems to fix and strengthen characters, and to develop prepotency—a fact of considerable evolutionary interest, since various forms of isolation may bring about in-breeding in natural conditions. But even when the stock is sound to start with, there seem to be limits to close in-breeding, as von Rath and von Guiata found with rats and mice. As many breeders have recorded, there is a tendency to debility, abnormality, and sterility. According to Reibmayr, the success of a human race is in part dependent on the alternation of periods of sustained in-breeding, in which characters are fixed, and periods of cross-breeding, in which the advantages of "fresh blood" are secured. It is appropriate here to notice that an increased knowledge of the number of cases in which self-pollination or autogamy occurs in plants has led to a somewhat modified statement of the Knight-Darwin conclusion that nature abhors self-fertilization; and the essay of Möbius may be referred to for its vigorous protest against the prevalent idea that continuous vegetative multiplication necessarily results in degeneration.

Hybridization.—Our knowledge of the possibilities of hybridization in artificial conditions and of its actual occurrence in nature is slowly increasing, but few general statements can as yet be ventured. That it occurs readily in some cases, and is rarely successful in others, is well known, but the reasons for this appear to be manifold. One of the results of Pflüger's extensive experiments on the hybridizing of Amphibians points to the importance of what may be called the mechanical factors; thus the spermatozoa of *Rana fusca*, which have very pointed heads, thinner than those of related forms, can fertilize the eggs of nearly all other species (*R. arvalis*, *R. esculenta*, and *Bufo communis*), but the blunt, thick-headed spermatozoa of *R. arvalis* and *R. esculenta* cannot fertilize the eggs of any other species. On the other hand, Hertwig's experiments on sea-urchins suggest that the possibility of crossing depends in great part on the state of the egg; thus eggs in good condition resist the entrance of foreign spermatozoa to which stale eggs prove receptive. It has also been made clear that segmentation may occur after hybridization without further development succeeding; thus T. H. Morgan fertilized the ova of a starfish with the spermatozoa of a sea-urchin, and reared hybrid gastrulæ, but no further stages. While a general result of hybridization is to induce variation, *i.e.*, to alter the normal expression of inheritance, the results seem extraordinarily diverse and unpredictable, the offspring sometimes resembling the male parent, sometimes the female, sometimes neither. In some cases the result is novel, in other cases there seems to be a return to the characters of an ancestral form. In the latter case it may be that latent characters which have for a time been unexpressed are suddenly permitted to develop, or that a new permutation of hereditary qualities independently reproduces an old pattern. Ewart paired a pure white fantail cock-pigeon with a cross previously made between an owl and an archangel pigeon, and the result was a couple of which one resembled the Shetland rock-pigeon, and the other the blue rock of India; von Guiaita found that if the Japanese dancing mouse was crossed with an albino, the second generation consisted of grey mice like the wild forms. Standfuss has suggested that in crossing butter-

flies the phylogenetically older species is prepotent over the younger; Vernon has shown that in sea-urchins the characters of the hybrid offspring incline to be those of the species whose elements were relatively the more mature when fertilization occurred. In short, the variable results seem to be such as might ensue from a germinal struggle between hereditary characteristics of varying strength. Suchetet has recorded 82 cases of what he believes to be genuine species-hybridism in mammals, and 178 in birds: of the 82 crosses between mammals of different species, 62 resulted in sterile offspring; of the 178 crosses between distinct species of birds, only 22 have been known to result in fertile offspring. As to the causes of the sterility little is as yet known, but Suchetet speaks of cases where the gonads were atrophied and of others where the ducts were abnormal.

Telegony.—The ancient and still widespread belief that offspring may resemble not so much, or not only, their parents or ancestors, but a previous mate of their mother, has been much discussed during recent years. Ewart (1899) has experimented especially with horse and zebra, and has not in any case found satisfactory evidence of telegony. Moreover, he has pointed out that the reversions which not infrequently follow the crossing of different breeds may have supplied the material on which the belief in telegony has grown. Other critics have for the most part been content to point out the inherent difficulties in any theory of the mechanism of telegony, whether on the infection-hypothesis (according to which the sperm of the previous sire exerts an influence upon the bodily constitution or gonads of the mother) or on the saturation-hypothesis (according to which an influence from the unborn offspring of the first crossing is supposed to affect the body or gonads of the mother in a manner so specific that offspring by a second sire may present resemblance to the first, with which they are in no way genetically related). At present the scientific evidence is so distinctly unfavourable to belief in the occurrence of telegony, that to discuss suggested explanations or criticisms seems unnecessary.

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(J. A. T.)

Reptiles, as known in the existing world, are the modified, and in many respects degenerate, representatives of a group of vertebrate animals which attained its maximum development in the Mesozoic period. So far as can be judged from the skeleton, some of the members of this group then living might have become mammals by very slight change, while others might as readily have evolved into birds. It is therefore probable that the class Reptilia, as now understood, comprises the direct ancestors both of the Mammalia and Aves. Assuming that its extinct members, which are known only by skeletons, were organized essentially like its existing representatives, the class ranks higher than that of the lowest five-toed vertebrates (class Amphibia) in the investment of the fœtus by two membranous envelopes (the amnion and allantois), and in the total absence of gills even in the earliest embryos. It ranks below both the Mammalia and Aves in the partial mixture of the arterial blood with the venous blood as it leaves the heart, thus causing the organism to be cold-blooded; it also differs both from Mammalia and Aves in retaining a pair of aortic arches, of which only the left remains in the former, while the right one is retained in the latter. No feature in the endoskeleton is absolutely distinctive, except possibly the degeneration of the parasphenoid bone, which separates the Reptilia from the Amphibia. In the exoskeleton, however, the epidermis forms horny scales, such as never occur in Amphibia, while there are no traces of any structures resembling either hairs or feathers, which respectively characterize Mammalia and Aves.

There is little doubt that true reptiles date back to the latter part of the Palæozoic period, but at that epoch the Amphibia approached them so closely in the characters of the skeleton that it is difficult to distinguish the members of the two classes among the fossils. Some of the Palæozoic Amphibia—a few of the so-called Labyrinthodonts—are proved to have had well-developed gill-arches in their immature state, while there are conspicuous marks of slime-canals on their skulls. Others are merely regarded as Amphibia because they closely resemble the genera which are proved to have been gill-breathers when immature. All these genera, however, so far as known, agree with the existing Amphibia in the production of their large parasphenoid bone as far forwards as the vomers to form a rigid and complete basicranial axis (Fig. 1, A). Those genera which less resemble the typical Labyrinthodonts are characterized by the reduction of the parasphenoid bone so that it no longer reaches the vomers; in these animals the weakened skull exhibits a secondary basicranial axis formed by the approximation of the pterygoids to the median line (Fig. 1, B). The latter condition is universal in existing reptiles, and may therefore perhaps be regarded as a diagnostic feature. If so, the oldest known undoubted reptile is *Palæohatteria,* from the Lower Permian of Saxony.

In the structure of the skull *Palæohatteria* is much like the existing *Sphenodon,* the cheek-plates which cover the temporal and masseter muscles on each side being pierced by two great vacuities, one superior-temporal, the other lateral-temporal. The majority of the earliest reptiles, however, either resemble the Labyrinthodonts in having the biting muscles completely covered with a roof of bony plates, or exhibit a slight shrinkage of this investment so that a superior-temporal vacuity appears. As the various groups or orders become differentiated, this shrinkage or reduction continues, while the shape of the ossifying ear-capsule changes, and the squamosal

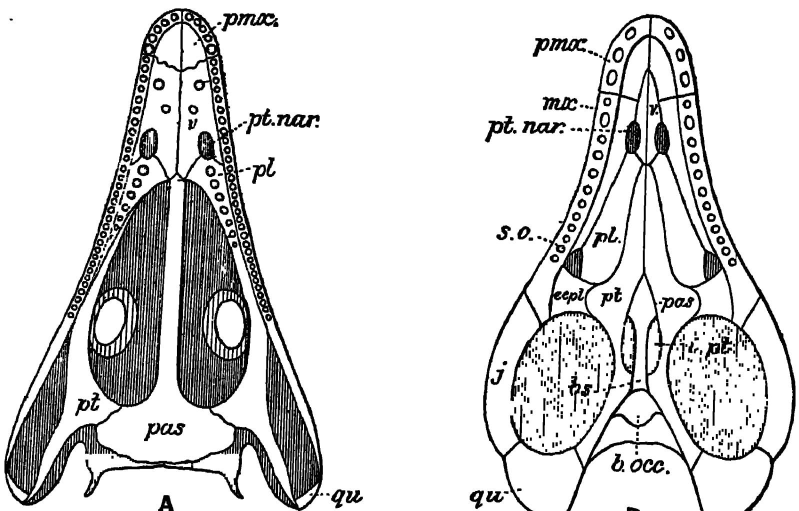

Fig. 1.—A, Palate of Palæozoic Amphibian (*Archegosaurus decheni*). (*After Credner.*) B, Palate of Mesozoic Reptile (*Plesiosaurus macrocephalus*). (*After C. W. Andrews.*) *b.occ*, basioccipital; *bs*, basisphenoid; *ecpt*, ectopterygoid; *i.pt*, interpterygoid vacuity; *j*, jugal; *mx*, maxilla; *pas*, parasphenoid; *pl*, palatine; *pmx*, premaxilla; *pt*, pterygoid; *pt. nar*, posterior nares; *qu*, quadrate; *s.o*, suborbital vacuity; *v*, vomer.

bone, which covers the organ of hearing in the fishes, and presumably also in the Palæozoic Amphibia, is gradually thrust outwards from all connexion with this capsule except at its hinder angle. The resultant modifications are diagrammatically represented in Fig. 2. In one series of orders, comprising the Anomodontia, Chelonia, Sauropterygia, and Ichthyopterygia (Fig. 2, B, C), the superior-temporal vacuity (*s*) first appears; and the cheek-plates in the broad temporal arch thus formed may be variously fused together, sometimes even irregularly perforated—showing at first, indeed, the usual inconstancy of a new and not completely established feature. From the earliest members of this series of reptiles, palæontology seems to demonstrate that the Mammalia (with one robust temporal arcade or zygomatic arch) arose. In a second series, comprising the orders Rhynchocephalia, Dinosauria, Crocodilia, and Ornithosauria (Fig. 2, D), the broad arch of cheek-plates is regularly pierced by a lateral-temporal vacuity, which leaves a narrow bar above, another narrow bar below, and uncovers the middle part of the quadrate bone. By the constant loss of the lower, and the frequent loss of the upper, bar, some members of this series eventually pass into the order Squamata (Lacertilia + Ophidia), in which the quadrate

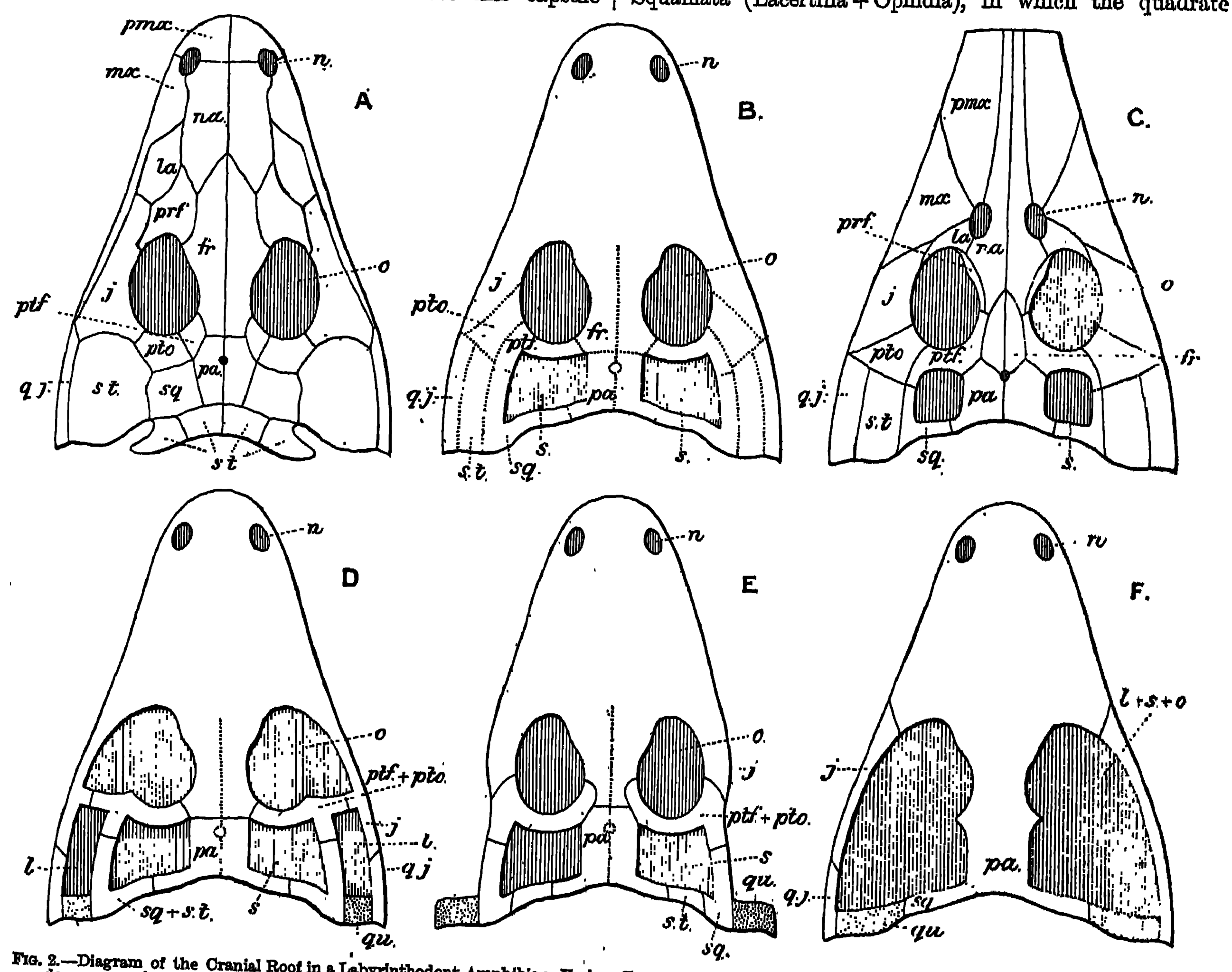

Fig. 2.—Diagram of the Cranial Roof in a Labyrinthodont Amphibian, Various Types of Reptiles, and a Bird. A, Labyrinthodont Amphibian (*Mastodonsaurus giganteus*). B, Generalized Anomodont or Sauropterygian, passing with slight modification into the Chelonian (sutures dotted to denote inconstancy in fusion of elements). C, *Ichthyosaurus*. D, Generalized Rhynchocephalian, Dinosaurian, Crocodilian, or Ornithosaurian. E, Generalized Lacertilian, often losing even the arcade here indicated. F, Generalized bird. *fr*, frontal; *j*, jugal; *l*, lateral temporal vacuity; *la*, lachrymal; *mx*, maxilla; *n*, narial opening; *na*, nasal; *o*, orbit; *pa*, parietal; *pmx*, premaxilla; *prf*, prefrontal; *ptf*, postfrontal; *pto*, postorbital; *q.j*, quadrato-jugal; *qu*, quadrate; *s*, supratemporal vacuity; *s.t*, supratemporals and prosquamosal; *sq*, squamosal. Vacuities shaded with vertical lines, cartilage bones dotted. (*From A. S. Woodward, "Outlines of Vertebrate Palæontology."*)

bone is completely exposed and loosely attached to the skull (Fig. 2, E); other reptiles exhibiting a similar modification may readily have acquired the typical Avian skull (Fig. 2, F) by the loss of the upper and the retention of the lower temporal bar in question.

In view of these and other palæontological considerations, the Reptilia may be classified into orders as follows:—

ORDERS OF CLASS REPTILIA.

1. **Anomodontia.**—Bones of postero-lateral region of skull forming a complete roof over the temporal and masseter muscles, or contracted into a single broad zygomatic arch, leaving a superior-temporal vacuity. Pineal foramen present. Ribs double-headed. No abdominal ribs. A large separately ossified epicoracoid. Limbs for support as well as progression; third and fourth digits with not more than three phalanges. Dermal armour feeble or absent. *Range.*—Permian and Triassic.

2. **Chelonia.**—Postero-lateral region of skull as in Anomodontia, except bones of ear-capsule more modified. No pineal foramen. Ribs single-headed. No sternum. Pectoral and pelvic arches unique in being situated completely inside the ribs. No epicoracoid. Abdominal ribs replaced by three or four pairs of large plates, which, with the clavicles and interclavicle, form a plastron. Limbs only for progression; some of the long bones with separately ossified epiphyses; third and fourth digits with not more than three phalanges. A regular dorsal carapace of bony plates intimately connected with the neural spines, and ribs of seven to nine dorsal vertebræ. *Range.*—Upper Triassic to Recent.

3. **Sauropterygia.**—Bones of postero-lateral region of skull contracted into a single broad zygomatic arch, leaving a superior-temporal vacuity. Pineal foramen present. No fused sacral vertebræ. All dorsal ribs single-headed, articulating with transverse processes of the neural arches. Abdominal ribs forming dense plastron. Apparently no sternum. Coracoid, pubis, and ischium in form of much expanded plates. Humerus and femur with separately ossified conical epiphyses. Limbs modified as paddles, with not more than five digits, of which the third and fourth always have more than three phalanges; all digits usually consisting of numerous phalanges. No dermal armour. *Range.*—Upper Triassic to Cretaceous.

4. **Ichthyopterygia.**—Bones of postero-lateral region of skull contracted into a single broad zygomatic arch, leaving a superior-temporal vacuity. Pineal foramen present. Vertebral centra short and deeply biconcave, with feeble neural arches which are almost or completely destitute of zygapophyses. No fused sacral vertebræ. Cervical and dorsal ribs double-headed, articulating with tubercles on the vertebral centra. Abdominal ribs forming dense plastron. Apparently no sternum. Coracoid an expanded plate, probably with cartilaginous epicoracoid. Pelvis very small, not connected with vertebræ. Limbs modified as paddles, with digits of very numerous short phalanges, which are closely pressed together, sometimes with supplementary rows of similar ossicles. No dermal armour. A vertical triangular caudal fin, not supported by skeletal rays. *Range.*—Upper Triassic to Cretaceous.

5. **Rhynchocephalia.**—Bones of postero-lateral region of skull contracted into two slender zygomatic bars, leaving a superior-temporal and a lateral-temporal vacuity, and partly exposing the quadrate bone from the side. Pineal foramen present or absent. Ribs single-headed. Abdominal ribs present. Sternum present. Epicoracoid cartilaginous. Limbs only for progression; third and fourth digits with four or five phalanges. Dermal armour feeble or absent. *Range.*—Lower Permian to Recent.

6. **Dinosauria.**—Postero-lateral region of skull as in Rhynchocephalia. No pineal foramen. Cervical and dorsal ribs double-headed. No abdominal ribs. Sternum present, but apparently no clavicular arch. Limbs for support as well as progression; third and fourth digits with four and five phalanges respectively. Dermal armour variable. *Range.*—Triassic to Cretaceous.

7. **Crocodilia.**—Postero-lateral region of skull as in Rhynchocephalia. No pineal foramen. Cervical and dorsal ribs double-headed. Abdominal ribs present. Sternum present; also interclavicle, but no clavicles. Limbs only for progression on land or swimming; third and fourth digits with four or five phalanges. Dermal armour variable. *Range.*—Lower Jurassic to Recent.

8. **Ornithosauria.**—All bones extremely dense, light, and hollow, the organism being adapted for flight. Postero-lateral region of skull as in Rhynchocephalia. No pineal foramen. Cervical and dorsal ribs double-headed. Abdominal ribs present. Sternum present, and keeled for attachment of pectoral muscles; no clavicular arch. Fifth digit of hand much elongated to support a wing-membrane, but with only four phalanges. Hind limb feeble. No dermal armour. *Range.*—Lower Jurassic to Cretaceous.

9. **Squamata.**—Bones of postero-lateral region of skull much reduced and partly wanting, never forming more than a slender superior-temporal bar, thus completely exposing the quadrate, which is only loosely attached to the cranium at its upper end. Pineal foramen present. Ribs single-headed. No abdominal ribs. Sternum present when there are limbs. Limbs, when present, only for progression; third and fourth digits at least with more than three phalanges. Dermal armour feeble or absent. *Range.*—Cretaceous to Recent.

Order 1. ANOMODONTIA.—The Anomodonts are so named in allusion to the peculiar and unique dentition of the first-discovered genera. They are precisely intermediate between the Labyrinthodont Amphibia and the lowest or Monotreme Mammalia. They flourished at the period when the former are known to have reached their culmination, and when the latter almost certainly began to appear. Many of them would, indeed, be regarded as primitive Mammalia, if they did not retain a pineal foramen, a free quadrate bone, and a complex mandible. The term *Theromorpha* or *Theromora* is thus sometimes applied to the Order they represent. So far as known, they are all land-reptiles, with limbs adapted for habitual support of the body, and their feet are essentially identical with those of primitive mammals. Most of them are small, and none attain a gigantic size. They first appear in the Permian of Europe and North America, and also occur in the Triassic both of Europe and India, but they are best represented in the Karoo formation (Permian and Triassic) of South Africa. The *Pariasauria* most closely resemble the Labyrinthodont Amphibia, but have a single occipital condyle. One genus (*Otocœlus*) has a carapace suggesting that it may be an ancestral Chelonian. The *Theriodontia* exhibit the marginal teeth differentiated

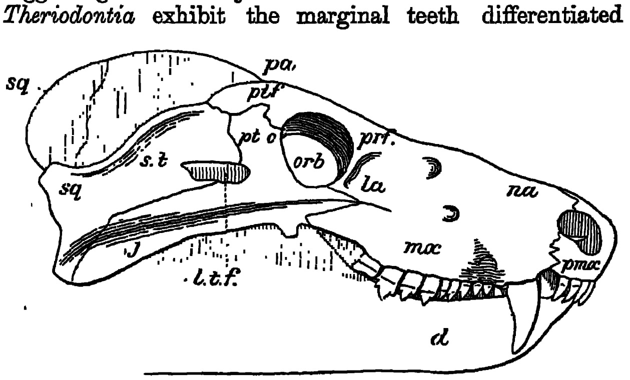

FIG. 3.—Skull of an Anomodont (Theriodont) Reptile (*Cynognathus crateronotus*), one-fifth nat. size.—Karoo formation (Permian or Triassic), South Africa. *d*, dentary; *j*, jugal; *l.t.f*, incipient lateral temporal vacuity; *la*, lachrymal; *mx*, maxilla; *na*, nasal; *orb*, orbit; *pa*, parietal; *pmx*, premaxilla; *prf*, prefrontal; *pt.o*, postorbital; *ptf*, postfrontal; *s.t*, supratemporal (prosquamosal); *sq*, squamosal. (*From A. S. Woodward, "Outlines of Vertebrate Palæontology."*)

(in shape) into incisors, canines, and molars (Fig. 3). They have two occipital condyles, as in mammals. The *Dicynodontia* have one pair of upper tusks or are toothless: their occipital condyle is trefoil-shaped, as in Chelonia.

Order 2. CHELONIA.—This Order occurs first in the Upper Triassic of Würtemberg, where a complete "shell" has been found (*Proganochelys*). They are proved to have been toothless since the Jurassic period, and have only changed very slightly since their first appearance. The marine turtles seem to have first acquired elongated paddles and vacuities in the shell during the Cretaceous period, and the Trionychia, destitute of epidermal shields, apparently arose at the same time.

Order 3. SAUROPTERYGIA.—These are amphibious or aquatic reptiles (Fig. 4). The head is comparatively small in most genera, and the neck is usually elongated though not flexible. The tail is insignificant, generally short, and both pairs of paddles seem to have been concerned in progression. The Order appears to have arisen from a group of land-reptiles, for its earliest members, from the Triassic of Europe (*Lariosaurus*), South

Africa (*Mesosaurus*), and Brazil (*Stereosternum*), are all amphibious animals. They are comparatively small, and their limbs are only just becoming paddle-like. The skull suggests affinities with the terrestrial Anomodontia, and the shape of the scapula and the epiphyses of the humerus and femur seem to show some connexion with the Chelonia. The truly aquatic Sauropterygians of the Jurassic (Fig. 4) and Cretaceous periods possess most effective paddles with elongated digits, and as the genera are traced upwards in the geological formations it is possible to observe how the arches supporting the limbs become more rigid until the maximum of strength is reached. Some of the largest Upper Jurassic and Cretaceous species must have been 10 metres in length. They were cosmopolitan in their distribution, but became extinct before the dawn of the Tertiary period.

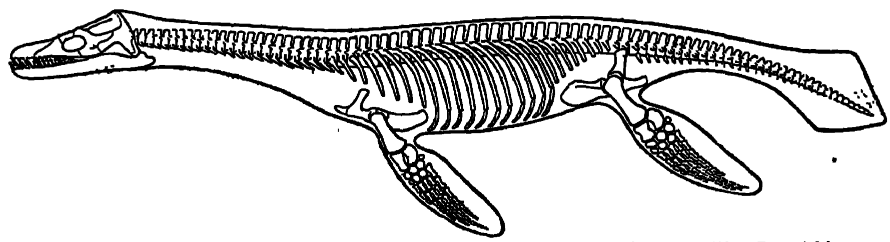

FIG. 4.—*Plesiosaurus rostratus*: restoration of skeleton by W. G. Ridewood.—Lower Lias, Dorsetshire.

Order 4. ICHTHYOPTERYGIA.—The Ichthyosaurians are all fish-shaped, with a relatively large head and very short neck. Both pairs of paddles are retained, but the hinder pair is usually very small, and locomotion seems to have been chiefly effected by a large caudal fin. This fin, as shown in impression by certain fossils from Würtemberg and Bavaria, is a vertical, triangular, dermal expansion, without any skeletal support except the hindermost part of the attenuated vertebral column, which extends along the border of its lower lobe (Fig 5). Another triangular fin, without skeletal support, is known to occur on the back, at least in one species (Fig. 5). Some of the genera are proved to have been viviparous. Like the Sauropterygia, the Ichthyopterygia appear to have originated from terrestrial ancestors, for their earliest Triassic representatives (*Mixosaurus*) have the teeth less uniform and the limbs slightly less paddle-shaped than the later genera. In this connexion it is noteworthy that their hollow conical teeth exhibit curious infoldings of the wall, like those observed in many Labyrinthodonts, while their short, biconcave vertebræ almost exactly resemble those of the Labyrinthodont *Mastodonsaurus* and its allies. As the Ichthyosaurs are traced upwards in geological time, some genera become almost, or quite, toothless (*Baptanodon*), while the paddles grow wider, and are rendered more flexible by the persistence of cartilage round their constituent bones (*Ophthalmosaurus*). They were cosmopolitan in distribution, but disappeared from all seas at the close of the Cretaceous period. The largest forms, with a skull 2 metres in length, occur in the Lower Lias.

Order 5. RHYNCHOCEPHALIA.—These are small lizard-shaped reptiles, which have scarcely changed since the Triassic period. Though now represented only by *Sphenodon* or *Hatteria*, which survives in certain islands off New Zealand, in the Mesozoic epoch they ranged at least over Europe, Asia, and North America. They comprise the earliest known reptile, *Palæohatteria*, from the Lower Permian of Saxony, which differs from the Triassic and

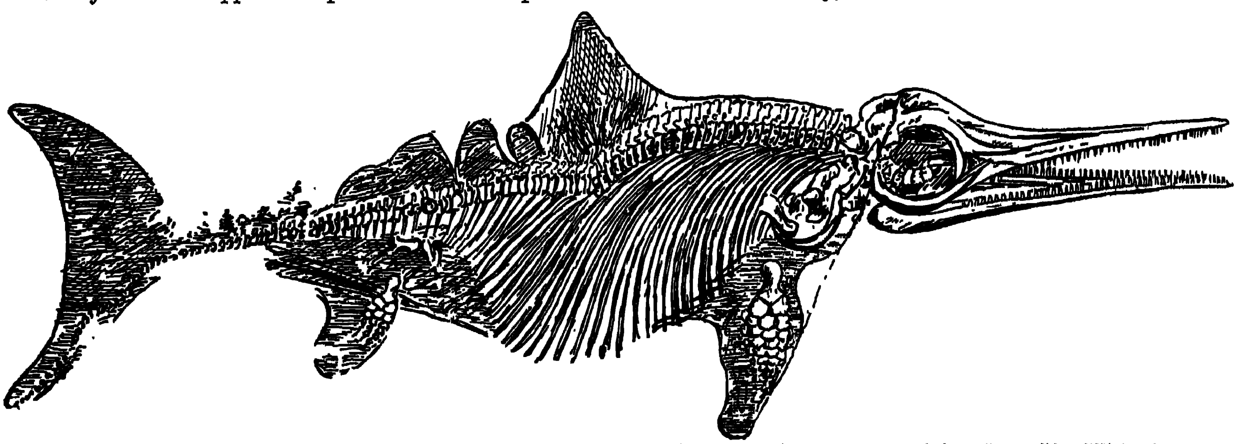

FIG. 5.—*Ichthyosaurus quadriscissus*: outline of specimen showing dorsal and caudal fins, about one-sixth natural size.—Upper Lias, Würtemberg. (*After E. Fraas.*) The irregularities behind the triangular dorsal fin are torn pieces of skin.

later genera in having an imperfectly ossified pubis and ischium, more numerous abdominal ribs, and the fifth metatarsal bone normal. They also seem to include various Triassic genera (e.g., *Aetosaurus*, *Belodon*), which may perhaps belong to the ancestral stock of the Dinosauria and Crocodilia. Other Triassic genera (*Hyperodapedon*, *Rhynchosaurus*) scarcely differ from *Sphenodon*, except in the dentition. In the late Cretaceous and early Eocene periods one genus (*Champsosaurus*) was truly aquatic, with gavial-shaped head.

Order 6. DINOSAURIA. — The Dinosaurs are land-reptiles which flourished on all the continents during the Jurassic and Cretaceous periods, in the interval between the decline of the Anomodontia and the dominance of the Mammalia. They first appeared as carnivorous reptiles in the Triassic period in Europe, India, South Africa, and North America, but afterwards also comprised numerous massive herbivores in nearly all parts of the world except the Australian and New Zealand regions. Among the latter are the largest known land animals of any age: *Brontosaurus*, from the Jurassic of Wyoming, measures at least 17 metres in length, and the femur of *Atlantosaurus*, from the Jurassic of Colorado, indicates a still larger animal. The species of some genera (e.g., *Iguanodon*, Fig. 6) appear to have had a bipedal gait, with the pelvis and hind limbs much like those of the struthious birds. The bones of some are also hollow, thin-walled, and dense, with perfectly ossified articulations. It has therefore been suggested that certain arboreal Dinosaurs were the ancestors of the class Aves. Those genera which comprise species evidently quadrupedal in gait exhibit a very different and typically reptilian pelvis, and are often

heavily armoured. Some of the latest Cretaceous forms from North America bear large horns on the head (e.g., *Triceratops*, Fig. 7).

Order 7. CROCODILIA.—Typical crocodiles can be traced downwards to the Lower Lias at the base of the Jurassic formations, but all the Jurassic and some of the Cretaceous genera have the secondary bony palate less extended backwards than that in the Tertiary and existing genera, while their vertebræ have flattened or concave ends, instead of exhibiting a ball-and-socket articulation. Some of the Upper Jurassic crocodiles (*Metriorhynchus*) were more truly aquatic than any now living, with the fore limbs degenerate, the hind limbs much enlarged for swimming, and the dermal armour lacking. Typical crocodiles and alligators date back to the close of the Cretaceous period, and they did not become extinct in Europe until the beginning of the Miocene period. Remains of an extinct alligator (*Diplocynodon*) are common in the Upper Eocene sands of the Hordwell cliffs, Hampshire.

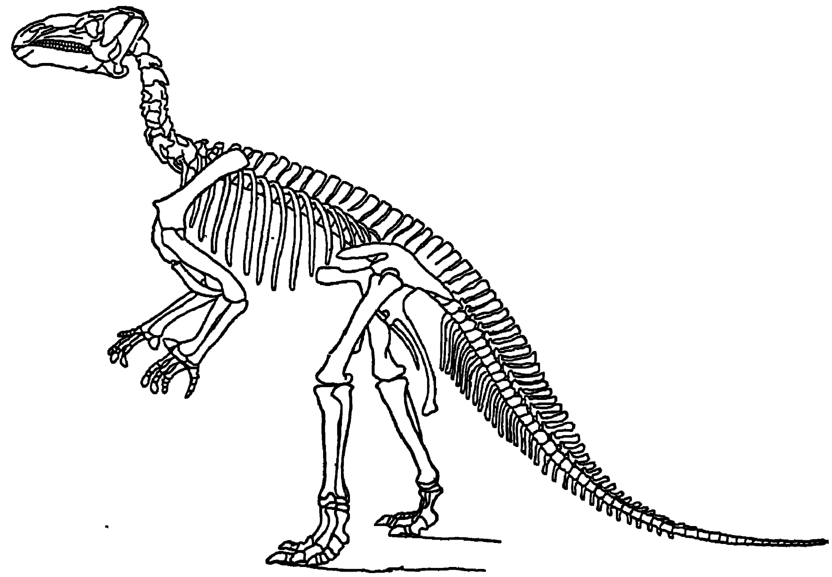

FIG. 6.—*Iguanodon Bernissartensis*: restoration of skeleton by O. C. Marsh, one-eightieth natural size.—Wealden, Bernissart, Belgium.

Order 8. ORNITHOSAURIA.—The flying reptiles are completely evolved at their earliest known appearance in the Lower Lias (*Dimorphodon*), and exhibit little essential change as they are traced upwards through the Mesozoic formations. The latest Cretaceous genera, however, comprise the largest species, which have been found in Europe, North America, and Brazil. Some of these (*Pteranodon*) are toothless, and their wings are so large that for adequate support the pectoral arch is fixed to the vertebræ like a pelvis. The wing-membranes are only known in the European Jurassic genus, *Rhamphorhynchus* (Fig. 8), found well preserved in the fine-grained lithographic stone of Bavaria.

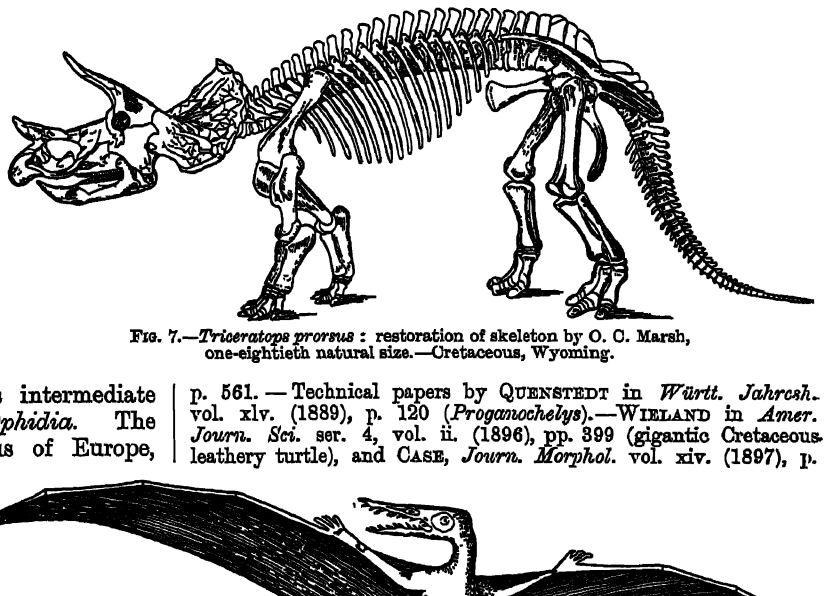

FIG. 7.—*Triceratops prorsus*: restoration of skeleton by O. C. Marsh, one-eightieth natural size.—Cretaceous, Wyoming.

Order 9. SQUAMATA.—The ancestors of the lizards and snakes can only be traced back definitely to the latter part of the Cretaceous period. They were then represented by two suborders of aquatic reptiles, the *Dolichosauria* and *Pythonomorpha* (or *Mosasauria*), which are in many respects intermediate between the existing *Lacertilia* and *Ophidia*. The *Dolichosauria*, from the Upper Cretaceous of Europe, are small and snake-like in shape, but with completely formed limbs. The *Pythonomorpha* are known from Europe, North and South America, and New Zealand, and sometimes attained a very large size, the typical *Mosasaurus camperi* from Maastricht being about 15 metres in length. Their limbs are powerful paddles. The *Lacertilia* and *Ophidia*, so far as known, are exclusively Tertiary and Recent reptiles. Marine snakes (*Palæophis*) occur in the Eocene of the London and Hampshire basins.

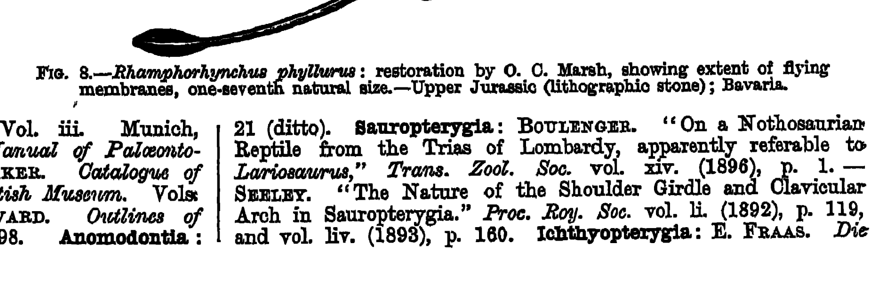

FIG. 8.—*Rhamphorhynchus phyllurus*: restoration by O. C. Marsh, showing extent of flying membranes, one-seventh natural size.—Upper Jurassic (lithographic stone); Bavaria.

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Requena, a town of Spain, province of Valencia, on the left bank of the river Magro, with a station on the railway from Valencia to Utiel. Population (1877), 13,527; (1897), 14,495. The town is irregularly built, with only a few good-looking streets, a modern theatre and town-hall, and two squares. There are three parish churches, San Nicolas being the oldest, of the 13th century, partly restored in 1727. Near the town are the sulphurous springs of Fuentepodrida.

Reservation of the Eucharist. — The practice of reserving the sacred elements for the purpose of subsequent reception prevailed in the Church from very early times. The Eucharist being the seal of Christian fellowship, it was a natural custom to send portions of the consecrated elements by the hands of the deacons to those who were not present (Justin Martyr, *Apol.* i. 65). From this it was an easy development, which prevailed before the end of the 2nd century, for churches to send the consecrated Bread to one another as a sign of communion (the so-called Eulogiæ mentioned by Irenæus, *ap.* Eus. *H. E.* v. 24), and for the faithful to take it to their own homes and reserve it in *arcæ* or caskets for the purpose of communicating themselves (Tert. *ad Uxor.* ii. 5, *de Orat.* 19; St Cypr. *de Lapsis*, 132). Being open to objection on grounds both of superstition and of irreverence, these customs were gradually put down by Councils of the 4th and 5th centuries. But some irregular forms of reservation still continued: the prohibition as regards the lay people was not extended, at any rate with any strictness, to the clergy and monks; the Eucharist was still carried on journeys; occasionally it was buried with the dead, and in a few cases the pen was even dipped in the chalice in subscribing important writings. Meanwhile, both in East and West, the general practice has continued unbroken of reserving the Eucharist, in order that the "mass of the presanctified" might take place on certain "aliturgic" days, that the faithful might be able to communicate when there was no celebration, and above all that it might be at hand to meet the needs of the sick and dying. It was reserved in a closed vessel, which took various forms from time to time, known in the East as the ἀρτοφόριον, and in the West as the *turris*, the *capsa*, and later on as the *pyx*. In the East it was kept against the wall behind the altar; in the West, in a locked aumbry in some part of the church, or (as in England and France) in a pyx made in the form of a dove and suspended over the altar.

In the West it has been used in other ways. A portion of the consecrated Bread from one Eucharist, known as the "Fermentum," was long made use of in the next, or sent by the bishop to the various churches of his city, no doubt with the object of emphasizing the solidarity and the continuity of "the one Eucharist"; and amongst other customs which prevailed for some centuries, from the 8th onward, were those of giving it to the newly ordained in order that they might communicate themselves, and of burying it in or under the altar-slab of a newly consecrated church. At a later date, apparently early in the 14th century, began the practice of carrying the Eucharist in procession in a monstrance; and at a still later period, apparently after the middle of the 16th century, the practice of Benediction with the reserved sacrament, and that of the "forty hours' exposition," were introduced in the churches of the Roman communion. It should be said, however, that most of these practices met with very considerable opposition both from Councils and from theologians and canonists, amongst others from the English canonist William Lyndwood (*Provinciale*, lib. iii. c. 26), on the following grounds amongst others: that the Body of Christ is the food of the soul, that it ought not to be reserved except for the benefit of the sick, and that it ought not to be applied to any other use than that for which it was instituted.

In England, during the religious changes of the 16th century, such of these customs as had already taken root were abolished; and with them the practice of reserving the Eucharist in the churches appears to have died out too. The general feeling on the subject is expressed by the language of the 28th Article, first drafted in 1553, to the effect that "the sacrament of the Lord's Supper was not by Christ's ordinance reserved, carried about, lifted up, or worshipped," and by the fact that a form was provided for the celebration of the Holy Eucharist for the sick in their own homes. This latter practice was in accordance with abundant precedent, but had become very infrequent, if not obsolete, for many years before the Reformation. The first Prayer-Book of Edward VI. provided that if there was a celebration in church on the day on which a sick person was to receive the Holy Communion, it should be reserved, and conveyed to the sick man's house to be administered to him; if not, the curate was to visit the sick person before noon and there celebrate according to a form which is given in the book. At the revision of the Prayer-Book in 1552 all mention of reservation is omitted, and the rubric directs that the communion is to be celebrated in the sick person's house, according to a new form; and this service has continued, with certain minor changes, down to the present day. That the tendency of opinion in the English Church during the period of the Reformation was against reservation is beyond doubt, and that the practice actually died out would seem to be equally clear. The whole argument of some of the controversial writings of the time, such as Bishop Cooper on *Private Mass*, depends upon that fact; and when Cardinal du Perron alleged against the English Church the lack of the reserved Eucharist, Bishop Andrewes replied, not that the fact was otherwise, but that reservation was unnecessary

in view of the English form for the Communion of the Sick: "So that reservation needeth not; the intent is had without it" (*Answers to Cardinal Perron, &c.*, p. 19, Library of Anglo-Catholic Theology). It does not follow, however, that a custom which has ceased to exist is of necessity forbidden, nor even that what was rejected by the authorities of the English Church in the 16th century is so explicitly forbidden as to be unlawful under its existing system; and not a few facts have to be taken into account in any investigation of the question. (1) The view has been held that in the Eucharist the elements are only consecrated as regards the particular purpose of reception in the service itself, and that consequently what remains unconsumed may be put to common uses. If this view were held (and it has more than once made its appearance in Church history, though it has never prevailed), reservation might be open to objection on theological grounds. But such is not the view of the Church of England in her doctrinal standards, and there is an express rubric directing that any that remains of that which was consecrated is not to be carried out of the church, but reverently consumed. There can therefore be no theological obstacle to reservation in the English Church: it is a question of practice only. (2) Nor can it be said that the rubric just referred to is in itself a condemnation of reservation: it is rather directed, as its history proves, against the irreverence which prevailed when it was made; and in fact its wording is based upon that of a pre-Reformation order which coexisted with the practice of reservation (Lyndwood, *Provinciale*, lib. iii. tit. 26, note *q*). (3) Nor can it be said that the words of the 28th Article (see above) constitute in themselves an express prohibition of reservation, strong as their evidence may be as to the practice and feeling of the time. The words are the common property of an earlier age which saw nothing objectionable in reservation for the sick. (4) It has indeed been contended (by Bishop Wordsworth of Salisbury) that reservation was not actually, though tacitly, continued under the second Prayer-Book of Edward VI., since that book orders that the curate shall "minister," and not "celebrate," the communion in the sick person's house. But such a tacit sanction on the part of the compilers of the second Prayer-Book is in the highest degree improbable, in view of their known opinions on the subject; and an examination of contemporary writings hardly justifies the contention that the two words are so carefully used as the argument would demand. Anyhow, as the bishop notes, this could not be the case with the Prayer-Book of 1661, where the word is "celebrate." (5) The Elizabethan Act of Uniformity contained a provision that at the universities the public services, with the exception of the Eucharist, might be in a language other than English; and in 1560 there appeared a Latin version of the Prayer-Book, issued under royal letters patent, in which there was a rubric prefixed to the Order for the Communion of the Sick, based on that in the first Prayer-Book of Edward VI. (see above), and providing that the Eucharist should be reserved for the sick person if there had been a celebration on the same day. But although the book in question was issued under letters patent, it is not really a translation of the Elizabethan book at all, but simply a reshaping of Aless's clever and inaccurate translation of Edward VI.'s first book. In the rubric in question words are altered here and there in a way which shows that its reappearance can hardly be a mere printer's error; but in any case its importance is very slight, for the Act of Uniformity specially provides that the English service alone is to be used for the Eucharist. (6) It has been pointed out that reservation for the sick prevails in the Scottish Episcopal Church, the doctrinal standards of which correspond with those of the Church of England. But it must be remembered that the Scottish Episcopal Church has an additional order of its own for the Holy Communion, and that consequently its clergy are not restricted to the services in the Book of Common Prayer. Moreover, the practice of reservation which has prevailed in Scotland for over 150 years would appear to have arisen out of the special circumstances of that Church during the 18th century, and not to have prevailed continuously from earlier times. (7) Certain of the divines who took part in the framing of the Prayer-Book of 1661 seem to speak of the practice as though it actually prevailed in their day. But Bishop Sparrow's words on the subject (*Rationale*, p. 349) are not free from difficulty on any hypothesis, and Thorndike (*Works*, v. 578, Library of Anglo-Catholic Theology) writes in such a style that it is often hard to tell whether he is describing the actual practice of his day or that which in his view it ought to be. (8) There appears to be more evidence than is commonly supposed to show that a practice analogous to that of Justin Martyr's day has been adopted from time to time in England, viz., that of conveying the sacred elements to the houses of the sick during, or directly after, the celebration in church. And in 1899 this practice received the sanction of Dr Westcott, then bishop of Durham. (9) On the other hand, the words of the oath taken by the clergy under the 36th of the Canons of 1604 are to the effect that they will use the form prescribed in the Prayer-Book and none other, except so far as shall be otherwise ordered by lawful authority; and the Prayer-Book does not even mention the reservation of the Eucharist, whilst the Articles mention it only in the way of depreciation.

The matter has become one of no little practical importance owing to modern developments of English Church life. On the one hand, it is widely felt that neither the form for the Communion of the Sick, nor yet the teaching with regard to spiritual communion in the third rubric at the end of that service, is sufficient to meet all the cases that arise or may arise. On the other hand, it is probable that in many cases the desire for reservation has arisen, in part at least, from a wish for something analogous to the Roman Catholic customs of exposition and benediction; and the chief objection to any formal practice of reservation, on the part of many who otherwise would not be opposed to it, is doubtless to be found in this fact. But however that may be, the practice of reservation of the Eucharist, either in the open church or in private, has become not uncommon in recent days.

The question of the legality of reservation was brought before the two archbishops in 1899, under circumstances analogous to those in the Lambeth Hearing on Incense (*q.v.*). The parties concerned were three clergymen, who appealed from the direction of their respective diocesans, the bishops of St Albans and Peterborough and the archbishop of York: in the two former cases the archbishop (Temple) of Canterbury was the principal and the archbishop of York (Maclagan) the assessor, whilst in the latter case the functions were reversed. The hearing extended from 17th to 20th July; counsel were heard on both sides, evidence was given in support of the appeals by two of the clergy concerned and by several other witnesses, lay and clerical, and the whole matter was gone into with no little fulness. The archbishops gave their decision on 1st May 1900 in two separate judgments, to the effect that, in Dr Temple's words, "the Church of England does not at present allow reservation in any form, and that those who think that it ought to be allowed, though perfectly justified in endeavouring to get the proper authorities to alter the law, are not justified in practising reservation until the law has been so altered." The

archbishop of York also laid stress upon the fact that the difficulties in the way of the communion of the sick, when they are really ready for communion, are not so great as has sometimes been suggested.

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Resiczabánya (*Resicza*), a mining town of south Hungary, in the county of Krassó-Sözrény. In the neighbouring coal and iron mines, and in the forges and iron-works belonging to the Austrian State Railway Company, above 3000 workmen are employed. In the vicinity is the bath and sanatorium of Anina. Population (1891), 10,164; (1901), 11,770.

Respiratory System. See PATHOLOGY and PHYSIOLOGY.

Retford, East, a municipal borough and market-town, Nottinghamshire, England, in the Bassetlaw parliamentary division of the county, 36 miles by rail north-east of Nottingham. A scheme of drainage to cost £44,000 has been undertaken. Swimming baths were built in 1896 by the corporation at a cost of £3000. Population of the municipal borough (1881), 9748; (1901), 12,339.

Réunion, a French island and colony in the Indian Ocean, 130 miles south-west of Mauritius and 371 east of Madagascar. It is elliptic in form; its greatest length is 45 miles, and greatest breadth 32 miles; and it has an area of about 1000 square miles. In 1878 the population amounted to 183,529; in 1898 to 173,230. The falling off is entirely due to the economic troubles which have weighed on the island since the extension of sugar production in Europe. Of the population in 1898, 143,000 were of French nationality; this number included 2400 Europeans or descendants of the old colonists, the remainder being negroes and of mixed race. The foreign element consisted of 30,000 imported labourers, of whom from 15,000 to 16,000 were from India, 14,000 from Africa, and about 1000 from China. The number of labourers from India has decreased since 1882, when the Indian Government ceased to authorize the sending of coolies for service on the plantations. The number in Réunion in 1887 was 26,400, of whom 17,600 were men. It is remarkable that the birth-rate of these Indians should be lower than their death-rate. Réunion is administered by a governor, who has under his orders a director of the interior and a *procureur général*, and is assisted by a privy council. The elective general council sits at St Denis, and the island sends a senator and two deputies to the French Parliament. The island is divided into two arrondissements, the Windward with five cantons and nine communes, and the Leeward with four cantons and seven communes. The important towns are St Denis, which had, in 1881, 30,835, and in 1899, 32,850 inhabitants, and which has a bishopric, a court of first instance, and an appeal court; St Pierre (27,901); St Paul (20,000); and St Louis (13,300).

Agriculture.—The area of the cultivated lands is estimated at 148,200 acres (or 230 square miles), of which 86,450 acres are under sugar-cane, the remainder being under either alimentary produce (maize, manioc, potatoes, haricots) or colonial produce (coffee, vanilla, cacao). The sugar-cane and coffee represent the essential agricultural wealth of the colony, though both labour under serious difficulties. The sugar crop in 1860 amounted to 68,000 tons; in 1889, to 28,000 tons; but in 1897 rose to 45,000 tons. The coffee harvest about the middle of the century reached 60,000 cwt., had fallen to 3800 cwt. in 1883, but has since risen to 14,000 cwt. This diminution is due partly to foreign competition, partly to diseases of the coffee plant. On the other hand, the cultivation of vanilla has made steady progress since 1848. In that year the production amounted to 110 ℔; in 1873 it reached 44,000 ℔; in 1885, 110,000 ℔; in 1897, 220,000 ℔; but this enormous increase has caused a fall in the prices. The cacao yield is still about 6600 ℔; cinchona cultivation is profitable, unlike cotton-growing, which has not succeeded. The forests formerly extended all over the island; now they only cover about 200 square miles, and the administration is attempting to replant the higher circles, Salazie among others, with eucalyptus and caoutchouc trees. The number of live stock is small and tends to diminish, comprising only 2500 horses, 8000 asses and mules, 8000 oxen, 28,000 pigs, 28,000 goats and sheep. Réunion possesses many fowl, and agriculture is held in esteem.

Industries.—Although the sand on the beach contains ferruginous elements, no mining enterprise is carried on. The island has warm springs at Cilaos (3500 feet), at Salazie (2600 feet), and at Mafatte (1850 feet), and these places form so many sanatoria. There are works for sugar, rum, flour, and for plaiting straw for hats. Many of the sugar factories, however, have disappeared, ruined by outside competition.

Commerce.—The total trade amounted in 1860 to the value of £4,464,000 (the highest during the century); in 1880, to £2,394,000; in 1900, to £1,533,240. In 1900 the imports amounted to £883,570 (£547,700 from France) and the exports to £698,500 (£649,670 to France, £33,710 to French colonies, and the remainder to Mauritius). France sent to the colony in 1897 cottons (£56,000), wines (£68,000), salt fish (£22,280), utensils (£12,680), furs (£18,920), toys (£17,760), machinery (£8960), and buys from the colony, sugar (£490,000), vanilla (£80,000), sago (£25,040), spirits (£24,000), oils (£16,400).

Shipping.—The shipping movement in 1900 comprised 138 vessels of 189,625 tons entered, and 135 of 188,308 tons cleared. Of these, 95 of 151,650 tons and 93 of 151,126 tons respectively were under the French flag. The ports are those of St Pierre and of Pointe des Galds (opened in 1886). St Denis and St Paul have, besides, open roadsteads.

Communications.—The island has 199 miles of national roads and many local roads. The railway, 83¼ miles in length, opened in 1882 between St Benoit and St Pierre, was taken over by the State in 1887, in consequence of forfeiture by the company. At the latter date the annual receipts amounted to no more than £33,880, and this condition has scarcely improved. Réunion is connected by a regular service of the Messageries Maritimes with Marseilles. The distance is 6637 miles, and the passage 23 to 29 days.

Finance.—The budget of the island amounts to £332,000, of which £178,800 is contributed by the mother country. This subsidy has almost doubled since 1885, in which year it did not exceed £94,000.

DU BUISSON. *Île de la Réunion*. St Denis de la Réunion, 1889.—LEVASSEUR. *La France*. T. ii. Paris, 1893. (P. L.)

Reus, a town of Spain, province of Tarragona, important railway station; its port, Salou, is 4 miles off, on the Mediterranean. Population, 26,752 in 1897. It has suburbs full of villas, with gardens extending over several thousand acres, all well irrigated. There is an active trade in the agricultural products of the fertile region around the city. The local industries, that have been important since the Middle Ages, developed considerably in the last quarter of the 19th century. They include (besides cotton, linen, and woollen goods) silk, alcohol, leather, flour, ceramics, mosaics, soap, earthenware, jams, wine, shoemaking, and refineries. The town has important flour, wine, and fruit export houses. There is a model farm belonging to the municipality in the suburbs. Reus has excellent primary, normal, and higher-grade schools, many private and religious schools, an academy of fine arts, and public library. The new town has continuously spread outside the promenades. Marshal Prim was a native of Reus. The hospitals and foundling refuge, the institute, and the town-hall are handsome modern buildings. The inhabitants are famous for their enterprising spirit and laborious habits, and Reus is considered second only to Barcelona in the Lancashire of Spain for its manufacturing success.

Reusch, Franz Heinrich (1823–1900), Old Catholic theologian, was born at Brilon, in Westphalia, on 4th December 1823. He studied general literature at Paderborn, and theology at Bonn, Tübingen, and Munich. The friend and pupil of Döllinger, he took his degree of Doctor in Theology at Munich, the university of which Döllinger was so long an ornament. He was ordained priest in 1849, and was immediately afterwards made chaplain at Cologne. In 1854 he became *privat-docent* in the exegesis of the Old Testament in the Catholic Theological Faculty at Bonn; in 1858 he was made extraordinary, and in 1861 ordinary, professor of theology in the same university. From 1866 to 1877 he was editor of the *Bonner Theologisches Literaturblatt.* In the controversies which followed upon the proclamation of the Infallibility of the Pope, Reusch attached himself to the party of his leader Döllinger, and he and his colleagues Hilgers, Knoodt, and Langen were interdicted by the archbishop of Cologne in 1871 from pursuing their courses of lectures. In 1872 he was excommunicated. For many years after this he held the post of Old Catholic *curé* of Bonn, as well as the position of vicar-general to the Old Catholic Bishop Reinkens, but resigned both in 1878, when, with Döllinger, he disapproved of the permission to marry granted by the Old Catholic Church in Germany to its clergy. From that time he retired into lay communion, but continued to give lectures as usual in the Old Catholic Faculty of Theology in the University of Bonn, and to write on theological subjects. He was made rector of that university in 1873. In 1874 and 1875 he was the official reporter of the memorable Reunion Conferences held at Bonn in those years and attended by many distinguished theologians of the Oriental and Anglican communions.

Reusch was a profound scholar, an untiring worker, and a man of simple and lovable character, clear in expression and exact in method. His works were voluminous, and among them were contributions to periodical literature, and especially to the *Revue Internationale de Théologie*, a review started at Bern at the instance of the Old Catholic Congress at Lucerne, in order to promote intercommunication and eventual reunion between the Churches opposed to the papal claims. Among his works are several on the Old Testament, and chief among these is a manual of introduction to it, which passed through four editions; a pamphlet on *Die Deutschen Bischöfe und der Aberglaube;* and another on the falsifications to be found in the treatise of Aquinas against the Greeks; as well as essays on the history of the Jesuit Order, and a book of prayers, which passed through three editions. But his fame will mainly rest on the works which he and Döllinger published jointly. These consisted of a work on the Autobiography of Cardinal Bellarmine, the *Geschichte der Moralstreitigen in der Römisch-Katholischen Kirche seit dem XVI. Jahrhundert*, and the *Erörterungen über Leben und Schriften des hl. Liguori.* During the last few years of his life he was smitten with paralysis and was unable to work. His last contribution to literature was an article on the inspiration of the Scriptures, communicated to the *Revue Internationale de Théologie* of April 1894. He died 3rd March 1900, leaving behind him in manuscript a collection of letters to Bunsen about Romish cardinals and prelates, which has since been published. (J. J. L*.)

Reuss, Edouard Guillaume Eugène (1804–1891), Protestant theologian, was born at Strasburg, studied theology at Göttingen under Eichhorn, and Oriental languages at Halle under Gesenius, and afterwards at Paris under Silvestre de Sacy. From 1829 to 1834 he taught biblical criticism and Oriental languages at the Strasburg Theological School; he then became assistant and afterwards regular professor of theology at that university. The sympathies of Reuss were German rather than French, and after the annexation of Alsace to Germany he remained at Strasburg, and retained his professorship till, in 1888, he retired on a pension. He had a full mastery of both languages, and wrote sometimes in French and sometimes in German. In 1852 he published his *Histoire de la théologie chrétienne au siècle apostolique*, which gives a systematic narrative of the causes which stimulated and directed the theological labours of the first generation of Christians, with a view to linking together all the theories that form the main subject of this book. This was followed in 1863 by *L'histoire du canon des saintes écritures dans l'église chrétienne.* It was the criticism and exegesis of the New Testament which formed the subject of Reuss's earlier labours—in 1842, indeed, he had published in German a history of the books of the New Testament; but after a time he turned his attention also to Old Testament criticism, a study for which he was especially fitted, owing to his profound knowledge of Hebrew. In 1881 he published in German his *History of Old Testament Scripture*, a veritable encyclopædia, which embraces the public and domestic history of Israel, the literature and thought, art, archæology, and general life of the people from the dawn of history till the taking of Jerusalem by Titus.

Reuss, who died at Strasburg on the 15th of April 1891, belonged to the more modern section of the Liberal party in the Lutheran Church. His critical position was to some extent that of Graf and Wellhausen, allowing for the circumstance that he was in a sense their forerunner, and was actually for a time Graf's teacher. His earliest views were summed up in the formula "The Prophets are earlier than the Law, and the Psalms are later than both," a statement that, with the necessary additions in detail, expresses the present position of Old Testament criticism. For many years Reuss edited the *Beiträge zu den theologischen Wissenschaften.* With Baur and Cunitz, and after their death alone, he edited the monumental edition of Calvin's works. His critical edition of the Old Testament appeared a year after his death. (A. Z.)

Reuss, two principalities of Germany, in Thuringia. (1) Reuss the Elder, with an area of 122 square miles, and population (1885), 55,904; (1900), 68,287. Density, 559 inhabitants to the square mile. Of the total, 98 per cent. were in 1895 Evangelical Lutherans. In 1900 there were 1953 horses, 14,447 cattle, 10,118 pigs, and 2337 sheep. In 1895 there were 5225 farms, of which 4552 were each less than 25 acres in extent. In 1900 the state revenue and expenditure were balanced at £77,050. There is no public debt. The contribution to the imperial exchequer was fixed at £33,980 for the year 1900. (2) Reuss the Younger, with an area of 319 square miles, and population (1885), 110,598; (1900), 138,993, the density being 435 inhabitants to the square mile. Except for 2090 Roman Catholics, 181 Jews, and 477 "others," the people in 1895 were all Protestants. In 1900 there were in the principality 34,009 cattle, 27,013 pigs, 8929 sheep, and 4579 horses. Out of a total of 8558 farms in the principality in 1895, no less than 7086, or 82·8 per cent., were each less than 25 acres. For the period 1899–1901 the public revenue and expenditure were each fixed at £136,570 annually. The public debt was £52,000 in 1899, and the contribution to the imperial exchequer in 1900 was fixed at £66,545.

Reutlingen, a town of Würtemberg, Germany, 36 miles by rail south of Stuttgart. The church of St Mary

was restored in 1899–1900. There are a textile school, a school for women's work, and an agricultural school. It has multifarious industries. Population (1900), 21,481.

Revel, or Reval, a fortified seaport, State dockyard, and district town of Russia, in the government of Esthonia, 249 miles by rail west-south-west of St Petersburg. Its population in 1881 was 50,490, and in 1897, 64,578, of whom half were Esthonians and 30 per cent. Germans. It is the seat of a branch Board of the Admiralty and of the administration of the Baltic lighthouses. Its port, which is one of the most important in Russia, has a depth of from 4 to 6 fathoms, and a roadstead $3\frac{1}{2}$ miles wide; this is not quite protected from the north-west winds, and freezes nearly every winter, but is annually visited by about 400 foreign ships and about 1400 vessels engaged in the coasting trade. The exports, chiefly grain, timber, flax, and hemp, were valued at 33,826,000 roubles in 1897; and the imports, chiefly manufactured goods and machinery, at 56,305,000 roubles. There is considerable trade with Finland. Baltic Port is a sort of annex to the port of Revel.

Revelstoke, British Columbia, on the Canadian Pacific Railway, where it crosses the Columbia river. It is a divisional point of the railway, and the junction for connexion with the Arrow Lakes and the West Kootenay district. It is also a distributing point for the mines to the north and the important and promising section of country known as the Trout Lake district to the south. Population (1800), 1600.

Revere, a town of Suffolk county, Massachusetts, U.S.A. It is a few miles north-east of Boston, of which it is a suburb, in the eastern part of the state, on a line of the Boston and Maine Railroad. Population (1880), 2263; (1890), 5668; (1900), 10,395, of whom 2917 were foreign-born.

Revilla Gigedo, an uninhabited insular group belonging to Mexico, in the North Pacific, about 420 miles from the coast of the state of Colima, 18° N. and 112° W. It comprises the large island of Socorro (San Tomas), 25 miles by 12, and the three scattered islets of San Benedicto, Roca Partida, and Clarion, with a total area of 320 square miles. It is probably of volcanic formation, with an extinct cone 3660 feet high in Socorro. The archipelago, which takes its name from a Spanish viceroy who ruled from 1746 to 1755, presents some remarkable zoological features, comprising several birds and reptiles allied to, but of different species from, those of the mainland.

Rewa, a native state of India, in the Baghelkhand agency. Area, about 10,000 square miles. Population (1881), 1,305,124; (1891), 1,508,943. Many of the inhabitants belong to the Gonds and Kols. Gross revenue (1897–98), Rs.11,45,915, of which Rs.6,31,828 was derived from land, Rs.1,70,928 from customs, and Rs.1,73,660 from forests. Expenditure, Rs.18,20,343, of which Rs.3,24,469 was for palace, Rs.2,59,188 for army, Rs.1,45,514 for public works, and Rs.4,16,253 for famine relief.

The Maharaja Raman Singh was born in 1876 and succeeded in 1880. During his minority the administration was reformed. The southern portion of the state is crossed by the branch of the Bengal-Nagpur Railway from Bilaspur to Katni, which taps the Umaria coal-field, yielding 150,000 tons, now under the management of the state. A branch line from Sutna on the East Indian Railway, the residence of the political agent for Baghelkhand, to the town of Rewa, has recently been constructed as a famine relief work. The state suffered from famine in 1896–97, and again to a less extent in 1899–1900; but on both occasions adequate measures of relief were provided.

The town of Rewa is 131 miles south of Allahabad. Population (1891), 23,626. It has a high school, with 432 pupils; also the Victoria and zenana hospitals, and a model gaol. The town of Sutna or Satna, headquarters of the Baghelkhand political agency, has a population (1891) of 6771.

Rewa Kantha, a political agency or collection of native states in India, within the Gujarat division of Bombay; stretching for about 150 miles between the plain of Gujarat and the hills of Malwa, from the river Tapti to the Mahi, crossing the Nerbudda or Rewa, from which it takes its name. The number of separate states is 61, many of which are under British jurisdiction. The only important one is Rajpipla (*q.v.*). Total area, 4980 square miles. Population (1881), 549,892; (1891), 733,506. In 1901 the population was 478,889, showing a decrease of 35 per cent., due to the results of famine. Estimated gross revenue, Rs.27,07,329; tribute (mostly to the Gaekwar of Baroda), Rs.1,16,700; number of police, 1167; number of schools, 185, with 9779 pupils in 1897–98. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. The Panch Mahals were constituted a British district out of this tract in 1876.

Rewari, a town of British India, in the Gurgaon district of the Punjab, situated in 28° 12′ N. and 70° 40′ E., 32 miles south-east of Gurgaon. It has a railway station. Population (1881), 23,972; (1891), 27,934; municipal income (1897–98), Rs.57,161. It is on an ancient site, formerly a native capital, and at one time a British cantonment. It is now an important centre of trade, being the junction for the Rewari-Ferozepore branch of the Rajputana Railway. There are manufactures of brass-ware and turbans, and two factories for ginning and pressing cotton. There is a municipal high school.

Reyer, Ernest (1823–——), French composer, was born at Marseilles, 1st December 1823. At the age of sixteen he went to Algeria, and remained there some years. The outcome of his residence there was a symphonic ode entitled *Le Sélam*, the musical orientalism of which had, unluckily for him, already been anticipated by Félicien David in *Le Désert*. *Maître Wolfram*, a one-act opera from his pen, was produced at the Opéra Comique in 1854; and in 1858 *Sacountala*, a ballet of his composition, figured on the bills of the Opéra. It was the production of *La Statue* at the Théâtre Lyrique in 1861 that brought Reyer's name prominently before the public. This work is notable for the sincerity of its accents, and also for the picturesqueness of its Eastern colouring. Reyer was now to wait several years before obtaining a real and permanent success. *Erostrate*, an opera produced at Baden-Baden in 1862, and given at the Paris Opéra some ten years later, was a failure. The composer had in the meanwhile set to work on an opera founded upon the Nibelungen-lied. *Sigurd*, the subject of which is the same that inspired Wagner in *Siegfried* and *Götterdämmerung*, lay on hand for a long while, being at last produced for the first time in Brussels in 1884, and subsequently brought out at the Paris Opéra, where it has since remained in the *répertoire*. Despite crushing comparisons, *Sigurd* is a work of great value, revealing high and noble aspirations, and displaying its composer's elevated notions as regards the form of the "lyrical drama." *Salammbô*, Reyer's last opera, founded upon Flaubert's well-known romance, followed the same road as *Sigurd*, reaching Paris *viâ* Brussels, being produced in the Belgian capital in 1890, and meeting with emphatic success. Gluck, Weber, Berlioz, and Wagner are the composers who have exercised most influence over Reyer. An intimate friend of Berlioz, Reyer was also one of the earliest champions of Wagner in France. He is well known as a writer on music, and preceded Berlioz as musical critic to the *Journal des Débats*. Reyer is librarian of the Paris Opéra, and a member of the Institute.

Rheims (or Reims), a town of France, in the department of Marne, 97 miles from Paris by rail. It is important on account of its industries, which increased very considerably during the last quarter of the 19th century. Population (1881), 93,683; (1901), 107,773. The increase was most marked in the suburb of Les Contures on the east of the town. Wool, combed and carded in numerous establishments, is spun in 20 factories, and in 30 others woven into flannel, merino, cloth, and woollen goods of all kinds. Some of these establishments are important; for example, two machine combing mills employ more than 2000 workmen, and the whole wool industry occupies in all 24,000 hands. Rheims possesses an office for the *conditionnement* of wool, similar to that in Lyons for silk. This office, which determines the loss of weight resulting from the drying of the wool, registers annually about 8800 tons of combed and spun wool. The woollen industry has, however, been on the decline. In 1898 the measuring house dealt with only 123,097 pieces measuring 4,575,150 metres, as compared with 275,333 pieces measuring 12,941,193 metres in 1890, the decline having been continuous; but in 1899, 137,898 pieces measuring 6,272,843 metres were dealt with. Fifteen dyeworks employ 1000 workers, and one of these factories annually treats 50,000 pieces, each 110 yards in length. Rheims is also the most important market for raw wool in France. Transactions annually reach a value of from £5,000,000 to £6,000,000, half of which is appropriated by the industries of Rheims itself. Fifty firms trade in champagne wines, and employ 16,000 workmen, exporting in 1899 29,368,825 bottles—one-quarter of them for France—and barrels totalling in weight 11,893 tons. The value of the trade in this commodity reaches £4,000,000. Rheims, an important railway centre, is surrounded by a chain of detached forts measuring 39 miles and extending as far as Épernay. A large garrison occupies the town and forts. The Musée Lapidaire of the archiepiscopal palace has been transferred to the cloister of St Rémi, and the courtyard of the hospital which occupies the old abbey of that name was in 1898 enriched with a handsome sculptured fountain. A statue of Jeanne d'Arc has been erected, and in 1888 a monument to the Abbé de la Salle, founder of the order of Christian Brothers.

Rheinberger, Joseph Gabriel (1839–1901), German composer, was born at Vaduz, Liechtenstein, 17th March 1839. His musical abilities were manifested so early that he was appointed organist of the parish church when he was but seven years old, an appliance being specially attached to the organ by which the pedals could be brought within reach of the child's feet. A three-part Mass composed by him was performed in the following year. He was taught at first by Philipp Schmutzer, choir director at Feldkirch; he entered the Munich Conservatorium in 1851, and remained there till 1854 as a pupil of Professor E. Leonhard for piano, Professor Herzog for organ, and J. J. Maier for counterpoint. After leaving the school he had private lessons from Franz Lachner, and was appointed a professor in the conservatorium in succession to Leonhard in 1859. In 1860 he became professor of composition, and was appointed organist of the Michelskirche, a post he held till 1866. From 1854 he was accompanist, and from 1864 conductor, of the Munich Oratorio Society, resigning in 1877; and from 1865 to 1867 was "répetitor" at the Hofoper. In 1877 he succeeded Wüllner as Hofkapellmeister, and from that time his attention was largely devoted to sacred music. His compositions include works of importance in every form, from the operas *Die sieben Raben* (Munich, 1869) and *Thürmers Töchterlein* (Munich, 1873) and the oratorio *Christoforus*, op. 120, to the well-known quartet for piano and strings in E flat, op. 38, the nonet for wind and strings, op. 139, and the seventeen organ sonatas, which form notable additions to the literature of the instrument. A splendid teacher, he was a master of contrapuntal effect, and had a strong sense of the different styles required for various musical forms, while the flowing, melodious character of his music, the fertility of his invention, and the brilliance of his technique, gained for him the title of the "Raff of Southern Germany." He died in November 1901.

Rheine, a town of Prussia, province of Westphalia, on the Ems, at the point where it becomes navigable, 29 miles by rail west of Osnabrück. It is the seat of cotton industries, and has also manufactures of jute, machinery, tobacco, and flour. Population (1900), 10,373.

Rheydt, a town of Prussia, Rhine province, 19 miles west by south of Düsseldorf by the railway to Aix-la-Chapelle. The manufacture of velvet has now been added to the industries. Population (1900), 34,034.

Rhine, the principal river of Germany, flowing also through Switzerland and Holland. The traffic on this stream has increased enormously since the foundation of the German empire. In 1871 the traffic between the Rhine ports and the seaports of the Baltic and North Seas was confined to three small vessels which plied between Cologne and London, though there was of course a much larger purely river traffic. A dozen or fifteen years later vessels of 800 to 1200 tons began to make the voyage between Cologne and London, and afterwards the carrying capacity was increased first to 1600 tons, and subsequently to 1750 tons. In 1899 this particular traffic gave occupation to 32 vessels of 24,240 tons, and the bulk of goods they carried amounted to 105,540 tons; while there were in addition 105 lighters varying in capacity from 70 to 950 tons.

Besides London, Hamburg, Bremen, and the chief Baltic ports as far as Riga and St Petersburg participated in this traffic. The boats which ply up and down the river itself, without venturing upon the open sea, are mostly craft of 100 to 200 tons, owned in the great majority of cases by their captains, men principally of German or Dutch nationality. This fleet is computed to number some 8500 craft, with an aggregate capacity of over 2 million tons, of which about one-tenth are steamships. The traffic at the chief German ports of the river aggregated 4,489,000 tons in 1870, but by 1900 this had grown to a total of 17,000,000 tons, thus distributed:—Ruhrort, 6,512,000 tons; Duisburg, 3,000,000 tons; Cologne, 1,422,000 tons; and Mannheim, 6,021,000 tons. And these are not the only ports on the river; a large trade is also done at Kehl (a new port), Maxau (for Carlsruhe), Ludwigshafen, Mainz, Bonn, Rotterdam, and a host of smaller places. The amount of traffic which passed the town of Emmerich near the Dutch frontier, both ways, increased from an annual average of about 6 million tons in 1881–85 to over 21½ million tons in 1899. Notwithstanding the inherent difficulties of construction caused by the great variations in the level of the stream, amounting sometimes to 20 feet or more, the chief ports of the Rhine are admirably constructed, and well equipped with modern contrivances for loading and unloading vessels. Boats carrying as much as 600 tons are often able to proceed as far up stream as Strasburg, and smaller craft get as far as Hüningen, a little above Basel. Large passenger boats ply regularly between Mainz and Düsseldorf, and sometimes extend their journeys as high up as Mannheim, and as far in the other direction as Rotterdam. The efforts of the river authorities are being directed to the deepening and improvement of the navigable channel from the sea to Strasburg, the low-water depths aimed at being 10 feet from Rotterdam to the German frontier, and 10 feet thence to Cologne; 8 feet 3 inches from Cologne to St Goar, and 6 feet 6 inches from St Goar to Mannheim. At present the Rhine in Holland has a depth of about 9 feet and a width of 1200 to 1300 feet, though the Merwede branch exceeds this depth by 8 inches. Altogether a sum approaching £2,500,000 was spent in Holland within the latter part of the 19th century on the improvement of the Rhine and its principal arteries. Above Mannheim the depth of the stream is always less than 5 feet, and

generally varies between that figure and 4 feet 6 inches. The difficulty of ascending the rapids near Bingen is usually surmounted by the help of steam hauling machinery placed on the bank, though powerful tugs are also coming into use for this purpose. The work of blasting out the rocks which at that spot projected in the bed of the river, begun in 1830, was continued down to the year 1887, so that now there are two navigable channels of sufficient depth for all vessels which ply up and down that part of the stream. The navigability of some of the chief German tributaries of the Rhine has also been improved. For instance, in the years preceding 1886 the Main was canalized for 20 miles above Frankfort, the depth being increased from 2⅜ feet to 8¼ feet at a cost of £400,000. In addition three new canals have still further increased the usefulness of this great waterway. The first of these is the Merwede canal, which connects Amsterdam with the Waal at Gorinchem (Gorkum). The next connects Strasburg with the Rhine—the Strasburg–Rhine canal, 4 miles long, 40 to 60 feet wide and 8 feet deep. The third is the Rhine–Weser–Elbe canal, which consists of three divisions—the middle division, coinciding with the Dortmund–Ems canal (see Ems), opened in 1899; the eastern division, to coincide with the Midland canal, which is only in part constructed; and the western division, which exists only in the plans, of which there are two—(*a*) the South Emscher canal, from the Rhine at Neuenkamp, near Duisburg, to the Dortmund–Ems canal at Herne, 27 miles long; and (*b*) the Lippe canal, 40 miles long, from the Rhine at Wesel along the river Lippe to the Dortmund-Ems canal at Datteln. These projected works would give a continuous waterway from the busiest mining and industrial districts of Westphalia to the extreme east of the empire. In 1884 the German Reichstag appointed a commission to inquire into the "relations" of the Rhine, that is, its tendency to cause floods, the distribution of its precipitation, its fall in various parts of its course, and so forth. The results of these investigations were published in the elaborate work, *Der Rheinstrom und seine Nebenflüsse* (Berlin, 1889), and in the further *Bericht der zur Untersuchung der Rheinstromverhältnisse niedergesetzten Reichskommission* (1891). The Rhine is no longer the barrier between east and west, but is spanned by railway bridges in about thirty places, notably at Dordrecht, Zalt-Bommel, and Nimeguen in Holland; at Wesel, Duisburg, Düsseldorf, Cologne, Bonn, Coblenz, Mainz, Mannheim, Spires, Kehl, Schaffhausen, and Constance in Germany; and at Basel and Ragaz in Switzerland.

See Treutlein. "Die neueren Deutschen Rheinstromstudien und ihre Ergebnisse," in *Ausland* (1893), a series of papers giving the digested results of the two works quoted in the text.—H. Blink. "Der Rhein in den Niederlanden," in Kirchhoff's *Forschungen zur Landes- und Volkskunde*, vol. iv. Heft 2.—Chambalu. *Die Stromveränderungen des Niederrheins seit der vorrömischen Zeit.* Cologne, 1892.—Horn. *Der Rhein, Geschichte und Sagen seiner Burgen, &c.* Stuttgart, 1893.

Rhine Province. See Prussia, Rhenish.

Rhode Island, one of the six New England states, the smallest in the American Union, and the last of the original thirteen to adopt the Federal Constitution, lying between 41° 18′ and 42° 3′ N. and 71° 8′ and 71° 53′ W. Its greatest length is 48 miles; its greatest width 37 miles. Its area covers 1250 square miles, of which 165 square miles is water surface. It is bounded on the N. and E. by Massachusetts, on the W. by Connecticut, and on the S. by the Atlantic Ocean. Narragansett Bay, running north 30 miles, divides it into two unequal parts. In the bay are many islands; the largest is Rhode Island, whence the state derives its name. Block Island lies 10 miles out in the ocean. The surface is hilly, though the highest elevation, Durfee Hill, Gloucester, is only 805 feet above the sea. The climate is not as changeable as that of other parts of New England. Narragansett Bay tempers the atmosphere, and the cold east winds that afflict Boston, 40 miles away, are rarely felt. Newport and the towns upon the coast are warmed by the influence of the Gulf Stream.

Population.—In 1880 the population was 276,531; in 1890, 345,506; in 1895, 384,758; and in 1900 it was 428,556. The population, therefore, increased 24 per cent. from 1890 to 1900, and the density per square mile rose from 328·1 to 407. Rhode Island is consequently the most densely peopled state in the Union. Of the total population in 1900, 210,516 were males and 218,040 were females, constituting respectively 49·1 per cent. and 50·9 per cent. of the total population, as compared with 48·6 per cent. and 51·4 per cent. respectively in 1890. The foreign-born population, which in 1850 constituted 16·5 per cent. of the population, numbered in 1890, 106,305 (or 30·8 per cent.), and in 1900, 134,519 (or 31·4 per cent.). Of the native-born white population in 1900, nearly one-half (140,292 out of 285,278) were sprung from parents of whom at least one was of foreign origin. Providence was slightly above the average percentage in its foreign-born population. Of the foreign-born population in 1895 Ireland contributed the largest number, followed by Canada, England, Scotland and Wales, Italy, Sweden, Germany, Russia, Portugal, in the order named. The Canadians were mostly of French descent. The coloured population, which in 1748 amounted to 9·4 per cent. of the total, has become relatively stationary, being 2·2 per cent. of the total both in 1890 and in 1900. Out of 127,144 adult males in 1900, 11,675 were illiterate (unable to write), of whom 9932 were foreign-born.

The state is divided into five counties. There are 5 incorporated cities: Providence, the capital (175,597), Pawtucket (39,231), Woonsocket (28,204), Newport (22,034), Central Falls (18,167); 32 towns (of which 12 contain more than 4000 inhabitants); and 1 "district." Newport is the most fashionable watering-place in the Union. Bristol is famous for its yacht-building establishments. The defenders of the "America Cup" have been built there for several years. The urban population in 1890, designating as such the total population of all places of more than 4000 inhabitants, was 310,335, or 89·8 per cent. of the total; in 1900 it was 392,509, or 91·6 per cent.—a higher ratio of urban to total population than exists in any other state of the Union. The death-rate of the entire state in 1890 was 20·9; in 1900 it was 19·1.

In *manufactures*, notwithstanding its small size, Rhode Island is one of the most important states of the Union.

	1890.	1900.	Increase, per cent.
Number of establishments	3377	4189	24
Capital	$126,483,401	$183,784,587	45·3
Wage-earners (average number)	81,111	96,528	19
Total wages	$33,239,313	$41,114,084	23·7
Value of products	142,500,625	184,074,378	29·2

In 1890 the wage-earners engaged in manufactures comprised 23·5 per cent. of the population; in 1900, 22·5. It is interesting to note that while the number of men, 16 years of age and over, among the wage-earners increased nearly 30 per cent., the number of women of like age so employed increased only 5·4 per cent. (while their total wages increased 20·4 per cent.), and the number of children under 16 so employed decreased 13·5 per cent. (although their total wages decreased only 1·8 per cent.). The three most important manufacturing products of the state are textiles, jewellery, and foundry and machine-shop products. There were 218 establishments engaged in the manufacture of textiles, with products valued at $78,133,258; 214 in the manufacture of jewellery, with products valued at $13,320,620; and 149 in the manufacture of foundry and machine-shop products, which were valued at $13,269,086. Under the general group of textile industries are included the manufacture of cotton goods (products, $26,435,675), of worsted goods (products, [illegible]), of woollen goods (products, $5,330,550), dyeing and finishing textiles (products, $8,484,878). In the manufacture of cotton goods the state in 1900 was third in the United States. In 1895, 1,924,486 spindles were running and 43,106 looms; one establishment in Providence contained more than 400,000 spindles. Providence is the first city in the United States in the manufacture of jewellery.

Other Industries.—Underlying Narragansett Bay and the land east of it are extensive coal deposits, the extreme eastern bed of anthracite in the United States. Graphite is mined in Cranston for blast furnaces. Magnetic iron is found in Cumberland. At Lime Rock, Lincoln, the best lime in America has been steadily produced for more than 200 years. In the southern part of the state are extensive granite quarries. Westerly granite is universally known and employed in monumental work. The fisheries reported in 1895 an invested capital of $921,429, and

the yearly product is more than $1,000,000. Agricultural productions are not important, though market-gardening is carried on on a large scale not far from Providence, large crops being secured by irrigation. In 1900 there were 5948 farms in the state, comprising altogether 455,602 acres, or 67·6 per cent. of the total land surface of the state. The total value of farm property in 1900 was $26,989,189, and of farm products (1899) $6,333,864.

Transportation.—In 1899 there were 548 miles of steam and 182 miles of electric railways. More than 500 miles of steam railways are controlled by the New York, New Haven, and Hartford Railroad, which corporation also controls the steamboat lines running from Providence to New York. Steamships, owned largely outside the state, run from Providence to Philadelphia, Baltimore, Norfolk, Savannah, and Jamaica, W.I. The total steam tonnage of the state (not including yachts) is 22,391·13.

Finances.—The total valuation of property was $399,897,333. The state tax (18 c. per $100) is always included in levying local taxes. The state debt, 1st January 1899, was $2,300,000. The town and city debt was $28,612,407. In January 1900 the banks of the state, with their capital and deposits, were as follows :—

Banks.	Capital (including Surplus).	Deposits.
59 National	$24,222,980	$26,587,874
6 State	916,675	837,220
8 Trust companies	4,926,909	27,745,177
35 Savings	...	73,186,624
108	$30,066,564	$128,356,895

Depositors in savings banks, 146,321.

Education, Religion, &c.—The present school system is largely the work of the late Henry Barnard. The attendance in 1899 was 65,527 ; the number of teachers, 1858. The schools are supported by the towns and cities and not by the state, the "Permanent School Fund" amounting (December 1899) to only $245,525. The state normal school and the Rhode Island School of Design are situated in Providence. In Kingston is the Rhode Island College of Agriculture and Mechanic Arts, with a faculty of 23 and 180 students in 1899. Brown University is the chief educational institution. Though it is under Baptist control, it is unsectarian in spirit. Within ten years the faculty has increased from 26 to 92, the students from 285 to 925, and the endowment has been more than doubled. Two million dollars was secured by subscriptions for its permanent fund in 1900–1901 A women's college is connected with the university. Its students are taught in separate classrooms by the university professors, and receive degrees on the same terms as men. The system is not one of co-education, but of coordinate education. Of religious denominations, the Roman Catholic has 52 churches, with 96,755 members, and property valued at $2,295,700 ; the Baptist (Regular) has 75 churches, with 12,055 members, and property valued at $1,151,960 ; the Protestant Episcopal has 63 churches, with 9458 members, and property valued at $1,189,700 ; the next denominations in order are : Congregational, Methodist Episcopal, Baptist (Free Will) and Unitarian. Of charitable institutions, the principal are the Butler Hospital for the Insane and the Rhode Island Hospital, in Providence, and the soldiers' home, in Bristol. In Cranston, on the "state farm" of 533 acres, are the reformatory and penal institutions of the state, the workhouse, the hospital for insane, the almshouse, the prison, the Providence county gaol, and the reform school ; the number of inmates in 1899 was 2193.

History and Politics.—Roger Williams was the founder of the colony. Ordered in 1636 to leave the colony of Massachusetts Bay because of religious opinions, he fled to the "Narragansett country," and at Providence founded the state, of which religious liberty was the chief corner-stone. A royal patent obtained by him limited authority exercised under it to "civil things," and a charter granted by Charles II. in 1663 provided for entire freedom in religious matters. A property qualification was required of all voters. Under this charter the state was governed until 1843. The present laws relating to suffrage were enacted in 1888 ; their chief defect is that they entail unequal representation. All towns and cities are represented in the State Senate by one senator, without regard to population. The membership of the House of Representatives is limited to 72, and each town must have one representative. But no city may have more than one-sixth of the whole number of members. Thus Providence, with 175,597 people, can have but 12 members, one to 14,633 persons, while West Greenwich has one representative for 721 inhabitants, and the twelve smallest towns, with 14,657 people, have as many representatives as Providence. All state officers are elected annually. The governor has no veto power. The state is Republican in politics ; McKinley received a plurality of 22,978 votes over Bryan in 1896, and 13,972 votes in 1900. (W. H. Mu.)

Rhodes, the most easterly of the islands in the Aegean Sea, forming, with the islands of Symi, Kasos, Karpathos, Castelorizo, Tilos, and Sharki, one of the four sanjaks into which the Archipelago vilayet of Turkey is divided. The governor-general of the vilayet resides at the town of Rhodes, at the north-east extremity of the island. The facilities afforded by the lines of steamers that run from Smyrna to the islands of the Sporades and the small towns on the Asia Minor coast have destroyed the important transit trade which Rhodes formerly enjoyed. In 1900 the exports—sponges, storax oil, valonea, and fruits—amounted to £27,400, and the imports to £180,500. The population of the island comprises 7000 Moslems, 21,000 Christians, and 2000 Jews.

Rhodes, Cecil John (1853–1902), British colonial and Imperial statesman, was born on 5th July 1853, at Bishop Stortford, in Hertfordshire. His father was a clergyman, but he claimed descent from yeoman stock. His family appear to have been first known as farmers and graziers about the beginning of the 18th century. Towards the middle of that century his great-grandfather, Mr Samuel Rhodes, acquired considerable wealth, and became the possessor of a large estate at Dalston. His grandfather, Mr William Rhodes, owned a property attached to Layton Grange, in Essex, and Mr Rhodes's father, the Rev. Francis William Rhodes, afterwards succeeded to this estate. Cecil John Rhodes was the fifth son in a large family of sons and daughters. At the time of his birth his father held the living of Bishop Stortford. The boy was educated at Bishop Stortford grammar school with the intention of preparing for the Church ; but at the age of sixteen his health broke down, and in the latter part of 1870 he was sent to join an elder brother, then engaged in farming in Natal. In that year diamonds were discovered in the Kimberley fields. By the end of 1871 Mr Rhodes and his brother were among the successful diggers. The dry air of the interior restored Mr Rhodes's health, and before he was fully nineteen he found himself financially independent, physically strong, and free to devote his life to any object which commended itself to his choice.

Rhodes has left behind him an interesting record of the manner in which he was affected by the situation. He determined to return to England, and to complete his education by reading for a degree at Oxford ; but before doing so, he spent eight months in a solitary journey through the then little known parts of the country lying to the north of the Orange and Vaal rivers. He went through Bechuanaland to Mafeking, thence to Pretoria, Murchison, Middelburg, and back through the Transvaal to Kimberley. The journey, made in an ox-waggon at a rate of progression of some 15 to 20 miles a day, represented a walking tour of eight months through the vast spaces of rolling veldt which at that time filled those regions of Southern Africa. He saw one of the healthiest countries in the world barely occupied. He knew the agricultural possibilities of Natal. He knew its mineral wealth. The effect of the combined influences on his mind, in the circumstances in which he found himself, was profound. The idea took passionate possession of him that the fine country through which he moved ought to be secured for occupation by the British race, and that no Power but Great Britain should be allowed to dominate in the administration of South Africa. When he brought his self-imposed pilgrimage to an end, he had found an object to which he proposed to devote his life. It was nothing less than the governance of the world by the British race. A will exists written in Mr Rhodes's own handwriting a couple of years later, when he

was still only twenty-two, in which he states his reasons for accepting the aggrandizement and service of the British Empire as his highest ideal of practical achievement. The document begins with the characteristic sentence: "I contend that the British race is the finest which history has yet produced." The argument, continued through some twenty foolscap pages, is a clear if somewhat crude summary of the articles of faith on which the edifice of modern British Imperialism is based. It puts forward broadly, as an aim which must appeal to every elevated mind, the conception of working for the governance of the entire world by its finest race; and it ends with a single bequest of everything of which he might die possessed, for the furtherance of this great purpose. Five-and-twenty years later his final will carried out, with some difference of detail, the same intention.

The share which he allotted to himself in the general scheme was the extension of the area of British settlement in Africa, but he did not attempt to address himself immediately to public work. He returned, in accordance with his first resolve, to Oxford, where he matriculated at Oriel. In 1873 his health again failed, and he was sent back to South Africa under what was practically a death sentence. Years afterwards he saw the entry of his own case in the diary of the eminent physician whom he consulted, with a note, "Not six months to live." South Africa again restored him to health. Three years later he was back at Oxford, and from 1876 to 1878 he kept his terms. During this period he spent the Long Vacation each year in South Africa, where his large financial interests were daily increasing in importance. He was a member of the Cape Ministry when, after a further lapse of years, he kept his last term and took his degree. He did not read hard at Oxford, and was more than once remonstrated with in the earlier terms for non-attendance at lectures. But he passed his examinations; and though he was never a student in the university sense of the term, he was to the end of his life a keen devourer of books. He kept always a special liking for certain classic authors. Aristotle was the guide whom as a lad he followed in seeking the "highest object" on which to exercise the "highest activity of the soul." Marcus Aurelius was his constant companion. There exists at Grote Schuur a copy of the *Meditations* deeply scored with Mr Rhodes's marks.

CECIL RHODES.
(From a photograph by Elliott and Fry, London.)

During this Oxford time, and on to 1881, Mr Rhodes was occupied with the amalgamation of the larger number of the diamond mines of Kimberley with the De Beers Company, an operation which established his position as a practical financier and gave him an important connexion and following in the business world. This following and connexion, extended as it was by subsequent developments, was to Mr Rhodes in many of his larger political undertakings as a fighting army to a general. His enemies made it the subject of severe criticism. To many admirers who shared his ideas on public questions his connexion with the financial world and his practical success were a stumbling-block. It was often wished for him that he had "kept himself clear of all that." But this was not his own view. His ideals were political and practical. To him the making of money was a necessary preliminary to their realization, and he was proud of his practical ability in this direction. He was personally a man of most simple tastes. His immense fortune was spent in the execution of his ideals, and it has been justly said of him that he taught the world a new chapter of the romance of wealth. He rallied round him what may be called a new school of millionaires, who found in his example an inspiring suggestion for the employment of money.

In 1881 Mr Rhodes entered public life as a member of the Cape Assembly. It was the year of the Majuba settlement. South Africa was convulsed with questions which had arisen between the British and the Dutch, and leaders of Dutch opinion at the Cape ventured to speak openly of the formation of a United States of South Africa under its own flag. The British party needed a rallying-ground, and Mr Rhodes took his stand on a policy of local union combined with the consolidation and expansion of Imperial interests. He offered to Dutch and British alike the ideal of a South African Federation governing itself within the Empire, and extending, by its gradual absorption of native territories, the range of Imperial administration. Local self-government was, in his opinion, the only enduring basis on which the unity of the Empire could be built, and throughout his life he was as keen a defender of local rights as he was of Imperial unity. There was a period somewhat later in his career when this attitude on his part gave rise to a good deal of misapprehension, and his advocacy of the elimination of direct Imperial interference in local affairs caused him to be viewed in certain quarters with suspicion as a Separatist and Independent. Those who were inclined to take this view were greatly strengthened in their suspicions by the fact that at a critical moment in the struggle for Home Rule in Ireland Mr Rhodes contributed £10,000 to the funds of the Separatist party. The subsequent publication of his correspondence on the subject with Mr Parnell, who was at that time leading the Home Rule party, demonstrated, however, the essential fact that, whatever might have been the secret intentions of the extreme Irish Home Rulers, Mr Rhodes's contribution was made strictly subject to the retention of the Irish members at Westminster, and that his interest in the Irish question arose solely from a belief that the Home Rule movement, if successful in establishing the double principle of local self government combined with Imperial representation, would be, in his own words, the "commencement of changes which will eventually mould and weld together all parts of the British Empire." He remained of the opinion that the

Home Rule movement, wisely treated, would have had a consolidating and not a disruptive effect upon the organization of the Empire.

In South Africa the influence which he acquired over the local independents and over the Dutch vote was subsequently an important factor in enabling him to carry out the scheme of northern expansion which he had at heart. His first attention on entering public life was given to this question. In 1881 Cape Colony was confined upon the north by the Orange river. The Bechuana territory, which lay beyond the river, was a sort of no man's land through which ran the trade routes to the north. It was evident that any Power which commanded the trade routes would command the unknown northern territory beyond. The London Convention of 1881 limited the westward extension of the Transvaal to a line east of the trade routes. Nevertheless the reconstituted Republic showed itself anxious to encroach by irregular overflow into native territories, and Mr Rhodes feared to see the extension of the British colonies permanently blocked by Dutch occupation. One of his first acts as a member of the Cape Assembly was to urge the appointment of a delimitation commission. He served in person on the commission, and obtained from the native chief Mankoroane, who claimed about half of Bechuanaland, a formal cession of his territories to the British Government of the Cape. The Cape Government refused to accept the offer; but as a result of Mr Rhodes's urgent representations, an Imperial Protectorate was, after much discussion, declared over Bechuanaland in 1884. The British flag was thus carried to the 22nd parallel. In the same year a second Convention was signed in London laying down definite frontiers on the eastern border of Bechuanaland within which the Transvaal undertook to confine itself. With the consent of Great Britain, Germany occupied almost at the same time the territory on the Atlantic coast which is now known as German South-West Africa. Mr Rhodes occupied the position of resident deputy commissioner in the new British territory towards the end of 1884. When he took up the duties of his office he found that, notwithstanding conventions to the contrary, a further determined attempt had been made on the part of the Dutch to overrun the border. The country had been practically seized by a Boer commando. An old Dutchman who knew the value of the position said privately to Mr Rhodes, "This is the key of South Africa." The question at issue was whether Great Britain or the Transvaal was to hold the key. It was a question about which at that time the British public knew nothing and cared nothing. Mr Rhodes made it his business to enlighten them. President Kruger, speaking for the Government of the Transvaal, professed to regard the Dutch commandoes as freebooters, and to be unable to control them. It devolved upon Great Britain to oblige them to evacuate the territory. As the result of Mr Rhodes's exertions the necessary step was taken. The Warren expedition of 1884 was sent out. In the presence of British troops upon the frontier President Kruger recovered his controlling power over the Transvaal burghers, and without any fighting the commandoes were withdrawn.

It was the first round in the long duel fought on the field of South Africa between Mr Rhodes, as the representative of British interests, and President Kruger, as the head of the militant Dutch party. The score on this occasion was to Mr Rhodes, and the entrance to the interior was secured. But the 22nd parallel was far short of the limits to which Mr Rhodes hoped to see British influence extend, and he feared lest Germany and the Transvaal might yet join hands in the native territory beyond, and bar his farther progress towards the north. The discovery of gold at Johannesburg in 1886, by adding to the wealth and importance of the Transvaal, gave substance to this fear.

The territory to the north of the 22nd parallel was at that time under the domination of Lobengula, king of the Matabele, a native potentate celebrated alike for his ability and for the despotic character of his rule. There were rumours of Dutch and German emissaries at the kraal of Lobengula, engaged in persuading that chief to cede certain portions of his territory. Portugal also was putting forward shadowy claims to the country. It was in these circumstances that Mr Rhodes conceived the idea of forming a British Chartered Company, which should occupy the territory for trading and mining purposes as far as the Zambezi, and bring the whole under the protection of Great Britain. The idea took shape in 1887, in which year Mr Rhodes's first emissaries were sent to Lobengula. The charter of the British South Africa Company was granted in October 1889. Between the two dates his conception of the possibilities to be achieved by the Company had expanded. Mr Rhodes no longer limited the sphere of his operations to the Zambezi, but, crossing the river at the back of the Portuguese settlement at its mouth, he obtained permission to extend the territories of the Chartered Company to the southern end of Lake Tanganyika, including within the sphere of its operations a British settlement already made upon Lake Nyasa. He hoped to go farther still, and to create a connected chain of British possessions through the continent which might eventually justify the description "Africa British from the Cape to Cairo." The treaty negotiated between Great Britain and Germany in 1890 extended the German sphere of influence from the East Coast to the frontier of the Congo Free State, and defeated this hope. But Mr Rhodes did not wholly renounce the idea. In 1892, when the question of the retention or abandonment of Uganda hung in the balance at home, he threw all the weight of his influence into the scale of retention, and undertook at his own personal expense to connect that territory by telegraph with British possessions in the south. In the following year, 1893, it was found inevitable to fight the Matabele, and a war, prosecuted with a success that is perhaps unique of its kind, placed the country entirely in British hands. The territory thus added to the British Empire covered an extent of 750,000 square miles, of which large portions consist of healthy uplands suitable for white colonization. From this time onwards through his very active life Mr Rhodes gave constant attention and encouragement to the development of British administration in the new territory, to the construction of roads, telegraphs, and railways, the laying out of towns, the introduction of good breeds of farming stock, the planting and draining of agricultural land, and the working of minerals, upon which the financial stability of the new protectorate mainly depended. The pioneer party who constructed the first road and founded the first British stations in the country received their orders to cross the frontier in the end of 1889. By the and of 1899, before the outbreak of the South African war, though the country had passed through the trial of a war, two native rebellions, and the scourge of rinderpest, it had become, under the name of Rhodesia, a well-settled province of the British Empire, with a white population of some 12,000 to 13,000 persons, already clamouring for the privileges of self-government.

The six years which followed the granting of the charter may be regarded as the most successful of a singularly successful life. In 1896, not many months after the granting of the charter, Mr Rhodes accepted the position of prime

minister of the Cape. He was maintained in power very largely by the Dutch vote, which he spared no pains to conciliate; and having the confidence of both political sections of the colony, he found himself practically in a position to play the part of benevolent despot in South Africa. He used the position well so far as the public was concerned. While his scheme of northern expansion was making the rapid progress which has been indicated, he did much to elevate and to enlarge the field of local politics. He frankly declared and worked for the policy of uniting British and Dutch interests in South Africa; he took a keen interest in local education. He also during this period carried through some important reforms in native policy. He had the courage to restrict the franchise, introducing an educational test and limiting the exercise of voting power to men enjoying an income equal to a labourer's wage—thus abolishing, without making any distinction of colour, the abuses of what was known as the "blanket" vote. Long before the passing of the Franchise Act Mr Rhodes had openly stated his opinion that in dealing with an entirely distinct people there was no alternative between receiving them on an equal footing as citizens or treating them as a subject race. He was not prepared to receive the black races of South Africa on equal terms as citizens with the white, and he accepted the, to him, logical conclusion that there must be class legislation. In his heart he had perhaps a suspicion that every man who denied this conclusion was either fool or knave. For his own part, having accepted it, he accepted it frankly, and made no attempt to conciliate the sentimental party with pretences.

But his native policy was far from being one of simple restriction. He liked the natives; he employed them by thousands in the mining industry, he kept native servants habitually about his person, he seemed to understand their peculiarities and was singularly successful in dealing with them. The first canon of his native policy was that liquor should be kept from them; the second, that they should be encouraged to labour, and guaranteed the full possession of their earnings; the third, that they should be educated in the practical arts of peace. He appreciated the full importance of raising their territorial condition from one of tribal to individual tenure; and while he protested against the absurdity of permitting the uncivilized Kaffre to vote on questions of highly civilized white policy, he believed in applying to the native for his own native affairs the principle of self-government. Of these views, some received practical embodiment in the much-disputed Act known as the Glen Grey Act of 1894. In this connexion it may also be noted that he was one of the warmest and most convinced supporters of Lovedale, the very successful missionary institution for the education of natives in South Africa.

The position of benevolent despot has obvious drawbacks. In Mr Rhodes's case the dependence which the populations of Cape Colony were led to place on him had its reaction on the public in a demoralizing loss of self-reliance, and for himself it must be admitted that the effect on the character of a man already much disposed to habits of absolutism in thought and action was the reverse of beneficial. Mr Rhodes felt himself to be far stronger than any man in his own surroundings; he knew himself to be actuated by disinterested motives in the aims which he most earnestly desired to reach. Of this, when his life is viewed as a whole, there can be no reasonable doubt. He was profoundly impressed by a sense of the shortness of life, and he so far abused his power as to become intolerant of any sort of control or opposition. In the conception of his great schemes he frequently erred in detail, but he had not the patience to accept correction. Neither could he make allowance for candid difference of opinion. The man who thought with him was his friend, and was accepted as such; the man who differed from him was an antagonist, and either to be overridden or pushed aside. The inevitable result followed, that though Mr Rhodes did much of great and good work during the six years of his supreme power, he entirely failed during that period to surround himself, as he might have done, by a circle of able men fit to comprehend and to carry on the work to which his own best efforts were directed. To work with him was practically impossible for those who were not willing to accept without demur the yoke of dogmatic authority; and the methods which he employed were at times so crude as to alienate not only men naturally opposed to his political ideals, but some of the best minds working in the interests of Empire for aims not unlike his own. He had a few devoted personal friends, who appreciated his aims and were inspired by his example; but he was lacking in regard for individuals, and a great part of his daily life was spent in the company of satellites and instruments, whom he used with cynical unconcern for the furtherance of his ends. That the ends were generous and impersonal redeems, but cannot be held to justify, an insensitiveness to some of the finer elements of human intercourse which limited the range of his character and led him into his gravest errors.

In 1896 the brilliant period of his premiership was brought to an end by the incident which became famous under the name of the Jameson Raid. The circumstances which led to the Raid belong properly to the history of the Transvaal. It is enough to say briefly here that the large alien population which had been attracted to the Transvaal by the phenomenal wealth of the Johannesburg gold-fields, conceiving themselves to have reason to revolt against the authority of the Transvaal Government, resolved towards the end of 1895 to have recourse to arms in order to obtain certain reforms. Arming was to take place secretly, and the revolution was to be carried out when the mining population was sufficiently prepared to be in a position to take concerted action. Mr Rhodes, as a large mine-owner, was theoretically a member of the mining population. In this capacity he was asked to give his countenance to the movement; and in so far as his extensive property in the Transvaal suffered from conditions which other mine-owners pronounced to be intolerable, he had the same right as others to decide by what means it was advisable to endeavour to obtain redress. But as prime minister of a British colony he was evidently placed in a false position from the moment in which he became cognizant of a secret attempt to overturn a neighbouring Government by force of arms. He did more than become cognizant. The subsequent finding of a Cape committee, which he accepted as accurate, was to the effect that "in his capacity as controller of the three great joint-stock companies, the British South Africa Company, the De Beers Consolidated Mines, and the Gold Fields of South Africa, he directed and controlled the combination which rendered such a proceeding as the Jameson Raid possible." He gave money, arms, and influence to the movement; and as the time fixed for the outbreak of the revolution approached, he allowed Dr Jameson, who was then administrator of the British South Africa Company in Rhodesia, to move an armed force of some 500 men upon the frontier. Here Mr Rhodes's participation in the movement came to an end. It became abundantly clear from subsequent inquiry that he was not personally responsible for what followed. The intention had been that Dr Jameson, with the force under his orders, should assist the development of the revolution in the Transvaal, and hold himself ready to move across the frontier if required. Changes in the local situation in the

Transvaal gave promise of averting or postponing the open conflict, when unfortunately, by a series of misunderstandings, Dr Jameson, whose personal chivalry in the matter was not questioned, conceived it to be his duty to lead his force across the frontier and to deliver the first blow. The Transvaal military authorities, fully warned by secret information, had no difficulty in dealing with the incursion. The little force was surrounded and led ignominiously prisoners to Pretoria. A cipher correspondence, seized and published by the Boers, left the civilized world in no doubt as to Mr Rhodes's share in the previous preparation, and he was for a time believed to be responsible for the Raid itself. Subsequent inquiries held by committees of the Cape Parliament and of the British House of Commons acquitted him entirely of responsibility for Dr Jameson's final movement, but both committees found that he had acted in a manner which was inconsistent with his duty as prime minister of the Cape and managing director of the British South Africa Company .He himself practically acquiesced in this finding, though from a somewhat different point of view, blaming himself, not for having encouraged the revolution, but for having failed to hold the movement so completely in check as to have been able to prevent disaster. No one recognized more fully than himself the scope of the blunder which had been committed.

He displayed, in the circumstances, characteristic qualities of pluck and candour. He made no concealment of his own share in the catastrophe; he took full responsibility for what had been done in his name by subordinates, and he accepted all the consequences which ensued. He resigned his premiership of the Cape; and recognizing that his presence was no longer useful in the colony, he turned his attention to Rhodesia. His design was to live in that country, and to give all the stimulus of his own presence and encouragement to the development of its resources. The Matabele rebellion of March 1896 intervened to prevent the immediate realization of his plans. In June Imperial troops were sent up, and by the end of July the result of the military operations had driven the natives to the Matoppo Hills, where they held a practically impregnable position. The prospect was of continued war, with a renewal of a costly campaign in the following year. Mr Rhodes conceived the idea that he might effect single-handed the pacification which military skill had failed to compel. To succeed, it was essential that he should trust and be trusted. He accordingly moved his tent away from the troops to the base of the Matoppo Hills. He lay there quietly for six weeks, in the power of the enemy, if they had chosen to attack. Word was circulated among the natives that he had come alone and undefended to hear their side of the case. A council was held by them in the very depths of the hills, where no armed force could touch them. He was invited to attend it. It was a case of staking his life on trust. He displayed no hesitation, but mounted and rode unarmed with the messenger. Three friends rode with him. The confidence was justified. They met the assembled chiefs at the place appointed. The native grievances were laid before Mr Rhodes. At the end of a long discussion Mr Rhodes, having made and exacted such concessions as he thought fit, asked the question, "Now, for the future is it peace or is it war?" And the chiefs laying down their sticks as a symbol of surrendered arms, declared, "We give you one word; it is peace." The scene, as described by one of the eye-witnesses, was very striking. Mr Rhodes, riding away, characterized it simply as "one of the scenes which make life worth living."

His life was drawing towards its end. He had still a few years, which he devoted with success to the development of the country which bore his name. The railway was brought to Bulawayo, and arrangements were made for carrying the line on in sections as far as the south end of Lake Tanganyika, a construction which was part of his pet scheme for connecting the Cape by a British line of communication with Cairo. He also concluded arrangements for carrying a telegraphic land line through to Egypt, and had the satisfaction of seeing the mineral development of the country fairly started. But the federal union of South Africa, to which he had always worked as the secure basis of the extension of British rule in the southern half of the continent, was not for him to see. The South African war broke out in 1899. Mr Rhodes took his part at Kimberley in sustaining the hardships of a siege; but his health was broken; and though he lived to see victory practically assured to British arms, peace had not been concluded when, on 26th March 1902, he died at Cape Town.

His life's work did not end actually with his death. He left behind him a will in which he dedicated his fortunes, as he had dedicated himself, exclusively to the public service. He left the bulk of his vast wealth for the purpose of founding scholarships at Oxford of the value each of £300 a year, to be held by students from every important British colony, and from every state and territory of the United States of America. The sum so bequeathed was very large; but it was not for the munificence of the legacy that the will was received with acclamation throughout the civilized world: it was for the striking manifestation of faith which it embodied in the principles that make for the enlightenment and peace and union of mankind, and for the fine constancy of Mr Rhodes's conviction that the unity of the British Empire, which he had been proud to serve, was among the greatest of organized forces uniting for universal good. The bequests to American scholars were made with the expression of a hope "that such an education will encourage and foster an appreciation of the advantages which I implicitly believe will result from the union of the English-speaking peoples throughout the world." Those to British colonists were for the purpose "of giving breadth to their views, for their instruction in life and manners, and for instilling into their minds the advantage to the Colonies, as to the United Kingdom, of the retention of the unity of the Empire." The will was drawn up some years before his death. A codicil, signed during the last days of his life, gave evidence of some enlargement of his views as to the association of races necessary in order to secure the peace of the world, and added to the original scheme a certain number of scholarships to be held at the disposal of German students.

The publication of the will silenced Mr Rhodes's detractors and converted many of his critics. It set a seal which could not be mistaken upon his completed life. The revulsion of sentiment towards him was complete, and his name passed at once in the public estimation to the place which it is probably destined to take in history, as one which his countrymen are proud to count among the great makers of the British Empire. (F. L. S.)

Rhodesia, North. See CENTRAL AFRICA, BRITISH; and conclusion of RHODESIA, SOUTH: *History*.

Rhodesia, South, comprising the whole of that section of British South Africa which stretches from the Limpopo northwards to the Zambezi, and from the Bechuanaland Protectorate eastwards to Portuguese East Africa. It thus includes the former native territories of Matabeleland and Mashonaland, which, with the circumjacent Banyai, Manica and Makalaka districts, have a total area of 175,000 square miles, with a population

estimated at 425,000, roughly distributed between the two main sections as under:—

	Area in Square Miles.	Population.
Matabeleland, with Makalaká, . .	61,000	155,000
Mashonaland, with Banyai and Manica,	114,000	270,000

But these divisions have now little more than a historical interest, and since 1894 the whole region forms a single political domain. It was administered by the British South Africa Company till 1898. In that year the Company was partly relieved of its strictly administrative functions by a resident commissioner appointed by the Secretary of State, and an executive council, consisting of the resident commissioner, the Company's administrators, and at least four others nominated by the Company, with the approval of the State Secretary. There is also a legislative council, including the senior administrator as president, the resident commissioner, five nominees of the Company approved by the State Secretary, and four members elected by the registered voters. To this council the president submits the yearly budget, which must be approved by the high commissioner, who has the direct control of the military police, and the final decision in all land disputes with the natives, mineral rights being reserved to the Company. There is a high court, with civil and criminal jurisdiction, besides district courts and a secretary for native affairs, with subordinate native commissioners, natives and non-natives all having equal rights, except in respect of arms and liquor.

Townships have been established at Salisbury (the capital), at Victoria, Umtali, Bulawayo, Gwelo, Enkeldoorn, and Melsetter. Others are being formed elsewhere, and the demand for building sites is increasing, especially at Salisbury and Bulawayo, where there are municipalities, Government offices, banks, churches, hotels, schools, public libraries, and hospitals. Another indication of progress is the extent of land already surveyed, which in 1900 exceeded ten million acres, distributed in about equal proportions over Matabeleland and Mashonaland. This almost sudden transition from the sheer savagery everywhere prevailing down to past the end of the third quarter of the 19th century to the establishment of European institutions, and the spread of civilizing influences amongst the rude aborigines, was primarily due to the introduction of law and order under a strong and just Government, but also to the fairly salubrious climate, the almost boundless agricultural and mineral resources of the land, and the rapid development of its communications. In 1899 nearly 3000 miles of roads and post routes had already been opened, besides 500 miles of cross-roads in the mining districts. In November 1897 the Rhodesian Railway, forming a continuation of the Cape trunk line to Vryburg, in Bechuanaland, had reached Bulawayo. Another section of 150 miles was completed by June 1900, and the system is to be continued for 300 miles northwards to the Zambezi through the valuable coal-fields, at least 400 square miles in extent, which were discovered in November 1900 some 180 miles north-west of Bulawayo. Provision has also been made for a branch from Bulawayo south to Gwanda (80 miles), to be ultimately connected through Tuli with the Transvaal system; while another branch is projected from Bulawayo north-east to Salisbury, the present inland terminus of the line running through Umtali and Portuguese territory to the coast at Beira (opened 1st May 1899).

In 1899 nearly 1,250,000 letters and packages were forwarded through the 55 post offices already opened; and in the same year the telegraph system comprised over 2500 miles of wires, with 75 offices, through which 86,000 messages were despatched. For the climate, physical features, and other geographical details, see SOUTH AFRICA, BRITISH. (A. H. K.)

History.—The first people to establish themselves in historic times in the territories now forming Rhodesia were the Matabele, a famous Bantu tribe and an offshoot of the Zulus. Moselekatze, their first chief, was a warrior and leader who served under the Zulu despot Chaka. Being condemned to death by Chaka, Moselekatze fled, with a large division of the Zulu army. About 1817 he settled in territories north of the Vaal, not far from the present site of Pretoria; and in 1836 his tribe had become so important that a treaty of friendship was entered into with him by the governor of Cape Colony. In the same year a large number of the "trek Boers" had settled north of the Vaal river, and came in contact with the Matabele, who attacked and defeated them, capturing a large number of Boer cattle and sheep. In November 1837 the Boers felt themselves strong enough again to assail Moselekatze, and they did so with such success that they drove him and his tribe north of the Limpopo, where they settled and occupied the country subsequently known as Matabeleland. In 1870 Moselekatze died, and was succeeded by his son Lobengula. In 1882 President Kruger, who was then bent on extending the boundaries of the Transvaal in every direction, endeavoured to make a treaty with Lobengula, but without success. The Warren expedition of 1884 to Bechuanaland, while it checked for a time the encroachments of the Transvaal Boers, and preserved to Great Britain the highway to the north through Bechuanaland, also served to encourage colonists to speculate as to the future of the interior.

Foiled in Bechuanaland, it soon became evident that the Boers were determined to get a footing in Mashonaland, and that the Portuguese and Germans were also anxious to get as much of the territory there as they could obtain. In 1887 Lord Salisbury had his attention called to the fact that the Portuguese Government had recently issued a map in which their territories were represented as extending over the greater portion of Mashonaland, and even Matabeleland. He thereupon protested that under the Berlin Act no claim to territory in Central Africa could be recognized unless it was supported by actual occupation, and he further said that the Zambezi should be regarded as the natural northern limit to the territories of Great Britain in South Africa. Meanwhile gold prospecting had been taken up actively all over South Africa, following on the discoveries at Barberton and the Rand; and at this time Lobengula was besieged for all sorts of concessions by both Portuguese and Boers, as well as by adventurers from various parts of the world. Mr Cecil Rhodes, who for a long time had kept his eyes on the great territories of the north, for the route to which he had striven so keenly in political circles in Cape Town, decided to make an effort to retain the country for Great Britain. With considerable difficulty he persuaded Sir Hercules Robinson, then high commissioner, to send Mr Moffat, the missionary, as an embassy to Lobengula, to endeavour to obtain an understanding with him. The result was a treaty under which Lobengula promised to enter into no correspondence or treaty with a foreign Power, nor to sell or otherwise dispose of any part of his territories, without the consent of the high commissioner. In October 1888 Mr C. D. Rudd, who for a long time had been associated with Mr Rhodes in mining operations, visited Lobengula at considerable personal risk, and succeeded in obtaining a concession of all the mining rights in the country from him. In consideration of this concession Mr Rudd (representing the Gold Fields of South Africa Company, and also a syndicate in which Mr Alfred Beit, Mr Rhodes, and Mr Rudd were the largest holders) promised Lobengula £100 a month, 1000 rifles, and a considerable amount of ammunition. At the same

time Lobengula was induced to issue a notice warning off all other concession-hunters. Mr Rhodes then applied to the Imperial Government for a Royal Charter with which to consolidate and develop the new territories and their mineral wealth. In applying for this charter the founders of the company stated their objects to be the following:—(1) To extend northwards the railway and telegraph systems in the direction of the Zambezi; (2) to encourage emigration and colonization; (3) to promote trade and commerce; (4) to develop and work minerals and other concessions under the management of one powerful organization, thereby obviating conflicts and complications between the various interests that had been acquired within these regions, and securing to the native chiefs and their subjects the rights reserved to them under the several concessions. In making this application the boundaries were purposely left somewhat vague. They were described to be the region of South Africa lying immediately to the north of British Bechuanaland, to the north and west of the South African Republic, to the west of the Portuguese dominions.

At the outset of the company's existence Mr Rhodes and his directors determined to effect the occupation of the country. A pioneer force was therefore sent in under Colonel Pennefather, consisting of 500 mounted police and a few hundred pioneers. Accompanying this force as guide was the accomplished traveller, well known throughout South Central Africa, Mr F. C. Selous. The work of transport was attended with considerable difficulty, and roads had to be cut as the expedition advanced. Nevertheless in a few months the expedition had reached the site of what is now the town of Salisbury, and had also established on the line of march small forts at Tuli, Victoria, and Charter. Mr Archibald Ross Colquhoun was the first administrator. He had not long been in office when, in May 1891, difficulties arose with the Portuguese on their north-west frontier, both parties claiming a certain tract of territory in which a Portuguese trading station had been established. The result was a skirmish, in which a small company of British South Africa Police were victorious. In 1891 Dr Leander Starr Jameson was appointed administrator in succession to Mr Colquhoun. The Boers for several years past had been planning a settlement in the territories north of the Limpopo, and they now determined, in spite of the Moffat treaty and the British occupation, to carry out their object. An expedition known as the Banyailand Trek was organized under the leadership of Colonel Ferreira, and two large parties of Boers proceeded to the banks of the Limpopo. Information of the intended trek had been conveyed to Cape Town, and Sir Henry Loch (the high commissioner) at once sent a strong protest to President Kruger, informing him that any attempt to invade the Chartered Company's territories would be an act of hostility against the British Crown; and Mr Kruger issued a proclamation forbidding the trekkers to proceed. Meanwhile, however, a party had already started and reached the Limpopo, where they were met by Dr Jameson in command of the British South Africa Company's forces. He told them that they would on no account be allowed to proceed except as private individuals, who might obtain farms on application to the Chartered Company. Colonel Ferreira was arrested and detained for a few days, and the expedition then broke up and dispersed.

The pioneers having been settled in Mashonaland, Mr Rhodes recognized the extreme importance of endeavouring to give the country a port nearer than that provided by Cape Town. He therefore made overtures to Portugal, and in 1891 a treaty was concluded between Great Britain and Portugal which provided that a railway might be constructed to Beira through Portuguese territory, on condition that Portugal should receive a duty not exceeding 3 per cent. on the value of the goods imported. The treaty further stipulated for the free navigation of the Zambezi and the construction of telegraphs. The boundaries of the Chartered Company's territories and those of the Portuguese were clearly defined. Prospecting operations were at once started, and various gold mines were discovered containing traces of old workings. Fresh gold reefs were also opened up. The prospects of the country seemed promising, and although a good deal of fever occurred in the low-lying valleys under the conditions of camp life, the health of the community soon improved as more suitable habitations were erected.

The first pioneers settled in Mashonaland. Ever since the advent of Moselekatze north of the Limpopo, the unfortunate Mashonas had been the prey of the Matabele; they therefore accepted British occupation gladly, recognizing that the British South African forces were likely to protect them against the raids of Lobengula and his warriors. The Matabele, on the other hand, were loth to abandon their predatory excursions among the Mashonas, and in July 1893 a large *impi* (native force) was sent into Mashonaland, and entered not only native kraals, but also the streets of the new township of Victoria. An attempt was made to preserve the peace, but it was evident from the attitude taken by the Matabele that nothing short of the authority which only superior force could command would settle the question. The Matabele were a proud and fearless race of warriors, who had never yet come in conflict with white men, and had never been defeated in their conflicts with native foes. It is true that under Moselekatze, a generation before, they had been driven out of the Transvaal by the Boers, but the *indunas* (petty chieftains) of 1890 were but children when this defeat had been inflicted upon them. Dr Jameson's forces were slender; and Mr Rhodes, on being consulted, urged him by telegram to "Read Luke fourteen, thirty-one." On obtaining a Bible, Dr Jameson read the words: "Or what king, going to make war against another king, sitteth not down first, and consulteth, whether he be able with ten thousand to meet him that cometh against him with twenty thousand?" He telegraphed in reply: "All right. I have read Luke fourteen, thirty-one." The position, though dangerous, admitted of no delay, and Dr Jameson determined to risk an expedition with the forces at his command. His success on this occasion doubtless weighed with him on another and less fortunate one. The force available consisted of about 700 volunteers and 225 British Bechuanaland police, with some 700 natives. Dr Jameson determined to march to Bulawayo, the headquarters of Lobengula and the capital of Matabeleland. The force was divided into two columns, and was to be met by a further column of natives marching from the south under Khama. The first engagement took place on the Shangani river, where the two columns which had started from Fort Charter and Fort Victoria were both engaged. Majors Forbes and Allan Wilson commanded in these engagements; and after a hot contest with between 4000 and 5000 Matabele, the latter were repulsed, machine guns being used with terrible effect upon the enemy. On 1st November a second fight occurred on the high ground, in which it was estimated that 7000 of the Matabele attacked the laager of the two columns. The oldest and most tried regiments of Lobengula dashed right up to the muzzles of the guns, but were swept down before the modern rifles and machine guns with which the invaders were armed. Meanwhile the column of Khama's men from the south had reached the Tati,

and won a victory on the Singuesi river on 2nd November. On 3rd November Bulawayo was reached, and the columns from Mashonaland, accompanied by Dr Jameson and Sir John Willoughby entered the town, Lobengula and his followers being in full flight. An endeavour was made to induce Lobengula to surrender; but as no replies were received to the messages, Major Forbes, on 13th November, organized a column and started in pursuit. The pursuing party were delayed with difficult roads and heavy rains, and did not come up with Lobengula until the 3rd December. Major Allan Wilson, in command of thirty-four troopers, crossed the Shangani river in advance, and bivouacked close to Lobengula's quarters. In the night the river rose, and reinforcements were unable to join him. During the early morning the Kaffres surrounded the little band, and after fighting most gallantly to the last, Major Allan Wilson and all his followers, with the exception of three messengers who had been sent back, were killed.

In January Lobengula died. His *indunas* submitted to the Chartered Company's forces, and the war, which cost the Chartered Company £100,000, was thus ended. Matabeleland was rapidly occupied by pioneers and others who went to join them. The climate was healthy, the altitude of the country being higher than that of Salisbury. Various gold reefs were discovered. A township was started and grew rapidly at Bulawayo.

In 1895 a question arose between the Chartered Company and the Imperial Government as to the annexation of the Bechuanaland Protectorate. An Annexation Bill had just been passed by the Cape Government, annexing British Bechuanaland proper to the Cape Colony. The British South Africa Company now put in a claim for the British Bechuanaland Protectorate, and provisional arrangements for the administration of these territories under their control were made (see BECHUANALAND). But the "Jameson Raid" interfered with their completion, and the whole constitution of the British South Africa Company was subsequently remodelled. In 1896 Mr Cecil Rhodes resigned his position as managing director of the British South Africa Company, and Mr Alfred Beit retired from the Board in London. While these changes in the directorate were going on, there occurred, in March 1896, a revolt of the Matabele, near Bulawayo. A general massacre of outlying settlers took place, and the whole country was in a state of rebellion. Imperial troops were hurried up to the assistance of such police as the British South Africa Company still had at its command. Volunteers were enrolled, and much fierce fighting followed. Early in October Mr Rhodes, who had just returned from London, went to Bulawayo. After conference with the military and other authorities in command on the spot, he determined to go, with Dr Hans Sauer and Mr Colenbrander, and interview the native chiefs. They went unarmed into the heart of the Matoppo hills, and there arranged terms of peace with the native *indunas.* The interview involved grave personal danger to the emissaries, and depended for its success entirely upon Mr Rhodes's personality and influence over the native races; but it terminated what promised to be a long and disastrous native war.

In 1897 a Select Committee appointed by the British House of Commons "to inquire into the origin and circumstances of the incursion into the South African Republic by an armed force, and into the administration of the British South Africa Company," held their sessions. Among the numerous witnesses called upon to give evidence were all the directors of the British South Africa Company, with the exception of Lord Grey. The Committee were unanimous in condemning the Jameson Raid, and in holding Mr Rhodes mainly responsible for the measures which led up to it.

In April 1898 the shareholders in the Chartered Company unanimously re-elected Mr Rhodes a director. Mr Alfred Beit was also proposed, but declined to accept the position. He was, however, reappointed in June 1902. As a result of the report of the British South Africa Select Committee, the whole future administration of Rhodesia was taken into consideration by the British Government (the armed forces of the Company had already been placed under the direct control of the Crown), and on 20th October 1898 an Order in Council was passed providing for the future regulation of the country. An Imperial resident commissioner was appointed, who was also to be *ex officio* a member of the executive and legislative Councils; and there was to be a legislative Council, consisting of five nominated and four elected members. These changes tended rather to increase the direct influence of the High Commissioner. It was also provided that this Order in Council, technically known as the Southern Rhodesia Order, might, if required, be extended to any other part of South Africa under British protection south of the Zambezi. The first meeting of the newly appointed Council took place at Salisbury on the 15th of May 1899.

In the earlier part of 1899 Mr Rhodes visited London and Berlin in connexion with the furtherance of his schemes for the Trans-Continental telegraph extension from Cape Town to Cairo, and the Trans-Continental Railway. He endeavoured while in London to obtain from the Government the guarantee of a loan for the purpose of extending the railway, to be raised at 3 per cent., but was unsuccessful. He received, however, the support of various companies in Rhodesia, who amongst them subscribed £252,800 at 3 per cent. for the immediate extension of the railway for 150 miles; and on 2nd May he stated, at a meeting of the Chartered Company, that the Rhodesia Railways Limited would raise another £3,000,000 at 4 per cent., to be guaranteed by the Chartered Company. In this way he hoped that the remaining 1050 miles of railway from Bulawayo to the frontier of German East Africa might be constructed. In Berlin Mr Rhodes had an interview with the German Emperor, when arrangements were arrived at with regard to the passage of telegraph lines over German territory. Mr Rhodes acted on behalf of the African Trans-Continental Telegraph Company, of which he was the promoter and principal director; and on their behalf he received from the German Government leave to construct a telegraph line across German East Africa, from south to north, at the cost of the Company, the work having to be completed within five years, from October 1899, the Company being called upon further to erect an additional line at its own cost between the two stations nearest to the German frontiers, from Rhodesia on the one side and British East Africa on the other, for the telegraphic traffic of German East Africa.

The early settlers of Rhodesia, for the first ten years of that country's existence, had a great deal to contend against. The political unrest of the country, the final breaking up of the Bantu power within its territories, the immense difficulties of transport, the Matabele rebellion, and a terrible cattle plague, known as rinderpest, all tended to keep back the country's progress. Nevertheless, the sturdy colonists settled there never lost heart, and persistently, as occasion offered, continued their development of the various gold properties which offered sufficient inducement to mining. The progress of the whole country, in spite of all drawbacks, has in many respects been remarkable. In no colony in South Africa, and probably in very few countries elsewhere in the world, has the extension of telegraphic communication and railways been so rapid and considerable in proportion to the population of the country. The telegraph line reached Salisbury in 1892, and at the end of 1899 a total of 3613 miles had been constructed. In addition to the telegraph lines, telephones have also been established

in many townships, and police posts in the country. Bulawayo is already a considerable town, with massive stone and brick buildings in the streets. The churches, hospitals, Stock Exchange, Government offices, banks, clubs, and hotels are equal to those of many of the older towns in South Africa. Both Salisbury and Bulawayo have municipalities; and municipal authorities are doing excellent work in the shape of road-making, lighting, tree-planting, &c., as well as in the laying out of public parks. The railway from Beira reached Salisbury in May 1899.

An efficient and mobile police force of a thousand Europeans, and three hundred native troops under Imperial officers, have their headquarters at Salisbury and Bulawayo, and detachments of these are placed at various outposts. In addition to gold, coal has been found in Rhodesia in various parts, of excellent quality and in considerable abundance. Good timber is found in the valleys, and excellent examples of locally made furniture and of wood for paving have already been sent to England. In some parts of the country have been found ancient ruins of extreme interest, especially those of Zimbabye, near Victoria. At these various ruins, implements and ornaments, some of them in gold and of great antiquity, have been discovered.

Northern Rhodesia is divided into two territories—North-Eastern and North-Western Rhodesia—and is administered by the British South Africa Company under the Orders in Council of 1899 and 1900. There is a separate administrator for each territory, the headquarters of the former administration being at Fort Jameson, and of the latter at Lealui. The country, although more tropical than Southern Rhodesia, is, for the greater part, a continuation of the high and healthy South African plateau, which extends from the Karroo in Cape Colony through Southern Rhodesia and north of the Zambezi. The territories are believed to be highly mineralized, and valuable deposits of copper have already been discovered, and are being developed. The African Trans-Continental Telegraph line has been constructed through North-Eastern Rhodesia, and the proposed Cape to Cairo Railway will, after leaving Victoria Falls on the Zambezi river, pass through North-Western and North-Eastern Rhodesia to the northern border at Lake Tanganyika.

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(A. P. H.)

Rhondda, an urban district and coal-mining locality of Glamorganshire, Wales, crossed by the river Rhondda, a right-bank tributary of the Taff, and separated on the east by the Rhondda-fach river from the parliamentary borough of Merthyr Tydfil. Population (1891), 88,351; (1901), 113,735.

Rhône, a department of south-eastern France, traversed by the Cevennes Mountains and watered by the Saône and by the Rhône, two rivers uniting at Lyons.

Area, 1104 square miles. The population, 741,470 in 1881, had increased to 835,157 in 1901. The births in 1899 were 15,998, of which 2143 were illegitimate; deaths, 17,662; marriages, 6236. There were in 1896, 1207 schools, with 91,000 pupils, not more than 1 per cent. of the population being illiterate. Out of 610,090 acres of land cultivated in 1896, 321,100 acres were plough-land and 74,100 acres vineyards. In 1899 the wheat harvest was valued at £536,000; rye, £84,000; oats, £104,000; potatoes, £296,000; vines, £1,120,000. The live stock in 1899 included 16,880 horses, 90,120 cattle, 38,100 sheep, 24,470 pigs, and 29,280 goats. Mining in 1898 yielded 32,400 metric tons of coal and 310,000 tons of copper, from the mines of Chessy. The metal industry turned out in 1898, 17,000 metric tons of cast-iron, 450 tons of iron, and 3100 tons of steel, of the total value of £58,000. The department is, however, mainly engaged in textile industries. Tarare manufactures muslins; Ample, pins and cottons; Thizy, linens. Lyons shares with St Étienne the monopoly of the silk manufacture, the value of the annual production of velvets and ribbons of this second city of France amounting to 20 millions sterling. Lyons, the capital, had in 1901, 453,145 inhabitants.

Rhône, a river of France, rising in Switzerland in the Rhône glacier, between the Furka and Grimel peaks of the St Gothard mass. It flows generally south-west and west, though with many windings, through Switzerland and eastern France to its confluence with the Saône at Lyons, where it turns south to the Mediterranean. The following particulars with regard to the navigation of the Rhône are taken from the *Statistique de la Navigation Intérieure*, 1901. The figures are those for 1900. The tonnage includes wood floated. The Rhône is officially classed in three sections:—(1) From the Swiss frontier to Lyons, 96 miles, mean depth 3·28 feet, crossed by 20 bridges. This includes the so-called *flottable* part between the Swiss frontier and Parc, a distance of 25 miles, but in which the traffic is *nil.* Number of boats, 8469 (of which 8271 in descent); total tonnage of merchandise carried, 197,402. In this section the boats come down laden, but are usually drawn up empty by horses. (2) Lyons to Arles, 178 miles, mean depth 5·25 feet, crossed by 29 bridges. Number of boats, 4628 (of which 3108 in descent); total tonnage, 580,423. (3) Arles to the sea, 30 miles, depth 6·56 feet; boats 1607 (902 in descent); total tonnage, 328,733. *Petit Rhône*, 38 miles, mean depth 5·25 feet, boats 53 (all in descent); total tonnage, 4725.

The SAÔNE is classed between Jonvelle and Lyons; total length 260 miles, in two sections, each comprising two sub-sections:—(1) Jonvelle to Gray, 61 miles; Gray to St Jean-de-Losne, 40 miles; total, 101 miles. Of this the part between Jonvelle and Corre, 7 miles, is classed as *flottable*, but is without traffic, while of the part classed as navigable, a length of about 20 miles to Corre is practically abandoned. From this place the Saône is canalized. Mean depth 6·56 feet, crossed by 53 bridges; number of boats 2785 (1879 in descent); total tonnage, 501,624. (2) St Jean-de-Losne to Verdun 27 miles, Verdun to Lyons 104 miles, total 131 miles, crossed by 50 bridges, mean depth 6·56 feet, number of boats 6914 (5277 in descent); total tonnage, 814,858. The traffic from Ile Barbe across Lyons to the Rhône comprised 4560 boats (3377 in descent); total tonnage, 617,215.

Statistique de la Navigation Intérieure (Ministère des Travaux Publiques), 2 vols. 4to, Paris, 1901.

Rhyl, a seaside resort of North Wales, at the end of the Vale of Clwyd, about half-way between Chester (30 miles east-south-east) and Bangor. It is visited for its fine stretch of sands and its dry and bracing air. Its other attractions embrace an esplanade a mile long, golf links, and a pier 700 yards long. The Queen Alexandra Hospital was opened in 1902 by the Prince of Wales. Population (1891), 6491; (1901), 8473.

Ribeira, a township of Spain, in the province of Corunna, on the extreme south of the peninsula formed by the river of Muros y Noya and the estuary of Arosa. It lies in a hilly country, abounding in wheat, wine, fruit, fish, and game. Its port is Santa Eugenia de Ribeiro, on the Arosa estuary. The church and parish buildings are not worth notice. The population, chiefly occupied in agriculture, rearing of cattle, and fisheries, was 10,352 in 1887, and 10,700 in 1897.

Ribot, Alexandre Félix Joseph (1842——), French statesman, was born at St Omer on 7th February 1842. After a brilliant career at the University of Paris, where he was *lauréat* of the Faculty of Law, he rapidly made his mark at the bar. He was secretary of the Conference of Advocates and one of the founders of the *Société de législation comparée.* During 1875 and 1876 he was successively director of criminal affairs and secretary-general at the Ministry of Justice. In 1877 he made his entry into political life by the conspicuous part he played on the Committee of Legal Resistance during the Broglie ministry, and in the following year he was returned to the Chamber as Moderate Republican member for Boulogne, in his native department of Pas-de-Calais. His impassioned yet reasoned eloquence gave him an influence which was increased by his articles in the *Parlement.* He devoted himself especially to financial questions, and in 1882 was reporter of the

budget. He became one of the most prominent opponents of the Radical party, and distinguished himself by his attacks on the shortlived Gambetta ministry. Notwithstanding his dislike to the policy of colonial expansion he yet joined hands with M. Clémenceau, with whom he shared the chief part in the overthrow of Jules Ferry. At the general election of 1885 he was one of the victims of the Republican rout in the Pas-de-Calais, and did not re-enter the Chamber till 1887. After 1889 he sat for St Omer. He was a determined opponent of the Boulangist movement; and, alarmed by its menace to the existence of the Republic, he became a convert to the policy of Republican concentration. He entered office in 1890 as foreign minister in the Freycinet Cabinet. He had an intimate acquaintance and sympathy with English institutions, and his only published works—an address, *Biographie de Lord Erskine* (1866), and *Étude sur l'acte du 5 avril 1873 pour l'établissement d'une cour suprême de justice en Angleterre* (1874)—both deal with English questions; but he gave a fresh and highly important direction to French policy by the understanding with Russia, which was declared to the world by the visit of the French fleet to Cronstadt in 1891, and which subsequently ripened into a formal treaty of alliance. He retained his post in the Loubet ministry (February–November 1892), and on its defeat was entrusted with its reconstruction, remaining at the Foreign Office, and at the same time becoming president of the Council. In a few days fresh developments of the Panama scandal forced him to drop some of his colleagues. In the new allocation of offices he himself took the ministry of the interior. The Government resigned in March 1893 on the refusal of the Chamber to accept the Senate's amendments to the budget. On the election of Félix Faure as president of the Republic in January 1895, M. Ribot again became premier and minister of finance. By the irony of fate it was the opponent of French expansion in Tongking whose premiership saw Madagascar added to possessions of France; but this expedition had been decided long before, and M. Ribot himself had, in the preceding year, been president of the *commission des crédits* for that purpose. On 10th June he was able to make the first announcement of a definite alliance with Russia. Internal politics centred round the Carmaux strike. On 28th October the premier's action was approved by the Chamber; but two days later the Government was defeated on the question of the *Chemins de fer du Sud*, and resigned office. The real reason of its fall was the mismanagement of the Madagascar expedition, whose cost in men and money exceeded all expectations, and the alarming social conditions at home. M. Ribot was elected, at the end of 1898, president of the important commission on education, a post for which he was peculiarly fitted by his practical experience as professor at the *École des sciences politiques*. His staunch Republicanism did not deter him from an alliance with the forces of reaction and Cæsarism against M. Waldeck-Rousseau; but at the general election of 1902, though he himself secured re-election, his policy suffered a severe check.

Ribot, Theodule Armand (1839- ——), French psychologist, was born at Guingamps, 18th December 1839, and was educated at the Lycée de St Brieuc. In 1856 he began to teach, and was admitted to the École Normale Supérieure in 1862. He was made sub-professor of philosophy in 1867, and Doctor of Letters in 1873. In 1865 he accepted the chair of philosophy at the Lycée de Vesoul, three years later removing to the corresponding chair at Laval, where he remained till 1872. In 1885 he gave a course of lectures on "Experimental Psychology" at the College of France. In 1887 he was decorated with the Legion of Honour. His thesis for his doctor's degree, republished in 1882, *Heredité: étude psychologique*, is his most important and best known book. Following the experimental and synthetic methods, he has brought together a large number of instances of inherited peculiarities; he pays particular attention to the physical element of mental life, ignoring all spiritual or non-material factors in man. In his work on *La Psychologie anglaise contemporaine* (1870), he shows his sympathy with the sensationalist school, and again in his translation of Herbert Spencer's *Principles of Psychology*. Besides numerous articles he has written on Schopenhauer and on the contemporary psychology of Germany, also four little monographs on *Les Maladies de la mémoire* (1881), *De la Volonté* (1883), *De la Personalité* (1885), and *La Psychologie de l'attention* (1888), which supply useful data to the student of mental disease. As the editor of *La Revue philosophique*, a periodical which he himself founded, he has had a useful influence in encouraging the scientific study of psychology.

Ricasoli, Bettino, Baron (1809–1880), Italian statesman, was born at Broglio, 19th March 1809. Left an orphan at eighteen, with an estate heavily encumbered, he was by special decree of the grand duke of Tuscany declared of age, and entrusted with the guardianship of his younger brothers. Interrupting his studies, he withdrew to Broglio, and by careful management disencumbered the family possessions. In 1847 he founded the journal *La Patria*, and addressed to the grand duke a memorial suggesting remedies for the difficulties of the state. In 1848 he was elected Gonfaloniere of Florence, but resigned on account of the anti-Liberal tendencies of the grand duke. As Tuscan minister of the interior in 1859, he promoted the union of Tuscany with Piedmont, which took place on 12th March 1860. Elected Italian deputy in 1861, he succeeded Cavour in the premiership, and upon acquiring personal experience of the Southern provinces, abandoned his regionalist ideas in favour of a thoroughly unitary programme. As premier he admitted the Garibaldian volunteers to the regular army, revoked the decree of exile against Mazzini, and attempted reconciliation with the Vatican; but his efforts were rendered ineffectual by the *non possumus* of the pope. Disdainful of the intrigues of his rival Rattazzi, he found himself obliged in 1862 to resign office, but returned to power in 1866. On this occasion he refused Napoleon III.'s offer to cede Venetia to Italy on condition that Italy should abandon the Prussian Alliance, and also refused the Prussian decoration of the Black Eagle because Lamarmora, author of the alliance, was not to receive it. Upon the departure of the French troops from Rome at the end of 1866, he again attempted to conciliate the Vatican with a convention, in virtue of which Italy would have restored to the Church the property of the suppressed religious orders in return for a gradual payment of £24,000,000. In order to mollify the Vatican he conceded the *exequatur* to forty-five bishops inimical to the Italian régime. The Vatican accepted his proposal, but the Italian Chamber proved refractory, and, though dissolved by Ricasoli, returned more hostile than before. Without waiting for a vote, Ricasoli resigned office and thenceforward practically disappeared from political life, speaking in the Chamber only upon rare occasions. He died at Broglio on 23rd October 1880. His private life and public career were marked by the utmost integrity and by a rigid austerity, which earned him the name of the "Iron Baron." In spite of the failure of his ecclesiastical scheme, he remains one of the most noteworthy figures of the Italian Risorgimento. (H. W. S.)

Richardson, Henry Hobson (1838–1886), American architect, was born in the parish of St James, Louisiana, 29th September 1838. He graduated from Harvard College in 1859, and the same year went to Paris to study architecture, where he was admitted a member of the École des Beaux Arts. After his return to America he opened an office in New York, and was for eleven years (1867–78) in partnership with Mr Charles Gambrill, when he removed to Brookline (Boston), Massachusetts, where he resided till his death, 27th April 1886. His first commission (1866) was to design a church in Springfield, Mass. Thereafter he rose rapidly in his profession, and at the age of thirty-four (1872) was appointed the architect, after competition, for Trinity Church, Boston, of which Phillips Brooks was the rector. The building was dedicated in 1877, and is generally considered to be his masterpiece and the best example of ecclesiastical architecture in the United States. The style of the building, constructed of yellowish-grey granite trimmed with red sandstone, is—like much of Richardson's work—strongly influenced by the Romanesque of the South of France; while the massive square tower in the centre, perhaps the dominating feature, was suggested by the tower of Salamanca. Among his other buildings are the Court House in Pittsburg (which he himself considered his most successful work), the Brattle Square Church in Boston, Sever Hall at Harvard, the town-hall, railway station, and library at North Easton, Mass., and the City Hall, Albany, N.Y. He also designed the Field Building, Chicago, the Chamber of Commerce, Cincinnati, and a number of private residences. (For his place in the development of architecture in America see the article ARCHITECTURE in volume xxv. of this work.) His qualities as an artist have been summarized by an admiring critic and biographer (Mrs Schuyler van Rensselaer, in *Henry Hobson Richardson and his Works*), as strength, clearness, breadth in treatment, imagination, and a love for massive dignity of aspect and often for romantic effect. He married, in 1867, Miss Julia Gorham Hayden, of Boston.

Richepin, Jean (1849–——), French poet, novelist, and dramatist, was born at Medea (Algeria), 4th February 1849. His youth gave evidence of brilliant, if somewhat undisciplined, powers, for which he found physical vent in different directions—first as a *franc tireur* in the Franco-German War, and afterwards as actor, sailor, and stevedore—and an intellectual outlet in the writing of poems, plays, and novels which vividly reflected his erratic but unmistakable talent. A play, *L'Étoile*, written by him in collaboration with André Gill, was produced in 1873; but Richepin was virtually unknown until the publication, in 1876, of a volume of verse entitled *Chanson des Gueux*, whose outspokenness resulted in his being imprisoned and fined for *outrage aux mœurs*. The same quality has characterized his succeeding volumes of verse: *Les Caresses* (1877), *Les Blasphèmes* (1884), *La Mer* (1886), *Mes Paradis* (1894), *La Bombarde* (1899). His novels have developed in style from the morbidity and brutality of *Les Morts bizarres* (1876), *La Glu* (1881), and *Le Pavé* (1883), to the more thoughtful psychology of *Madame André* (1878), *Sophie Monnier* (1884), *Césarine* (1888), *L'Aimé* (1893), *Grandes Amoureuses* (1896), and *Lagibasse* (1899), and the more simple portrayal of life in *Miarka* (1883), *Les Braves Gens* (1886), *Truandailles* (1890), *La Miseloque* (1892), and *Flamboche* (1895). His plays, though occasionally marred by his characteristic proneness to violence of thought and language, constitute in many respects his best work. The most notable are *Nana Sahib* (1883), *Monsieur Scapin* (1886), *Le Flibustier* (1888), *Par le Glaive* (1892), *Vers la Joie* (1894), *Le Chemineau* (1897), *Le Chien de Garde* (1898), *Les Truands* (1899), *La Reine de Tyr* (1900), *La Cavalière* (1901).

Rich Hill, a city of Bates county, Missouri, U.S.A., on the Osage river, at the intersection of the Kansas City, Fort Scott, and Memphis and the Missouri Pacific railways, in the western part of the state, at an altitude of 784 feet. It is in a coal-mining region, and has varied manufactures, including zinc smelting, flour milling, and cigar making. Population (1880), 36; (1890), 4008; (1900), 4053, of whom 255 were foreign-born and 61 negroes.

Richmond, a parish and, since 1890, municipal borough in the Kingston division of Surrey, England, on the Thames, 10 miles west of the City of London by rail. The borough now includes Kew, Petersham, and North Sheen. In 1894 a footbridge and lock were opened. A new church has been erected; also a new theatre and opera house, and a town-hall in the Elizabethan Renaissance style, which cost, with some adjoining pleasure grounds, £24,000. The famous view from the top of Richmond Hill is secured to the public by an agreement, sealed 7th February 1896, between the corporation and the trustees of the Earl of Dysart, by an Act of Parliament of 1902, and by the acquisition in the same year, by the London County Council, with the assistance of the borough of Richmond and other interested local authorities, of the Marble Hill Estate and other property on the Middlesex shore. Population (1881), 19,066; (1891), 26,875; (1901), 31,677.

Richmond, a city of Indiana, U.S.A., capital of Wayne county, on a branch of the river Whitewater, and on the Grand Rapids and Indiana and the Pittsburg, Cincinnati, Chicago, and St Louis railways, in the eastern part of the state, at an altitude of 962 feet. The city is divided into seven wards, has a good water supply and drainage system, and has natural gas. It is in a rich farming region, and has considerable trade and manufactures of varied character. It is the site of Earlham College, which in 1899 had a faculty numbering 15 and was attended by 228 students, about half of whom were women. Population (1890), 16,608; (1900), 18,226, of whom 1467 were foreign-born and 1009 negroes.

Richmond, a city of Kentucky, U.S.A., capital of Madison county, a little east of the centre of the state, on the Louisville and Nashville Railroad, at an altitude of 926 feet. It is in an agricultural region, devoted to the cultivation of tobacco and the raising of fine horses. It contains Central University, a Presbyterian institution, opened in 1874, which had, in 1899, a faculty of 77 and was attended by 811 students, 145 of whom were women. Population (1880), 1424; (1890), 5073; (1900), 4653, of whom 52 were foreign-born and 2087 negroes.

Richmond, the chief city and capital of Virginia, U.S.A., on the north bank of the river James, near the head of navigation and at the foot of the falls. The city spreads over a group of hills, on which it is laid out in a fairly regular plan, and is divided into six wards, which, instead of being numbered, as in most cities, have received names, Clay, Jackson, Jefferson, Madison, Marshall, and Monroe. The water-works, which pump the supply from the river, and the gas-works are owned by the city. It is sewered, and its business streets are paved with granite blocks, while its residential streets are in the main macadamized.

The city has five railways, the Atlantic Coast Line, the Chesapeake and Ohio, the Richmond, Fredericksburg, and

Potomac, the Seaboard Air Line, and the Southern. The large commerce by sea which Richmond enjoyed before the Civil War has in great part disappeared, but its place has been taken by traffic by rail and by manufactures, in which the city has been aided by the fine water-power in the falls of the James. In 1900 Richmond contained 763 manufacturing establishments, with a total capital of $20,848,620. They employed 16,692 hands, and the product was valued at $28,900,616. Of this large total, the manufacture of tobacco made more than one-third, or $10,537,803, which illustrates the importance of the place as a tobacco market. Other manufactures of importance were boots and shoes, flour, fertilizers, and foundry and machine-shop products. Richmond is the seat of Richmond College, a Baptist institution opened in 1832. In 1899 it had a faculty of 17 and was attended by 262 students. Womans College, of the same denomination, opened in 1854, had in 1896–97 a faculty of 19, and was attended by 205 students. The assessed valuation of real and personal property was, in 1899, $69,552,821, the net debt of the city was $6,856,604, and the rate of taxation, $18·00 per $1000. Population (1890), 81,388; (1900), 85,050; of whom 2865 were foreign-born and 32,230 negroes.

Richmond, Sir William Blake (1842– ——), English painter and decorator, was born in London on 29th November 1842. At the age of fourteen he entered the Royal Academy schools, where he worked for about three years; but he was also guided in his art education by the teaching of his father, George Richmond, R.A., and by the advice of John Ruskin, who took much interest in his career. A visit to Italy in 1859 gave him special opportunity for studying the works of the old masters, and had an important effect upon his development. His first Academy picture was a portrait group, exhibited in 1861; and to this succeeded, during the next three years, several other pictures of the same class. In 1865 he returned to Italy, and spent four years there, living chiefly at Rome. To this period belongs the large canvas, "A Procession in Honour of Bacchus," which he exhibited at the Academy in 1869 when he came back to England. A visit to Algiers followed in the winter of 1870; in 1882 and 1883 he travelled through Greece and the Aegean Isles; and in 1885 went to Egypt, making on each occasion a great number of studies of the local scenery and architecture. His picture, "An Audience at Athens" (see Plate), was exhibited at the Grosvenor Gallery in 1885. He became Slade professor at Oxford, succeeding Ruskin, in 1878, but resigned three years later. He was elected an Associate of the Royal Academy in 1888, and Royal Academician in 1895; he received the degree of D.C.L. in 1896, and a knighthood of the Bath in 1897, and has held the office of professor of painting to the Royal Academy. His pictures have always been distinguished by notable qualities of design and by sound knowledge of the human form, and his portraits by elegance and refinement; but perhaps his highest capacity appears in his decorative work. His most conspicuous achievement in this branch of art is the internal decoration and the glass Mosaics of St Paul's Cathedral. Sir William Richmond has, it should be added, taken a keen interest in social questions, particularly in smoke-prevention in London.

Richter, Eugen (1839– ——), German politician, was born on 30th July 1839 at Düsseldorf. After attending the universities of Bonn, Heidelberg, and Berlin he entered the Government service, being stationed in his native town. In 1864 he was chosen burgomaster of Neuwied; but he was already known for his Liberal opinions, and the Government refused to confirm the appointment. He was hereupon transferred to Bromberg, in East Prussia, which to an inhabitant of the Rhineland was the worst form of exile, and in consequence he resigned his place in the public service. He now went to Berlin, where he earned his living as a journalist. He had already published a pamphlet advocating the freedom of public-houses from the control whether of gilds or the police, and was the most consistent advocate of those doctrines of *laissez faire* and individual liberty which the Germans call *Manchesterthum*. He was also keenly interested in the attempts made at that period to create co-operative societies among the working men, and wrote a work on co-operative stores. It was not long before he came into conflict with the Government; an electioneering pamphlet published in 1867 was confiscated; he was put on his trial but acquitted. In 1867 he was elected a member of the newly-formed Reichstag, and in 1869 of the Prussian Parliament. He soon became one of the most influential politicians in Germany. No one was more assiduous in his attendance or more frequent as a speaker; endowed with great fluency and an admirable memory, quickness in rejoinder, and a very great knowledge of affairs, and especially of financial matters, he at length became the most experienced member of Parliament in Germany. A member of the Progressive party, in 1880 one of the founders, and eventually the leader, of the *Freisinnige*, he was always in opposition. Next to Windthorst (*q.v.*) he was Bismarck's most dangerous opponent. After the great change of policy in 1878, for a time his influence was a great impediment to the Government; as a consistent adherent to free trade, he was the leader of the opposition to the introduction of protection, to the new Colonial policy, and to State Socialism. It was after 1880 that he raised the cry *Bismarck muss fort*. He always took a great part in debates on the military and naval establishments, in vain opposing the constant increase of army and navy. It was his refusal to support the Government proposals in 1893 for an increase of the army which led to the break up of his party: he was left with only eleven followers; and except among the middle class of Berlin and some other Prussian cities, the old Radical party, of which he was the chief representative, from that time had little influence in the country. Though a bitter enemy both to Clericalism and to Socialism, it is to his credit that he had so much faith in the justice of Liberal principles that he never was led to support the exceptional legislation by which the Prussian Government and the German people attempted to crush opinions with which they did not agree. He was equally active as a writer. Since 1882 he has been editor of the *Freisinnige Zeitung*; of his numerous brochures the most successful was his attack on Socialism, entitled *Der socialistische Zukunfts-Staat*, a clever and successful satire on the Socialist State of the future. This has been translated into English. He also wrote much on Prussian finance, and under the title *Das politische A, B, C Buch* compiled a very useful political handbook for Radical voters. He also published reminiscences of his youth (*Jugend-Erinnerungen*), and two volumes of parliamentary reminiscences (*Im alten Reichstag*).

Richter, Hans (1843– ——), Hungarian musical conductor, born at Raab, 4th April 1843, was the son of the Domcapellmeister there and of his wife, *née* Josephine Csazinsky, the first Viennese Venus in *Tannhäuser*. Naturally, the offspring of this couple was musical. Young Hans sang either soprano or alto in the Cathedral choir, according to requirement, and occasionally played the organ. But his public début was made as a drummer in Haydn's *Paukenmesse*. In 1853, at the age of ten, he appeared in a concert as pianist in

"An Audience in Athens during the Representation of the 'Agamemnon.'" By Sir W. B. Richmond, R.A.
(By permission of the Art Gallery Committee of the City of Birmingham.)

Hummel's E flat quintet; and in 1854, after his father's death, went to the Löwenburg Convikt (where Schubert was educated) in Vienna, and there became chorister in the Court Chapel. For five years from 1860 Richter studied under Heissler and Sechter in the Vienna Conservatorium, and the horn under Kleinecke. A year and a half after his first lesson he became hornist in the old Kärnthnerthor Theatre at £3 a month. Meanwhile he had devoted time to conducting. His orchestral post he resigned in 1866 on being appointed copyist to Wagner, then living at Triebschen, near Lucerne. There he copied *Die Meistersinger*. In December of the following year Von Bülow induced him to go to Munich, where he actually sang the part of Kothner in the 6th performance of *Die Meistersinger*. It was not till August 1868 that Richter made his first appearance as a conductor, at the Hof Theater, Munich (where he had just been appointed), in *William Tell*; but in the next year he resigned this post, went first to Paris, then to Brussels, and finally to Triebschen, where he copied *Der Ring des Nibelungen*. In April 1871 Richter took up his new duties as conductor of the Hungarian National Opera at Budapest, where he remained four years, until he began in May 1875 his long connexion with the Vienna Opera, which terminated only with the century. In the same year Richter directed the rehearsals and performances of *Der Ring* at Bayreuth, and in 1877 paid his first visit to England to conduct the Wagner Festival at the Albert Hall. There in 1879 he founded the Richter Concerts; in 1885 he became conductor of the Birmingham Triennial Festival, and was created Mus. Doc. Oxon. *honoris causâ*. In 1882 Richter also conducted a famous series of performances of Wagner's works (including the first in England of *Die Meistersinger* and *Tristan*) at Drury Lane, and some years afterwards became conductor of the Hallé Orchestra in Manchester. That Richter must be considered one of the most richly gifted and the most experienced of modern conductors is universally acknowledged. In the works of Beethoven and Brahms his surpremacy is unchallenged, while as a Wagnerian conductor few have reached his level.

Rickets. See PATHOLOGY: *Metabolic Diseases*.

Ricotti, Magnani Cesare (1822–——), Italian general and knight of the Annunziata, was born at Borgo Lavezzaro on 30th June 1822. As artillery lieutenant he distinguished himself and was wounded at the siege of Peschiera in 1848, and in 1852 gained further distinction by the courage with which he sought to prevent the explosion of a burning powder magazine. After serving from 1856 to 1859 as director of the Artillery School, he took part in the war against Austria, and commanded the 5th division at the battle of San Martino. In the war of 1866 he stormed Borgoforte, to open a passage for Cialdini's army. Upon the death of General Govone in 1870 he was appointed minister of war, and after the occupation of Rome bent all his efforts to army reform, in accordance with the lessons of the Franco-German War. He shortened the period of military service; extended conscription to all able-bodied men; created a permanent army, a mobile militia, and a reserve; commenced the renewal of armaments; and placed Italy in a position to put 1,800,000 men on a war footing. Ricotti fell from power with the Right in 1876, but returned to office with Depretis in 1884, and amended his previous scheme of reform. Resigning in April 1887, he took little part in public life until 1896, when, after the battle of Adowa, he was entrusted by King Humbert with the formation of a Cabinet. Having constructed his ministry, he made over the premiership to the Marquis di Rudini, retaining for himself the portfolio of war, and seeking to satisfy popular demands for the reduction of military expenditure by consolidating the tactical structure of the army without weakening its fighting power. Rudini, however, finding that Ricotti's ideas, which he himself shared, were not acceptable in the highest quarters, obliged him to resign office. His prestige as creator of the modern Italian army remained unimpaired, and his views on army consolidation enjoyed a large measure of technical and public favour.

Riesa, a town of Germany, on the Elbe, 12 miles by rail north-north-west of Meissen, in the circle of Dresden, kingdom of Saxony. There are 2 churches, a harbour with quays and a dockyard, rolling-mills and saw-mills, agricultural implement and other works, and sandstone quarries. The most important shipping station on the Elbe in Saxony, Riesa is the lading-place for transmarine goods to and from Bavaria, and a mart for herrings, petroleum, coal, grain, &c. Population (1890), 9389; (1900), 13,492.

Rifle.—A rifle is a musket with a grooved bore. The rifling of a firearm is the cutting away of the interior of the barrel or bore so as to form spiral grooves upon its surface. The objects of this spiral grooving are to guide the projectile down the barrel, force it to turn upon its own axis and impart to it a rotatory motion which it shall maintain during flight, and thus equalize any irregularities in its form or weight, and so lessen the tendency to depart from a straight line, and also in a measure to overcome atmospheric resistance. Rifling was invented about 1520, by Gaspard Kollner, a gunmaker of Vienna, according to some authorities; by Augustus Kotter of Nuremberg, according to others. In some cases the grooves were made straight, to admit a tight-fitting bullet and relieve the effects of fouling; they were more usually spiral. Parallel, half-round narrow grooves, probably two or more in number, constituted the rifle in its most primitive form; later, from three to twelve grooves were more common. The amount of turn varied in old rifles, from a half or three-quarters turn to one turn in two to three feet. The form and depth of grooving also greatly varied. Rifles were at first used for amusement, and were not employed in warfare until about the middle of the 17th century.

Military Rifles.—Rifles were not generally used in the British army until 1855. There are, however, instances of their occasional employment in the 17th and 18th centuries, particularly by Continental nations. In 1631 the Landgraf of Hesse had a troop of riflemen. Ten years later Maximilian of Bavaria had several troops armed with rifled arquebuses. Louis XIII. armed his bodyguard with rifles. Napoleon withdrew the rifle from his troops, to whom it had been issued during the wars of the Republic, nor did the French make any considerable use of it again until 1830, when the Chasseurs d'Orleans were armed with it for the invasion of Algeria. The British learnt the value of rifles during the American War of Independence, when the Government subsidized Continental *Jägers* armed with rifles to oppose the American backwoodsmen, whose rifle-shooting was most deadly.

It is interesting here to note the chief infantry firearms that preceded the modern military rifle. The hand cannon of 1471 was quickly superseded by the matchlock, which remained in use until the Commonwealth. About 1530 the wheel-lock was first brought to England, but few were supplied to English soldiers until the time of Charles I. In the reign of James I. some flint-locks were issued to leading regiments, and in the reign of William III. they came into general use. From them was developed the renowned "Brown Bess," a flint-lock smooth bore, for a century and a half the regulation musket of the British Army. Thus the weapon that won at Waterloo was

of the same type as that which the British used at Ramillies and Blenheim. In the Brown Bess and similar military muskets the bullet was two sizes smaller than the bore, wrapped in a loosely-fitting patch which formed the cartridge; the loading was therefore easy, whereas the muzzle-loading rifle with a closely-fitting ball was loaded with difficulty, particularly when foul, and for this reason was not generally used as a weapon of war. The Brown Bess had a high trajectory and a very low velocity, with an effective range of under 200 yards. The percussion system was only generally applied to the Brown Bess in 1842, a quarter of a century after its invention, and after an elaborate test at Woolwich in 1834. In 1800 the 95th Regiment (afterwards the Rifle Brigade) were armed with a weapon known as "Baker's Rifle," which weighed 9½ lb. The barrel was 2½ feet long, its calibre 20 bore, with seven grooves making a quarter turn in its length. A small wooden mallet was at first supplied with this rifle to make the ball enter the barrel, and it was loaded with great difficulty. In 1826 Delvigne, a French infantry officer, invented a breech with abrupt shoulders on which the spherical bullet was rammed down until it expanded and filled the grooves. The objection was that the deformed bullet had an erratic flight. In William IV.'s reign the Brunswick rifle was introduced into the British army. Its weight with bayonet was 11 lb 5½ ozs.; length of barrel 2 feet 6 inches; with two grooves making one turn in the length of the barrel; weight of spherical belted bullet 557 grs.; diameter ·696 inch; charge of powder 2½ drs. This rifle was not easily loaded, soon fouled, and shot wild beyond 400 yards.

In 1835 W. Greener produced a new expansive bullet, an oval ball, a diameter and a half in length, with a flat end, perforated, in which a cast metallic taper plug was inserted. The explosion of the charge drove the plug home, expanded the bullet, filled the grooves and prevented windage. A trial of the Greener bullet in August 1835, at Tynemouth, by a party of the 60th Rifles, proved successful. The range and accuracy of the rifle were retained, while the loading was made as easy as with a smooth-bore musket. The invention was, however, rejected by the military authorities on the ground that the bullet was a compound one. In 1852 the Government awarded Minié, a Frenchman, £20,000 for a bullet of the same principle adopted into the British service. Subsequently in 1857 Greener was also awarded £1000 for "the first public suggestion of the principle of expansion, commonly called the Minié principle, in 1836." The Minié bullet contained an iron cup in a cavity at the base of the bullet. In 1851 a rifle musket of the Minié pattern was introduced into the British army, and, though not generally issued, was used in the Kaffre War of 1851, and in the Crimea at the battles of the Alma and Inkerman. Its weight with bayonet was 10 lb 8¾ ozs., length of barrel 3 feet 3 inches, with four grooves, making one turn in 78 inches; charge of powder 2½ drs., and sighted from 100 to 1000 yards. The form of its bullet was at first conoidal, afterwards changed to cylindro-conoidal with a hemispherical iron cup. In 1855 the Enfield rifle, having in a series of trials competed favourably with the Minié and Lancaster rifles, was introduced into the British army; was used during the latter part of the Crimean war, having there replaced the Minié rifle pattern 1851 and the percussion musket 1852, and remained the general weapon of the entire infantry until the introduction of the breech-loader in the year 1867. This rifle weighed, with bayonet, 9 lb 3 ozs., with 39-inch barrel; diameter of bore ·577 inch; three-grooved with one turn in 78 inches. It fired a bullet of cylindro-conoidal form with hollow base, weighing 530 grains, made up into cartridges and lubricated as for the Minié rifle, adapted to this rifle by Pritchett, who was awarded £1000 by the Government. Short rifles of the same pattern, with five-grooved barrels 2 feet 9 inches long, and a sword bayonet, were supplied to the 60th Rifles and to the Rifle Brigade. Two small carbines of the same principle were at this time introduced for the cavalry and artillery, also a rifled pistol.

In 1854 Lord Hardinge, then Commander-in-Chief of the British army, sought the aid of Sir Joseph Whitworth, the first mechanician of the day, in considering the subject of rifling. After a long series of experiments the Whitworth rifle was produced with hexagonal bore, ·45 inch calibre, and with one turn in 20 inches. It was tried at Hythe in 1857, and beat the Enfield rifle by 3 to 1, up to 1800 yards upon a fixed rest. This trial and Whitworth's experiments proved the advantages of a sharp twist, a smaller bore, and elongated projectile; but Whitworth's rifle was never adopted into the Government service, probably because the hexagonal rifling wore badly, and owing to the difficulty of equal mechanical perfection in all similar rifles and ammunition. Several improvements were subsequently made in the sighting, grooving, and some other details of the Enfield rifle. In 1855 a box-wood plug to the bullet was used.

Between 1857 and 1861 four breech-loading carbines were experimentally introduced in the cavalry—viz., Sharp's, Terry's, Green's, and Westley-Richards'. The general adoption of the breech-loading principle may be said to date from 1867. The Prussians were the first to see its great advantages, and in 1848 had adopted the needle-gun breech-loader, afterwards so celebrated in the Danish war of 1864, against the Austrians in 1866, and against the French in 1870. In June 1864, and in October 1866, special military committees were appointed by the British War Office to consider and report on breech-loading arms, and proposals were invited from the various gunsmiths and manufacturers. Jacob Snider's method of conversion of the muzzle-loading Enfield to a breech-loader was first adopted, out of nearly fifty different proposals, and after laborious and protracted experiments, with the metallic cartridge-case improved in 1867 by Colonel Boxer, R.A. All available Enfield rifles were thus converted, and new arms made with steel barrels instead of iron. Great Britain was the first Power to adopt for her army a breech-loading rifle with metallic cartridge-case, which effectually secured the perfect obturation of the breech. In 1866 France adopted the Chassepôt rifle; in 1867 Sweden the Hagström, and Russia the Carte; in 1868 Italy the Carcano. All these were breech-loaders firing paper cartridges containing their own means of ignition. After further experiments by a fresh committee the Martini-Henry rifle was definitely adopted by the British Government in April 1871, with the short chamber Boxer-Henry ammunition. This rifle was a combination of Martini's block-action breech mechanism with Henry's barrel of ·45-inch calibre, firing a bullet of 480 grains from Boxer cases with a wad of wax lubrication at base of bullet, as proposed by Henry. The Henry rifling had seven grooves with one turn in 22 inches; the lands and the centres of the grooves were contained in the same circle. In the same year Spain adopted the block-action Remington rifle, Germany the Mauser, Holland the Beaumont, Italy the Vetterli, and Russia the Berdan II., all bolt-action rifles. All these weapons had a calibre of about 11 millimetres (·433 inch).

The next stage in the history of military firearms was the introduction of the repeating or magazine system. The Winchester rifle, an American invention, appeared in 1867 as one of the earliest magazine rifles. This weapon was used by Turkey in the Russo-Turkish war of 1877–78,

and there proved the enormous advantage of the repeating or magazine rifle, owing to its largely increased rapidity of fire. Meanwhile, in 1886 the question of the best calibre for small arms was reopened in England. In June 1887 the Small Arms Committee, after experiments with the small-calibre rifle invented in 1883 by Major Rubin, director of the Swiss Laboratory at Thun, recommended the small calibre for adoption into the British service. The essential features of Rubin's system were the employment of a compound bullet with a leaden core in a copper envelope, and the use of a compressed charge of black powder. In January 1888 a pattern of ·303-inch-calibre rifle, rifled on the Metford system and with the improved Lee bolt and magazine, was approved for trial by British troops. The Metford rifling is as follows:—diameter of bore, ·303″; depth of rifling, ·004″; width of lands, ·023″; twist of rifling, one turn in 10″ (left hand); radial grooves, 7 in number. About 1862, and later, W. E. Metford had carried out an exhaustive series of experiments on bullets and rifling. He invented the important system of light rifling, with increasing spiral with a hardened bullet. The Metford match rifle was prominent in all N.R.A. competitions from 1871 to 1894. In 1887 he laid down for the Small Arms Committee the proper proportions for the grooving, spiral, and cartridge chamber of the ·303 military rifle. This weapon proved satisfactory, and was finally adopted by the War Office as the Lee-Metford Rifle, Mark I., in December 1888. It had a magazine of eight cartridges. In December 1891 the Mark II. pattern was finally approved, with a ten-cartridge magazine, a much-simplified bolt, and many minor improvements. A magazine carbine, with barrel 21 inches long and a six-cartridge magazine, otherwise identical with the Lee-Metford Mark II., was also approved. The Lee-Metford Mark II. rifle has been further improved in its rifling to resist the wear of smokeless powder, and also in its bolt action, and is now known as the Lee-Enfield rifle, and under that name has been officially adopted as the rifle of the British army. The number of grooves has been reduced from seven to five. Neither the Lee-Metford nor the Lee-Enfield has increasing spiral grooves, which are found inconvenient for military arms from a manufacturing point of view.

The efficiency of the modern small-bore magazine rifle is largely due to the production and adoption of smokeless nitro-compound powder within recent years. France was the first country to adopt, about 1885, a smokeless powder with the Lebel magazine rifle. It was known as "Vielle" powder, or "Poudre B." Since then smokeless explosives have been universally adopted in all small-bore magazine military rifles. After exhaustive and lengthened experiments the smokeless explosive known as "Cordite," a composition of nitro-glycerine, gun-cotton, and mineral jelly, has been definitely adopted by the British authorities for the cartridges of the Lee-Metford and Lee-Enfield magazine rifles and other arms of the same calibre. In addition to its smokelessness, it possesses the further advantages of being comparatively non-fouling, giving a much higher muzzle velocity, with a smaller charge, than black powder, owing to the greater amount of gas produced, and at the same time developing lower maximum pressures, owing to its homogeneous character. (For further information about explosives, see PROPELLANTS.)

It is difficult to imagine how any further substantial improvement can be effected in the range and trajectory of the modern magazine rifle, although its mechanism, rifling, and rapidity of fire may continue to be improved. Its great value in warfare and the effect of its high velocity, low trajectory, long range, and smokeless ammunition on military tactics and strategy were fully demonstrated by the Boer war of 1899–1902. The Lee-Enfield military rifle weighs 10 ℔ 3½ ozs. with bayonet; is 4 feet 1·85 inches in length (without bayonet), with a barrel of 30·197 inches long; ·303 calibre, with five shallow grooves of increasing spiral with a left-hand turn of 1 in 10″; fires a long thin nickel bullet with leaden core with smokeless cordite explosive from a solid metallic cartridge-case; carries a ten-cartridge magazine with bolt-action and a cut-off that enables the rifle to be used as a single firer; and is sighted up to 2800 yards.

Match or Target Rifle.—The sport or pastime of target shooting has many times changed its character, owing to the steady improvement in the rifle and the different ranges or distances at which shooting is practised. Range usually governs the construction of the target rifle, long-range rifles not being necessarily the best weapons for a short range of, say, 200 yards. Limitations —such as the amount of powder charge, weight of bullet and rifle—are also usually arbitrarily imposed in order to encourage marksmen by starting all competitors on equal terms. The long-range match rifle is not the superior of the military rifle as a weapon, but as a scientific shooting instrument is the best small arm produced. The ordinary target rifle is a hybrid arm, combining the points of the long-range match, modern military, and best sporting rifles. The miniature match rifle is a gallery weapon, adapted for trick shooting, for a beginner, or for short-range practice.

The pastime of rifle shooting at fixed marks has been practised continuously in Switzerland from mediæval times. A rifle club ("Société de l'harquebuse et de la Navigation") has existed continuously in Geneva since 1474; and the "Schutzen-Gesellschaft der Stadt Zürich" since about the same date. It is not clear at what period rifles superseded smooth-bores in the practices of these clubs. From the beginning of the 19th century up to 1844 the rifle generally used in Great Britain had a polygrooved barrel ·630 inch in diameter, with spherical ball, and the arm weighed from 11 to 15 ℔. It was not fired in military fashion, but had a handle extending downwards fixed in front of the trigger-guard which was grasped by the left hand, the left arm being steadied against the body. This method of shooting is still followed by Swiss and German riflemen. The Swiss and Americans were formerly accredited as the finest rifle shots in the world, and are still fine rifle shots at medium ranges and with their customary conditions allowed. At long ranges they are behind the standard of shooting now ruling in Great Britain and her colonies. Target shooting as a sport or business was rarely practised in Great Britain until after the Crimean war and the establishment of volunteer rifle corps. Ranges were then obtained for practice. The inauguration of the "National Rifle Association" in 1860 opened a new and most important era in the history and development of the rifle. This admirable institution was established "for the encouragement of rifle corps and the promotion of rifle shooting throughout Great Britain. . . . As a national pastime to make the rifle what the bow was in the days of the Plantagenets, the familiar weapon of those who stand forth in the defence of their country." The N.R.A. has identified itself with the history of target rifle shooting wherever the English language has penetrated, and full information of such history will be found in its annual reports. The first meeting of the N.R.A. was held at Wimbledon in 1860. The first shot was fired by the Queen from a Whitworth rifle on a machine rest, at 400 yards, and struck the bull's-eye. The Whitworth muzzle-loading rifle won many of the important prizes at this and subsequent meetings prior to 1871. The use of this rifle was, up to that date, compulsory in the final stage of the

Queen's competition, except in 1865–66–67. Its most important features, arrived at after exhaustive experiments, were a smaller bore of ·450 inch, with an increased twist of rifling of one turn in 20 inches, and an elongated mechanically-fitting projectile. Long-range rifle construction is also largely indebted to Whitworth for the highly accurate and superior tools and processes introduced by him in this branch of manufacture.

In 1866 and after, Metford's system of hardened expanding bullets and shallow rifling gradually superseded the mechanically-fitting system of Whitworth, and the Whitworth rifle gradually lost its position.

In 1861 the Henry grooving for a cylindrical bullet, a modification of the Whitworth, first appeared. In 1864 Rigby, with a five-grooved rifle and a mechanically-fitting bullet, tied with the Whitworth rifle in the preliminary rifle trial of the N.R.A. at 1000 yards, and in a subsequent trial took the first place. In 1865 the Rigby rifle was consequently used in the second stage of the Queen's prize. By 1871 the Whitworth rifle had given place to the Metford system with hardened cylindrical bullets, shallow rifling, and increasing spiral. In 1867 the modern breech-loading rifle was first introduced, using a metallic cartridge containing its own means of ignition. The Metford system of rifling greatly assisted its development. In this year Rigby also produced his new model long-range rifle on the lines followed by Metford. In 1869 the work of the Government Committee caused a great impulse to be given to experimental rifle manufacture, and the Henry barrel came well to the front when used as a breech-loader. In 1870 the Martini-Henry, the new service arm, won the duke of Cambridge's prize, the extreme range in this competition being 800 yards. In 1871 the Enfield-Snider breech-loader replaced the Enfield muzzle-loader, and the Martini-Henry replaced the Whitworth in the second stages—800, 900, and 1000 yards ranges—of the Queen's prize. The Metford barrel was also used in breech-loaders, and the duke of Cambridge's prize—for the first time fired at 1000 yards—fell to it. During the twenty-three years from 1871 to 1894 the Metford military match rifle only four times failed to win this prize, while it took a preponderating share of other prizes. The years 1872 and 1873 marked a decided advance in the military breech-loader, though for fine shooting the muzzle-loader still seemed hard to equal. In 1873 an Irish team armed with Rigby muzzle-loading rifles visited Creedmoor, U.S.A., and were defeated by three points only by an American team armed with breech-loading rifles. In 1875 a team of American riflemen first visited Wimbledon with "army-pattern" breech-loading rifles, which were cleaned out after every shot, and met with considerable success. A feature of their shooting was the "back position," then a novelty. In 1876 the duke of Cambridge's prize was easily won with a Metford breech-loader, the same type of rifle also doing well in other long-range competitions. A great rifle contest took place at Creedmoor, U.S.A., this year—Ireland, Scotland, Australia, and Canada sending teams, the conditions being those of the Elcho Shield competition. A United States team secured first place, the Irish team being a close second. In 1877 the superiority of the cleansable and cleansed breech-loader over the increased fouling of the muzzle-loader was clearly demonstrated, though the muzzle-loader did not at once disappear. In 1878 the highest scores ever made with the muzzle-loader in Great Britain were recorded, greater care in cleaning the rifle after every shot being observed.

In 1883 the N.R.A. Council altered the conditions, wiping out after every shot was forbidden, but muzzle-loaders were not disqualified. The result was that the American type of rifle disappeared. The poor shooting of the Martini at 1000 yards induced the Council to take the retrograde step of reducing the maximum range for the Queen's prize to 900 yards, the 1000 range being considered beyond the power of the weapon. In 1890 the N.R.A. first met at the new ranges at Bisley. This year was noticeable for the excellent shooting made in the "any" rifle competitions by the Gibbs-Metford match rifle, particularly at 1000 yards range. The accepted type was ·461 calibre; 7 grooves ·0045 inch in depth; 80 grains of special black gunpowder, and a bullet of 570 grains. In 1892 and 1893 the Lee-Metford ·303 rifle with cordite ammunition was first used by the army teams. In 1890 and later the Hon. T. F. Fremantle and some others used Metford's copper-coated bullets in the Gibbs-Metford rifle with success, and in 1894 Captain Gibbs used these in his match rifle and achieved remarkable results, in many competitions making top scores. In 1895 many match rifle shots followed his example and used copper-coated bullets. In 1895 and 1896 the ·303 was equalled, and in some instances beaten, by the smaller-calibre Mannlicher rifle. This was partly due to faulty Lee-Metford ammunition. The ·303 now proved its superiority to the ·450 Martini, the regulars defeating the volunteers, especially at the longer ranges. The Bisley meeting of 1896 practically closed the series of contests with both the Martini and the military match rifles. The volunteers were to be thenceforth armed with the ·303, and with that bore future contests for the Queen's and St George's were to be held.

The results of the Bisley meetings since 1895 have proved that rifles of ·303 class, the British ·303 rifle particularly, are not so good for match rifles pure and simple as the larger bores using black powder. The light bullets are more subject to deflection by the wind at long ranges than the heavier speed-retaining bullets of the larger bores. Cordite powder cartridges also appear to give varying velocities. None of the nitro-powders used appears to have equalled the black powder in regularity of shooting. At the same time the object of the N.R.A. competitions is to encourage excellence in the use of the military service rifle in the first place, and in the case of the "any" rifle competitions to encourage the production of weapons of the highest efficiency for military purposes. Acting on these principles the rifles and carbines allowed by the N.R.A. regulations (1900) are classed as follows:—*Class I.*—Service rifle (S.R.): ·303 magazine rifles as issued by the Government or bearing the Government viewer's mark; inclusive weight not to exceed that of the corresponding regulation rifle; maximum length, 49½ inches; minimum pull of trigger, 6 lb; sights—strictly in accordance with Government service pattern, and without any shading appliances, extraneous supports, or laterally sliding wind-gauge. This is the rifle to be used in all the numerous S.R. competitions at Bisley, including the duke of Cambridge's prize, the St George's challenge vase, and the King's prize. *Class II.*—Match rifles (M.R.): any breech-loading rifle complying with the following conditions: when of British make to bear proof marks on barrel and breech; maximum weight, 10 lb; maximum length, 52 inches; maximum calibre, ·315; stock sufficiently strong, in the opinion of the Bisley committee, for service purposes, and without pad or shoe on the heelplate; minimum pull of trigger, 6 lb; sights, of any description except telescopic or magnifying. *Class III.*—Sporting rifles (Spor.): calibre, any; minimum pull of trigger, 3 lb; sights, open or such as are sanctioned by the council or committee. The Lyman backsight and the Beech combination foresight have been sanctioned. No lateral adjustment of fore or backsight is permitted.

Spirit levels are allowed. *Class IV.*—Carbines (Car.). Any *bonâ fide* Government pattern of carbine of ·303 calibre as issued by the Government or bearing the Government viewer's mark. Minimum pull of trigger, 6 ℔. Only service ammunition issued by the N.R.A. at the firing point is allowed to be used in the S.R. competitions. In M.R. competitions there are certain restrictions as to weight of bullet and length and diameter of cartridge. In sporting competitions any ammunition may be used.

Modern American Target Rifles.—In America, according to some authorities, there are three recognized departments of target shooting—namely, off-hand shooting; shooting from a simple rest; and shooting from a machine rest, with telescopic or any other sight. For the first two classes small-bore rifles of ·380 calibre or under only are used. The usual weight is from 8 to 10 ℔, with 28- or 30-inch barrel. Light charges for the shorter ranges are used. In the ·380 bore only 55 grains of powder with a 330-grain bullet is employed. In the second-class contests, from a simple rest, the barrel is longer and the weight increased to just under 12 ℔. The bore is generally ·380. The usual range is 200 yards. The third-class shooting from a machine rest, generally with telescopic sights, is not much practised. Every kind of rifle is employed, usually of large bore and weighing from 20 to 60 ℔. The long-range breech-loading match rifle, with which so much fine shooting was done when wiping out after each shot was allowed, weighed about 10 ℔; the breech mechanism, any falling block, as the Sharp, Farquharson, Deeley, and Edge or Wiley, that admitted the insertion of the cleaning rod at the breech; length of barrel 32 to 34 inches; seven or more grooves ·003 to ·005 in depth with a complete turn in 20 inches. A sharp continual spiral and very shallow grooves constituted the feature of the American plan. Rigby's plan was similar, with one turn in 18 inches and eight grooves, the lands being about half the width of the grooves. In the Wiley the grooves were fewer and wider. The Metford is an increasing twist, starting with one turn in 60 inches and finishing with one in 20, or sharper. The usual bore of the American long-range rifle was ·458 or ·461; powder, 76 grains of special "fouling" rifle powder; elongated cylindrical bullet of 540 grains. The pull-off was under 3 ℔. During recent years smaller-bore smokeless-powder rifles have also been used.

Continental Match Rifles.—The target rifle used by Continental marksmen is a modification of the old pattern Swiss rifle, with scroll guard, hollowed butt plate and hair trigger. This latter, a mechanical device to free the tumbler from the skear without sufficient pull on the trigger to influence the aim, is disallowed in military arms.

Sporting Rifles.—Prior to 1845 smooth-bore ball guns with double charge of powder and an ounce spherical ball were generally preferred to rifles for sporting purposes and for large game; sixteen-bore muzzle-loading rifles were occasionally used by British sportsmen in the East Indies before that date, firing $1\frac{1}{2}$ drs. of powder with a spherical ounce ball. These rifles were sighted to 200 yards, but the trajectory was high and the penetration weak; they were also difficult to load when foul. The twist of the rifling was also too rapid, causing the bullet to strip with heavy charges of powder. According to Captain Forsyth and others, up to 1860 there was no known rifle suitable for sporting purposes in India. Rifles of twelve-bore gauge, firing a spherical ball, were subsequently made, with broad and shallow grooves making one turn in 10 feet. The bullet, of the same diameter as the bore, was loaded with a thin patch that took the grooving. These rifles proved very successful, possessing velocity equal to a smooth-bore of the same calibre, accuracy for sporting distances, flat trajectory, and great striking power. In 1855 W. Greener produced the "Cape rifle" for South African sport, calibre ·450 or ·500; rifling, two deep grooves with one turn in 26 inches, with a flanged bullet to fit the grooves; weight, 12 ℔; sighted up to 1200 yards. This rifle was successful, and others were built by Purdey, who in 1856 named the pattern "Express Train." Since that date the word "Express" has been generally used to denote a rifle possessing high velocity, flat trajectory, and long fixed-sight range.[1] In America small-bore rifles were used earlier in the 19th century. The celebrated Kentucky rifles were of various sizes, firing spherical balls of 90, 60, and 40 to the ℔, and were renowned for their accuracy and fixed-sight range up to 100 yards. Some suppose that the modern Express rifle was developed from the Kentucky model. The modern Express rifle may be defined as a breech-loading rifle with a trajectory not exceeding $4\frac{1}{2}$ inches at 150 yards, with a muzzle velocity of at least 1750 feet per second. These rifles are usually double-barrelled, with 26- to 28-inch barrels of ·360, ·400, ·450, ·500, and ·577 bores, weighing respectively from $6\frac{1}{2}$ to 7 ℔, 7 to 8 ℔, $7\frac{3}{4}$ to 9 ℔, $8\frac{1}{4}$ to 10 ℔, and $10\frac{1}{4}$ to 12 ℔. The respective charges usually are: bullet, 150 grains; powder, 50 grains; 209 and 82; 270 and 110; 340 and 130; 520 and 160; but the leading gunmakers vary the respective amounts of these charges. The fixed-sight ranges of these rifles are respectively 130, 160, 150, 130, and 120 yards. Double and single Express rifles of ·303 bore with 26-inch barrels are also made. The rifle trial of 1883 arranged at Putney by J. H. Walsh ("Stonehenge"), then editor of the *Field*, originally established the excellence of the principle of these rifles; but they have since been improved in rifling and mechanism. The usual modern Express rifling is from five to seven shallow grooves, the grooves and bands being of equal width, with a twist suited to the length and diameter of the bullet.

The sights of sporting Express rifles are of some variety, and are usually designed and made with more care and accuracy than those of military rifles. The open V backsight on an ivory pyramid with two or three leaves up to 300 yards, and the enamelled bead foresight, are the most usual form. The more elaborate Lyman and Beech peepsights are also popular. Solid-drawn brass cartridge-cases are now always used for sporting rifles, except occasionally for some of the larger bores, in which paper cartridges may be used. The peculiarity of the Express bullet is its hollow point to ensure the expansion of the projectile on impact. This diminishes its penetration, but translates its velocity or energy into "shock." The size and shape of the hollow in the point vary according to the purpose required. If greater penetration is needed, the leaden bullet is hardened with mercury or tin, or the military nickel-coated bullet is used in the small-bore rifle. Explosive bullets filled with detonating powder were at one time used in Express and large-bore rifles for large game. The use of these bullets is now practically abandoned, owing to their uncertainty of action and the

[1] The term "point-blank range" is often used in this connexion. Strictly speaking, there is no such thing as "point-blank range," the bullet commencing to drop immediately it leaves the muzzle of the rifle. The path or trajectory of the bullet if fired horizontally is therefore always a downward curve. The higher the muzzle velocity the flatter is this curve. The "fixed-sight," or so-called "point-blank" range, is usually taken at such range and with such elevation as render the amount of drop of the bullet or curve of its path practically immaterial for sporting purposes, say a maximum of $4\frac{1}{2}$ inches. At shorter range this curve would therefore take the bullet so much above the line of fixed-sight aim, and must where necessary be allowed for.

danger in handling them. The use of the large four- and eight-bore rifle is restricted to the hunting of large and dangerous game. These are usually double-barrelled. The four-bore weighs from 14 to 18 lb with 20-inch barrels, and fires a charge of 12 to 14 drs. of powder, with a spherical bullet of 1510 grains. The great weight of this rifle is against its general use. The eight-bore rifle weighs from 11½ to 15 lb with 20- to 24-inch barrels, with a charge of 8 to 12 drs. of powder with a spherical ball. These rifles are accurate and effective up to 120 yards.

Rook and rabbit rifles are usually single-barrel breech-loading rifles of from ·220 to ·380 bore, hammerless, ejectors. The range is ordinarily restricted to 200 yards. The combination of a rifle and shot-gun is generally used in countries where the kind of game to be met with is not known beforehand, and by emigrants who can only afford one gun. The weapon is double-barrelled; the left usually rifled, and the right a smooth-bore. The proper proportions of bore are ·450 rifle barrel and sixteen-bore short barrel; or ·500 rifle and twelve-bore shot. This weapon has many drawbacks, being too heavy for a shot-gun and too light for a rifle, with a bad balance. More modern combinations of the rifle and shot-gun are Holland's "Paradox," a smooth-bore with the last three inches of the barrel ratchet-rifled; Lancaster's "Colindian" twisted oval bore without sharp-edged grooves or ridges in the barrel; and Bland's "Euoplia" with "invisible" undulating rifling, also without sharp-edged grooves or ridges. All these weapons fire heavy bullets more or less accurately up to 100 yards, are also used as shot-guns, and are made double or single barrelled and of various calibres, twelve-bore being the most common. The Morris tube is a small-bore rifle barrel capable of being inserted and used as required in a shot-gun or larger rifle. A shot-gun may thus be utilized as a small-bore rifle, or a large rifle as a saloon rifle for gallery practice.

The modern small-bore military rifle already described, such as the Lee-Enfield or the German Mauser or Austrian Mannlicher, now possesses all the best qualities of an Express sporting rifle—namely, accuracy, flat trajectory, high muzzle velocity, and long point-blank range up to 200 yards. This weapon is also a "long-range Express," and can be sighted up to 2800 yards. A sporting variety of the military weapon is now made, either double or single, ·256 to ·303 bore, the double-barrel with a very strong breech mechanism; the weight, as desired, beyond 8½ lb. The standard charge of black gunpowder is 71½ grains; of cordite, 30 grains; of "rifleite," 38 grains. The muzzle velocity of the ·303 bore with black powder is 1850 feet per second; with cordite, 2000 feet. This weapon is now one of the most efficient rifles for general game shooting. The hollow-pointed expanding bullet with soft lead nose is generally used in these rifles for ordinary sporting purposes, with the military solid metal cartridge-case. Some leading gunmakers make their latest single and double Express sporting rifles, firing nitro-powder cartridges, cordite, or rifleite, of from ·360 to ·577 bore, thus possessing the greater power and shock of the old eight-bore rifle firing black powder, combined with much of the handiness, long range, and flat trajectory of the smaller-bore smokeless Express rifle. The automatic principle, by which the firing of each cartridge loads the next and cocks the weapon, has not yet been applied to rifles, but is applied to some pistols and carbines, such as the Mauser. (H. S.-K.)

Riga, one of the chief seaports of Russia, at the head of the gulf of same name, in the government of Livonia. Its population, which was 180,935 in 1891, had increased to 281,884 in 1897, so that it now ranks sixth in the empire in order of population; 47 per cent. of the inhabitants are Germans, 25 per cent. Russians, and 23 per cent. Letts, with a small admixture of Esthonians, Jews, &c. The city has now a polytechnic, five gymnasia, several technical and theological middle schools, a pilot and navigation school, and a number of primary institutions, with about 20,000 pupils of both sexes. Industrial activity has also developed, and there are now 275 factories (mainly railway-carriage works, works for the manufacture of machinery, oil mills, and breweries), giving employment to 30,000 workmen, and showing yearly returns of 60,000,000 roubles. No less than 33 newspapers (18 in German) are published, and there are 43 public libraries. Having direct railway communication with all the fertile parts of southern and south-eastern Russia, Riga has become the second port for foreign trade on the Baltic, ranking next after St Petersburg. The chief exports are grain, flax, seed, eggs, butter, hemp, and timber, while the imports, which have rapidly increased, are chiefly colonial and manufactured goods. The port, which freezes on an average for 127 days every year, was visited in 1899 by 1236 ships, of which only 253 were under the Russian flag. The larger ships cannot reach Riga, and consequently are unloaded at Ust Dvinsk (formerly Dünaburg). By no means all the trade with the interior is commanded by the railways; no inconsiderable portion of the goods is carried by water. Every year about 28,000 tons are shipped to the town from the basin of the Dnieper, 50,000 tons from the basin of the Duna, and 89,000 tons from the other river basins —in all, 167,000 tons per annum.

Rimbaud, Jean Arthur (1854–1891), French poet and adventurer, was born at Charleville, in the Ardennes, on 20th October 1854, the second son of a captain in the French army, who in 1860 abandoned his wife and family. From early childhood Arthur Rimbaud, who was severely brought up by his mother, displayed rich intellectual gifts and a sullen, violent temperament. He began to write when he was ten, and some of the poems which now appear in his works belong to his fifteenth year. Before he was sixteen, in consequence of a violent quarrel with his mother, the boy escaped from Charleville with a packet of his verse, was arrested as a vagabond, and for a fortnight was locked up in the Mazas prison, Paris. A few days after being taken home, Rimbaud escaped again, into Belgium, where he lived for some time as a tramp, almost starved, but writing verses with feverish assiduity. A curious letter of this period exists, in which Rimbaud says that all recent French poetry, except certain pieces of Verlaine, absolutely "disgusts" him, and in which he announces his intention of creating a new thing in verse. In February 1871 he left his mother for a third time, and made his way to Paris, where he knew no one, and whence, after very nearly dying of hunger and exposure, he begged his way back to Charleville. There he wrote in the same year the extraordinary poem of *Le Bateau Ivre*, which is now hailed as the pioneer of the entire "symbolist" or "decadent" movement in French literature, in all its forms. He sent it to Verlaine, who encouraged the boy of seventeen (whom he supposed to be a man of thirty) to come again to Paris. Rimbaud spent from October 1871 to July 1872 in the capital, partly with Verlaine, partly as the guest of Théodore de Banville, and served in the army of the Commune. With Verlaine he travelled for thirteen months, after the fall of the Commune, through England and Belgium, where in 1873 he published the only work which he ever printed, *Une Saison en Enfer*, in prose; in

this he gives an allegorical account of his extravagant relations with Verlaine, which ended at Brussels by a double attempt of the latter to murder his young companion. On the second occasion Rimbaud was dangerously wounded by Verlaine's revolver, and the elder poet was imprisoned at Mons for two years. Meanwhile Rimbaud, deeply disillusioned, determined to abandon Europe and literature, and he ceased at the age of nineteen to write poetry. He settled for a while at Stuttgart, studying German, and in 1875 he disappeared. He set out on foot for Italy, and after extraordinary adventures found employment as a day-labourer in the docks at Leghorn. Returning to Paris, he obtained a little money from his mother, and then definitely vanished. For sixteen years nothing whatever was heard of him, but it is now known that he embarked as a Dutch soldier for the Sunda Isles, and presently deserting, fled to Sumatra and then to Java, where he lived for some time in the forest. Returning to Europe, after a vagabond life in every capital, he obtained in 1880 some menial employment in the quarries of Cyprus, and then worked his way to Aden and up into Abyssinia, where he was one of the pioneers of European commercial adventure. Here he settled, at Harrar, as a trader in coffee and perfumes, to which he afterwards added gold and ivory; for the next eleven years, during which he led many commercial expeditions into unknown parts of northern Africa, Shoa and Harrar were his headquarters, and he lived almost entirely with the natives, and as one of themselves. From 1888 to 1891, having prospered greatly as a merchant, he became a sort of semi-independent chieftain, intriguing for France, just outside the borders of civilization. From documents which were first produced in 1902, it appears that from 1883 to 1889 Rimbaud was in close relations with the Ras Makonnen and with Menelek, then only king of Shoa. At the death of the Negus John, in 1888, he was concerned in the formation of the empire of Ethiopia. From this time Rimbaud had a palace in the town of Harrar, and intrigued with the French Government in favour of Menelek and against Italy. Meanwhile, in 1886, believing Rimbaud to be dead, Verlaine had published his poems, under the title of *Les Illuminations*, and they had created a great sensation in Paris. But the author, in his Abyssinian hut of palm-leaves, was, and remained, quite unconscious of the fact. In March 1891 a tumour in his knee obliged Rimbaud to leave Harrar and go to Europe for surgical advice. He reached Marseilles, but the case was hopeless; the leg had to be amputated, and Rimbaud died there in hospital on the 10th of November 1891. The poems of Rimbaud all belong to his earliest youth. Their violent originality, the influence which they have exercised upon younger writers, the tumultuous existence of their author, and the strange veil of mystery which still hangs over his character and adventures, have given to Rimbaud a remarkable fascination. His life has been written by M. Paterne Berrichon (1898), and valuable reminiscences by his sister, Mlle Isabella Rimbaud. His *Œuvres* were collected in 1898 by MM. Berrichon and Delahaye, and in 1901 his statue was unveiled at Charleville. (E. G.)

Rimini, a town and bishop's see of the province of Forlì, Emilia, Italy, on the Adriatic coast, 69 miles south-east of Bologna by rail. Among the buildings may be mentioned an archæological museum, a bronze statue of Pope Paul V., and a technical school (1882). Rimini attracts numerous visitors for the sea-bathing it offers at Porta Marina; it also has mineral springs. Various industries are carried on—ironworks and foundries, sulphur furnaces, silk-mills, rope-walks, match factories, brick-works, flour-mills, and furniture shops. Population (1881), 19,158; (1899), about 21,000.

Riobamba, or RIOBAMBA NUOVA, chief town of the province of Chimborazo, Ecuador, Central America, situated on a high plateau, on the San Juan river, an affluent of the Chambo, 100 miles south-south-west of Quito, and 22 north-west of Chimborazo. It has manufactures of woollens and sacking. The plain to the south was the scene of a great battle with the Indians during the conquest, and in the vicinity are remains of an Inca palace. Population, 12,000.

Rio de Janeiro, capital and principal commercial centre of Brazil. The principal part covers an area of about two square kilometres, bounded on the S. by the Morros Castello and S. Antonio, and on the N. by S. Bento and Conceiçao. This section is divided into regular squares by narrow streets; in the principal ones are tramway lines, some horse lines, others electric. The length of these lines in the city limits is about 177 miles. The city has been spreading along the shores of the bay to the north and far back over the hills behind it, so that it now extends over a distance of 18 miles. The number of the buildings is estimated at 50,000. The former imperial palace of Boa Vista is now the National Museum. The present Government Palace is in the populous district of Cattele. Rio is one of the most unhealthy and, until almost the end of the 19th century, one of the most insanitary cities of Brazil, yellow fever being endemic. Tuberculosis and smallpox also make constant ravages. The mortality in 1896 was: pernicious abscesses, 766; yellow fever, 2919; other fevers, 1403; smallpox, 258; other diseases, 14,144. In 1898 the number of cases of yellow fever in Rio was 1177, deaths 1094; and of smallpox, 204, deaths 66. In 1899 there were 928 cases of yellow fever, and 720 deaths; in 1900 there were 2726 deaths from tuberculosis, 631 from smallpox, 344 from yellow fever, and 292 from bubonic plague, which made its first appearance there that year. Rio de Janeiro constitutes a separate political and administrative division, called the Federal District. It is governed by a mayor appointed by the president of the Republic, and has a municipal council elected by the people. The district is divided into 20 urban circumscriptions and 8 suburban ones. In 1890 the population of the Federal district was 674,972, and for 1900 was reported as 779,000. The receipts of the Federal District for 1898 were estimated at 17,656,436 milreis, and the expenditure at 15,826,270. Rio is the principal port of shipment in Brazil for coffee: in 1896, 2,784,958 bags (60 kil.) were exported; in 1897, 4,066,734 bags; in 1898, 3,441,166 bags; in 1899, 3,504,708 bags; and in 1900, 2,658,990 bags. The average value in 1898 was about 31s. 6d. per bag. The total exports of all kinds were valued at £6,750,000 in 1900, of which £5,670,000 was for coffee, £482,000 for gold, £151,000 for manganese, and £149,000 for hides. The principal imports are wheat, flour, coal, wines, cottons and textiles, machinery, &c. But the import trade has declined: £12,631,000 in 1898; £11,468,000 in 1899; £9,462,000 in 1900. The greater part of the immigration to Brazil passes through the port; in 1896 there were 100,547 immigrants; and in 1898–99, 27,650 were reported landed at Rio. The movement of all shipping engaged in foreign trade during the years 1896, 1897, 1898, 1899, and 1900 was: entered in 1896, 1535 vessels, of 2,469,628 tons; cleared, 1404 vessels, of 2,283,499 tons: entered in 1897, 1274 vessels, of 2,146,854 tons; cleared, 1220 vessels, of 2,044,858 tons; in 1898, 1218 vessels, of 2,069,161 tons, entered, and 1130 vessels, of 1,957,712 tons, cleared; in 1899, 1077 vessels, of 1,916,936 tons,

entered, and 1019 vessels, of 1,853,707 tons, cleared; in 1900, 843 vessels, of 1,522,754 tons, entered, and 790 vessels, of 1,407,122 tons, cleared. In the above the entries of British shipping in 1898 were 552 vessels, of 1,030,149 tons; in 1899, 482 vessels of 936,393 tons; and in 1900, 385 vessels of 791,250 tons.

Rio de Janeiro, an Atlantic state of Brazil, between 20° 50′ and 23° 19′ S. and 41° 01′ and 44° 52′ W. Area, 26,634 square miles. Population in 1890, 1,227,575 (exclusive of the city of Rio de Janeiro, which constitutes the Neutral Federal District or Distrito Federal). It is bounded on the N. by Minas Geraes, on the W. by São Paulo, on the S. and E. by the Atlantic. The capital, Nictheroy, on the Bay of Guanabara (or Rio), has 36,000 inhabitants. Amongst other towns may be named Rio Bonito (21,000), Campos (20,000), Itaborahy (18,200), Barra Mansa (12,200), Parahyba do Sul, Paraty, Pirahy, Rezende (16,000), S. Fidelis (14,500), Petropolis (12,200), Cabo Trio, Valenza, Carmo, Marica. The state is well supplied with railways. The principal agricultural product is coffee, the exports in 1900 amounting to 87,105,716 kilograms.

Rio de Oro, a Spanish colony on the north-west coast of Africa. It is situated about the middle of that part of the Sahara coast which Spain considers her own by right of occupation and exploration, between 23° 35′ and 23° 55′ N. The peninsula of Rio de Oro is united to the mainland by a sandy isthmus, and its length is 23 miles, and its breadth 1¼ to 2 miles, on an average about 20 feet above the sea-level. The bay between peninsula and mainland is 22 miles long, 5 broad, navigable over two-thirds of its extent, and with good anchorage in most of the channel, but the bar at its mouth is not always easy to pass in rough weather. The peninsula has very sparse vegetation, except in its southernmost part near Cape Durnford. There is an island in the bay, Isla Herne.

The climate is generally temperate, and not unhealthy except in the autumn. Esparto grass and manzanilla are grown in many places, but European plants are not easily acclimatized. On the peninsula and on the coast itself there are many hares, wolves, foxes, hyenas, gazelles, lizards, pelicans, and large crows. The natives of the coast are Arab tribes, a cross of Berbers and negroes, Mussulmans, very poorly clad, who rear cattle, sheep, camels, and have but few horses. They are very suspicious and treacherous in their intercourse with the Spaniards.

In 1884 the Hispano-African Company built a factory 7 miles from Cape Durnford, but in the following year it was pillaged and burnt by the natives. The Hispano-African Company for a while renewed its trade with the natives, but finally ceded its rights to the Transatlantic Company of Barcelona. War vessels from the Canary Isles visit Rio de Oro several times in the year, to carry reliefs, provisions, and war stores.

The best works of reference on Rio de Oro are those of Bonelli, who founded the *Nation* in 1884, the articles of Francisco Quiroga and Costa and Lorenzo Rubio in vols. i. and ii. of the *Revista de Geographia*. Costa thinks Rio de Oro is the Ciranis of Herodotus.

Rio Grande, one of the longest and most eccentric of the North American rivers. It is nearly 1800 miles from its source, in the Rocky Mountains of southern Colorado, to its mouth, on the Gulf of Mexico. Although navigable only in its lower 100 miles, normally without running water for vast stretches, and extending for almost its entire course through deserts, it has had a dominating influence over the cultural and political conditions of the vast country which it threads. For nearly 1000 miles it forms the natural and political boundary between the United States and Mexico. Below El Paso and along the Lower Rio Grande the course often shifts, thereby causing international complications. Historically the Rio Grande is interesting from its connexion with the early Spanish explorations of the 16th century. It presents many features of a complex physiographic type, being in portions a river of the Rocky Mountains, of the interior deserts, and of the Atlantic Coastal Plain. It also presents a complicated geological history, including the union of what were originally several streams. The different parts were given three distinct names by the Mexican inhabitants. The upper stretch, of some 500 miles, flowing southward from Colorado through New Mexico into Texas, was called the Rio del Norte. Except a small portion of the head-waters, this section is an intermittent stream, flowing sluggishly through the interior deserts of the Cordilleran region. Its bed above and below El Paso is at times dry. In May and June the sun melts the accumulated winter snows of the Colorado Rockies and floods the dry bed, the water from which the inhabitants turn upon their fields. A few miles below Presidio del Norte, Texas, the river enters a series of vast cañons cutting across range after range of the eastern line of the American Cordilleras, seeking an outlet from the basin deserts to the Atlantic coastal plain. This stretch, extending to the mouth of Devil's river, is 400 miles long, and is known as the Rio Bravo. In this portion of its course the river makes an angle, changing its course from south-west to north-east, and is popularly known as the Big Bend. Just above Del Rio the Rio Bravo emerges upon the broad coastal plain of the Gulf of Mexico. It now becomes the Rio Grande.

The Rio Grande, as a whole, attracts almost no lateral drainage except in the upper 300 miles of its course. In passing through the greater part of New Mexico and Texas it is constantly fed only by the Conchas and Pecos, which bring their permanent waters from distant countries. Its flow is continuous from its source to about the 35th parallel in New Mexico; thence to Presidio, Texas, it is interrupted. In this stretch the run-off aggregates far more than that of all the other portions combined. Even this normal run-off progressively decreases down stream (three years' observations) from 11·63 second feet at Del Norte, Colorado, to ·64 second feet at San Marcial, 500 miles below El Paso. At Presidio the flow first becomes continuous and copious, through the accession of the waters of the Conchas river of Chihuahua. In the Big Bend its volume is enhanced by copious subterranean springs breaking forth in its bed. The inflow of the Pecos largely increases the volume of the Lower Rio Grande. From below the mouth of the Pecos the river has no large contributing laterals. Below Presidio there are two seasons of overflow—in May or June, from the melting of the snows, and in August, from the tropical rains near the sources of the Conchas in Mexico. Although the United States Government has made many observations upon the flow of the Upper Rio Grande north of El Paso, none is recorded of the stream below that point. Of the two flowing tributaries, the Rio Grande and the Pecos, either might be considered the mother stream or head-water continuation of the Lower Rio Grande, as much as the Rio del Norte, now so considered. The Rio Conchas rises in the mountains of Chihuahua and flows almost due northward into the Rio Grande. The Pecos is almost equal to the Upper Rio Grande in length, and, so far as constant volume is concerned, a larger stream. Like the Rio Grande, it receives its waters from the ranges of the Rocky Mountains in northern New Mexico. It is also reinforced by numerous streams from the Sacramento Mountains. (R. T. H.)

Rio Grande do Norte, an Atlantic state of Brazil, the extreme eastern part of the republic, with Cape St Roque as its most easterly port, situated between 4° 54′ and 6° 28′ S. and 34° 52′ and 37° 48′ W. Area, 22,195 square miles. Population in 1872, 233,979; and in 1890, 313,979. It is bounded on the N. by the state of Ceará and the Atlantic Ocean, on the W. by Ceará, on the S. by Parahyba, and on the E. by the Atlantic. The capital, Natal, which is also the principal port of the state, has a population of 46,000, Mossoro has 3000, Ceará-Mirim 4000, and Macao 5000.

Rio Grande do Sul, or São Pedro do Rio Grande do Sul, a state of Brazil between 27° 05′ and 33° 45′ S. and 49° 32′ and 57° 20′ W. Area, 91,335 square miles. Population in 1872, 434,816; in 1890, 880,878; and in 1900, 968,231. It is bounded on the N. by S. Catharina, on the W. by the Argentine Republic

and Uruguay, on the E. by the Atlantic, and on the S. by Uruguay. The capital, Porto Alegre, has a population of nearly 100,000, of whom 10,000 are Germans. Between 1886 and 1894, 75,766 immigrants entered the state, principally Germans, Italians, and Poles. Other towns include Pelotas (30,000), Alegrete (12,000), Jaguarão (8000), Rio Grande, Bagé, Caçapava, Rio Pardo, S. José do Norte. There are 670 miles of railway in operation, and other lines are in process of construction. There are numerous prosperous German colonies, and their number and importance are constantly increasing. The oldest, S. Leopoldo, was founded in 1824.

Rioja, La, a province in the west of the Argentine Republic, bounded on the N. by Catamarca, on the E. by Catamarca and Cordoba, on the S. by San Luis, and on the W. by San Juan and Chile. Official area at the census of 1895, 34,546 square miles. Population in 1895, 69,502. The capital, La Rioja, had a population in 1895 of 5931. The gold, silver, and copper mines near Famatina and Chilecito constitute the principal sources of wealth of the province. The province is divided into eighteen departments. In 1895 there were 6446 farms, and 40,920 acres planted in cereals.

Rio Negro, a territory of the Argentine Republic, bounded on the N. by the territory of Pampa, from which it is separated by the Rio Colorado, on the S. by Chubut, on the E. by the Atlantic, and on the W. by Neuquen and Chile. Official area at the census of 1895, 75,924 square miles; population, 9241. The capital is Viedma, on the right bank of the Rio Negro, 20 miles from its mouth. The territory is divided into seven departments. In 1895 there were 82,050 head of cattle, 1,009,777 head of sheep, and 35,599 horses in the territory, and only 1168 acres planted in cereals.

Riot.—The criminal law as to riot has not been modified since 1885, but the materials for ascertaining the duties of justices, the police, ordinary citizens, and soldiers, with respect to the suppression of riots have been increased by the publication in the New Series of State Trials of the full reports of the prosecution of the mayor of Bristol for dereliction of duty in suppressing the Bristol riots of 1831, and a number of other leading cases on riot; and Lord Bowen and his fellow-commissioners in the report on the Featherstone riots (Parl. Paper, 1893–94, c. 7234) have dealt with the duty of soldiers called in to suppress riots. The substance of their views is as follows:—

By the law of England every one is bound to aid in the suppression of riotous assemblages. The degree of force, however, which may be lawfully employed in their suppression depends on the nature of each riot, for the force used must always be moderated and proportioned to the circumstances of the case and to the end to be attained. The taking of life can only be justified by the necessity for protecting persons or property against various forms of violent crime, or by the necessity of dispersing a riotous crowd which is dangerous unless dispersed, or in the case of persons whose conduct has become felonious through disobedience to the provisions of the Riot Act, and who resist the attempt to disperse or apprehend them. The necessary prevention of such outrage on person or property justifies the guardians of the peace in the employment against a crowd of even deadly weapons. Officers and soldiers are under no special privileges and subject to no special responsibilities as regards the principle of the law. A soldier for the purpose of establishing civil order is only a citizen armed in a particular manner. He cannot because he is a soldier be exonerated if without necessity he takes human life. The duty of magistrates and peace officers to summon or abstain from summoning the assistance of the military depends in like manner on the necessities of the case. A soldier can act only by using his arms. The weapons he carries are deadly. They cannot be employed at all without danger to life or limb, and in these days of improved rifles and perfected ammunition without some risk of danger to distant and possibly innocent bystanders. To call for assistance against rioters from those who can interfere only under such grave conditions ought, of course, to be the last expedient of the civil authorities. But when the call for help is made and a necessity for assistance from the military has arisen, to refuse such assistance is in law a misdemeanour. The whole action of the military when once called in ought from first to last to be based on the principle of doing, and doing without fear, that which is absolutely necessary to prevent serious crime, and of exercising care and skill with regard to what is done. No set of rules exists which governs every instance or defines beforehand any contingency that may arise. The presence of a magistrate is not essential, but is usual, and of the highest value to aid the commander of the troops by local knowledge. But his presence or absence has no legal effect on the duties or responsibilities of the military to use their arms when it becomes necessary to do so, and without recklessness or negligence and with reasonable care and caution; and where they have so acted the killing of a rioter is justifiable homicide, and the killing of an innocent bystander is homicide by misadventure. It is not usual to resort to extremities with rioters until after reading the proclamation under 1 Geo. I.; but this preliminary is by no means a condition precedent to the exercise of the common-law powers of suppressing riots.

The Crown cannot charge upon the local rates the expense of maintaining soldiers called into a district by the magistrates to suppress riots (*R.* v. *Glamorgan County Council*, L.R. 1899, 2 Q.B. 536), but the cost of extra police called in for the like purpose falls on the local rates. The old exceptional civil remedy against the inhabitants of a hundred in which damage to private property was done by rioters was abolished in 1886. When the Piccadilly riots occurred in that year no one knew that the injured shops were in the hundred of Ossulston, and difficulties arose in applying the old procedure. So a statute was passed (49 Vict. c. 11) for a special settlement of the claims, and the old statutes were repealed and replaced by the Riot Damage Act, 1886. Under this Act compensation is payable where rioters have injured or destroyed houses, shops, buildings, fixed or movable machinery, and appliances prepared or used for or in connexion with manufactures or agriculture, or for mines or quarries, or vessels stranded or in distress (see WRECK), or have injured, stolen, or destroyed property in houses, shops, or buildings. The compensation is payable out of the police rate for the district in which the damage is done; or if it was done afloat, for the district nearest to the scene of action. The claim is made on the police authority for the district. The time and form for making claims and the mode of fixing the amount of compensation is regulated by rules made by the Home Secretary on 30th June 1894 (Stat. R. and O. 1894, No. 636). In adjusting the amount regard is had to the conduct of the claimant, viz., as to precautions taken by him, his share, if any, in the riot, or provocation offered to the rioters. Failure to carry out a programme for athletic sports has been held to debar a claimant for damage done by a riot among the disappointed spectators who had paid to see the sports. The claimant must give credit for insurance money, or any other compensation received in respect of the damage; but the insurers or persons who paid such compensation may file a claim against the police-rate for the amount paid by them. Persons dissatisfied with the award of the police authority may sue for the recovery of their claim subject to a liability to pay all the costs if they do not get judgment for more than the amount awarded. The action, if it is not for more than £100, is to be brought in the county court. In Scotland there is also a civil remedy against the county or borough in which a riot takes place in respect of damage done by the rioters to houses, churches, buildings, and ships, and buildings or engines used in trade or manufacture. The remedy is given by a series of statutes: 1 Geo. I. st. 2, c. 5, § 9; 52 Geo. III. c. 130, §§ 3, 4; 56 Geo. III. c. 125, § 2; 57 Geo. III. c. 19, § 38, and 57 and 58 Vict. c. 60, § 515. The procedure for its enforcement is now regulated by 3 Geo. IV. c. 33, and amending statutes. The county or borough authorities may adjust claims without litigation, and pay them out of the general assessments. In Ireland the civil remedy against the county or borough

for malicious injury to property, real or personal, including ships in distress and their cargo, is wider than in England or Scotland, but it includes malicious injury by rioters where the injury is a crime within the Malicious Damage Act of 1861. Claims are now dealt with in the civil bill court, and not as formerly by the grand jury and judge of assize (61 and 62 Vict. c. 37, § 5). (W. F. C.)

Ripon, George Frederick Samuel Robinson, 1st Marquis of (1827——), British statesman, only son of the 1st earl of Ripon and his wife Lady Sarah, daughter of the 4th earl of Buckinghamshire, was born in London, 24th October 1827. He began his political life as *attaché* to a special mission to Brussels in 1849. Under his courtesy title of Viscount Goderich he was returned to the House of Commons for Hull in 1852 as an advanced Liberal. In 1853 he was elected for Huddersfield, and in 1857 for the West Riding of Yorkshire. In January 1859 he succeeded to his father's title, and in November of the same year to that of his uncle, Earl de Grey. A few months after entering the Upper House he was appointed under-secretary for war, and in February 1861 under-secretary for India. Upon the death of Sir George Cornewall Lewis in April 1863, he became secretary for war, with a seat in the Cabinet. In 1866 he was appointed secretary of state for India. On the advent of the Gladstone Administration in December 1868, Lord Ripon was appointed lord president of the Council, and held that office until within a few months of the fall of the Government in 1873, when he resigned on purely private grounds. In 1869 he was created a Knight of the Garter. In 1871 Lord Ripon was appointed chairman of the High Joint-Commission on the *Alabama* claims, which arranged the Treaty of Washington. In recognition of his services he was elevated to a marquisate. In 1874 he became a convert to Roman Catholicism, and this involved his resignation of the office of grand master of the English Freemasons. On the return of Mr Gladstone to power in 1880 Lord Ripon was appointed Viceroy of India, the appointment exciting a storm of controversy, meetings of protest being held in Exeter Hall and elsewhere, the marquis being the first Roman Catholic to hold the viceregal office. An account of his viceroyalty will be found in the article India: *History*. The new Viceroy was called upon to decide grave questions between the native population and the resident British, and he resolved upon a liberal policy towards the former. He extended the rights of the natives, and in certain directions curtailed the privileges of Europeans. Several of the Viceroy's measures, notably the Ilbert Bill of 1883—the object of which was to subject Europeans to trial by native magistrates in certain cases—irritated the Anglo-Indian population, and the measure was fiercely assailed. There probably never was a Viceroy so unpopular among Anglo-Indians or so popular with the natives. On Lord Ripon's departure from India in November 1884 there were extraordinary manifestations in his favour on the part of the Hindoo population of Bengal and Bombay, and more than a thousand addresses were presented to him. On his arrival in England the marquis delivered a number of vigorous speeches in defence of his administration. In 1886 he became first lord of the Admiralty in the third Gladstone Ministry; and on the return of the Liberals to power in 1892, he was appointed Colonial Secretary, which post he continued to hold until the resignation of the Government in 1895. For many years Lord Ripon was president of the Yorkshire College of Science at Leeds, and chairman of the West Riding County Council.

Ripon, a cathedral city and municipal borough, Yorkshire, England, West Riding, in the Ripon parliamentary division, 22 miles north-west of York by rail. A new cemetery, completed in 1894, has one chapel available for all denominations. In the same year new premises were erected for the Mechanics' Institution, in which a continuation evening school and technical classes are held. A clock tower was presented as a memorial of Queen Victoria's Diamond Jubilee, and a church institute was erected in 1900. There is a somewhat extensive trade in varnish, and its manufactures of saddle-trees, leather, &c., are in high repute. Population of the municipal borough (1881), 7390; (1891) (altered area), 7826; (1901), 8225.

Riposto, a seaport town of the province of Catania, Sicily, Italy, 19 miles north by east of Catania, on the east coast railway to Messina. It is one of the principal wine-exporting places in the island. In 1897 the port was cleared by 758 vessels of 365,116 tons. It has several cooperages. Population (1899), about 9000.

Ristitch, Jovan (1831–1899), Servian statesman, was born at Kragujevats in 1831. He was educated at Belgrade, Heidelberg, Berlin, and Paris. After failing to obtain a professorship in the High School of Belgrade, he was appointed in 1861 Servian diplomatic agent at Constantinople. His reputation was enhanced by the series of negotiations which ended in the withdrawal of the Turkish troops from the Servian fortresses in 1867. On his return from Constantinople he was offered a ministerial post by Prince Michael, who described him as "his right arm," but declined office, being opposed to the reactionary methods adopted by the Prince's Government. He had already become the recognized leader of the Liberal party. After the assassination of Prince Michael in 1868, he was nominated member of the Council of Regency, and on the 2nd January 1869 the first Servian Constitution, which was mainly his creation, was promulgated. When Prince Milan attained his majority in 1872, Ristitch became foreign minister; a few months later he was appointed prime minister, but resigned in the following autumn (1893). He again became prime minister in April 1876, and conducted the two wars against Turkey (July 1876–March 1877 and December 1877–March 1878). At the Congress of Berlin he laboured with some success to obtain greater advantages for Servia than had been accorded to her by the treaty of San Stefano. The provisions of the Treaty of Berlin, however, disappointed the Servians, owing to the obstacles now raised to the realization of the national programme; the Ristitch Government became unpopular, and resigned in 1880. In 1887 King Milan (who had assumed the royal title in 1882), alarmed at the threatening attitude of the Radical party, recalled Ristitch to power at the head of a coalition cabinet; a new Constitution was granted in 1888, and in the following year the king abdicated in favour of his son, Prince Alexander. Ristitch now became head of a Council of Regency, entrusted with power during the minority of the young king, and a Radical ministry was formed. In 1892, however, Ristitch transferred the government to the Liberal party, with which he had always been connected. This step and the subsequent conduct of the Liberal politicians caused serious discontent in the country. On the 1st (13th) April 1893 King Alexander, by a successful stratagem, imprisoned the regents and ministers in the palace, and, declaring himself of age, recalled the Radicals to office. Ristitch now retired into private life. He died at Belgrade on 4th September 1899. Though cautious and deliberate by temperament, he was a man of strong will and firm character. He was the author of two published works: *The External Relations*

of Servia from 1848 to 1867 (Belgrade, 1887) and *A Diplomatic History of Servia* (Belgrade, 1896). (J. D. B.)

Ritschl, Albrecht (1822–1889), German theologian, was born at Breslau, 21st March 1822. He studied at Bonn and at Halle. At the latter place he came under Hegelian influences through the teaching of Schaller and Erdmann. In 1845 he was entirely captivated by the Tubingen school. This did not last long with him, however, for his most important work on the *Origin of the Old Catholic Church* shows in its second edition (1857) entire emancipation from Baur's method. He was professor of theology at Bonn and Göttingen, his *Addresses on Religion* delivered at the latter university showing the impression made upon his mind by his enthusiastic studies of Kant and Schleiermacher. Finally, in 1864 came the influence of Lotze. He wrote a large work, *Rechtfertigung und Versöhnung* ("Justification and Reconciliation"), published during the years 1870–74, and in 1880–86 a *History of Pietism*. His system of theology is contained in the former. He died at Göttingen 28th March 1889.

Ritschl claims to carry on the work of Luther and Schleiermacher, especially in ridding faith of the tyranny of scholastic philosophy. His system shows the influence of Kant's destructive criticism of the claims of Pure Reason, recognition of the value of morally conditioned knowledge, and doctrine of the kingdom of ends; of Schleiermacher's historical treatment of Christianity, regulative use of the idea of religious fellowship, emphasis on the importance of religious feeling; and of Lotze's theory of knowledge and treatment of personality. Ritschl's work made a profound impression on German thought and gave a new confidence to German theology, while at the same time it provoked a storm of hostile criticism: his school has grown with remarkable rapidity. This is perhaps mainly due to the bold religious positivism with which he assumes that spiritual experience is real and that faith has not only a legitimate but even a paramount claim to provide the highest interpretation of the world. The life of trust in God is a fact, not so much to be explained as to explain everything else. No "theoretic" knowledge can exhaust its meaning: none can assail it. It is the highest and richest experience of man: there is no alternative but to take it as the fixed point from which all else is to be regarded. But Ritschl's standpoint is not that of the individual subject. The objective ground on which he bases his system is the religious experience of the Christian community. He starts from the point of view of a member of that believing society which refers its existence to the historical revelation of Jesus Christ, Founder and Redeemer. The "immediate object of theological knowledge is the faith of the community," and from this positive religious datum theology constructs a "total view of the world and human life." Thus the essence of Ritschl's work is systematic theology. He does not attempt to prove his data, but accepts their reality as if they were matter for natural science. Nor does he painfully work up to his master-category, for it is given in the knowledge of Jesus Christ revealed to the community. That God is love and that the purpose of His love is the moral organization of humanity in the "Kingdom of God"—this idea, with its immense range of application—is implied in Ritschl's initial datum.

From this vantage-ground Ritschl criticizes the use of Aristotelianism and speculative philosophy in scholastic and Protestant theology. He holds that such philosophy is too shallow for theology. Hegelianism attempts to squeeze all life into the categories of logic: Aristotelianism deals with "things in general" and ignores the radical distinction between nature and spirit. Neither of them is "vital" enough to sound the depths of religious life. Neither conceives "God" as correlative to human "trust" (cf. *Theologie und Metaphysik*, esp. p. 8 f.). But Ritschl's recoil carries him so far that he is left alone with merely "practical" experience. "Faith" knows God in His active relation to the "kingdom," but not at all as "self-existent."

His limitation of theological knowledge to the bounds of human need might, if logically pressed, run perilously near phenomenalism; and his epistemology ("we only know things *in* their activities") does not cover this weakness. In seeking ultimate reality in the circle of "active conscious sensation," he rules out all "metaphysic." Indeed, much that is part of normal Christian faith—*e.g.*, the Eternity of the Son—is passed over as beyond the range of his method. Ritschl's theory of "value-judgments" (*Werthurtheile*) illustrates this form of agnosticism. Religious judgments of value determine objects according to their bearing on our moral and spiritual welfare. They imply a lively sense of radical human need. This sort of knowledge stands quite apart from that produced by "theoretic" and "disinterested" judgments. The former moves in a world of "values," and judges things as they are related to our "fundamental self-feeling." The latter moves in a world of cause and effect. (*N.B.* Ritschl appears to confine Metaphysic to the category of Causality.) If this only meant that value-judgments are necessary for determining the relative value of given objects—*e.g.*, that, supposing the historical work of Christ to be a fact, we must be conscious of the need of redemption before we can appreciate the meaning of that work—then Ritschl's theory would be a welcome reassertion of an old but neglected truth. But the theory as formulated has such grave ambiguities, that his theology, which, as we have seen, is wholly based on uncompromising religious realism, has actually been charged with individualistic subjectivism. If Ritschl had clearly shown that judgments of value enfold and transform other types of knowledge, just as the "spiritual man" includes and transfigures but does not annihilate the "natural man," then within the compass of this spiritually-conditioned knowledge all other knowledge would be seen to have a function and a home. The theory of value-judgments is part too of his ultra-practical tendency: both "metaphysic" and "mysticism" are ruthlessly condemned. Faith-knowledge appears to be wrenched from its bearings and suspended in mid-ocean. Ritschl has no catholic medium in which spiritual and theoretic truths can be reconciled and harmonized. Perhaps if he had lived to see the progress of will-psychology he might have welcomed the hope of a more spiritual philosophy.

A few instances will illustrate (1) Ritschl's positive systematic theology, which takes for granted the data of Christian experience in the community and of historical revelation, working them up by the thoroughgoing teleological application of the conception of the Kingdom of God; (2) his repudiation of all "metaphysic"; (3) his elimination from faith of all that does not seem to bear on practical needs. The conception of God as Father is given to the community in Revelation. He must be regarded in His active relationship to the "kingdom," as spiritual personality revealed in spiritual purposiveness. His "Love" is His will as directed towards the realization of His purpose in the kingdom. His "Righteousness" is His fidelity to this purpose. With God as "First Cause" or "Moral Legislator" theology has no concern; nor is it interested in the "speculative" problems indicated by the traditional doctrine of the Trinity. "Natural theology" has no value save where it leans on faith. Again, Christ has for the religious life of the community the unique value of Founder and Redeemer. He is the perfect Revelation of God and the Exemplar of true religion. His work in founding the kingdom was a personal vocation, the spirit of which He communicates to believers, "thus, as exalted king," sustaining the life of His kingdom. His Resurrection is a necessary part of Christian belief (Ecke, pp. 198–199). "Divinity" is a predicate applied by faith to Jesus in His founding and redeeming activity. We note here that though Ritschl gives Jesus a unique and unapproachable position in His active relation to the kingdom, he declines to rise above this relative teaching. The "Two Nature" problem and the eternal relation of the Son to the Father have no bearing on experience, and therefore stand outside the range of theology.

Once more, in the doctrine of sin and redemption, the governing idea is God's fatherly purpose for His family. Sin is the contradiction of that purpose, and guilt is alienation from the family. Redemption, justification, regeneration, adoption, forgiveness, reconciliation all mean the same thing—the restoration of the broken family relationship. All depends on the Mediation of Christ, who maintained the filial relationship even to His death, and communicates it to the brotherhood of believers. Everything is defined by the idea of the family. The whole apparatus of "forensic" ideas (law, punishment, satisfaction, &c.) is summarily rejected as foreign to God's purpose of love. Ritschl is so faithful to the standpoint of the religious community, that he has nothing definite to say on many inevitable questions, such as the relation of God to pagan races. His school, in which Herrman, Kaftan, Harnack are the chief names, diverges from his teaching in many directions; *e.g.*, Kaftan appreciates the mystical side of religion, Harnack's criticism is very different from Ritschl's arbitrary

exegesis. They are united on the value of faith-knowledge as opposed to "metaphysic."

LITERATURE.—A. RITSCHL, *Die Christliche Lehre von der Rechtfertigung und Versöhnung*, 3rd edition, 1889; *Unterricht in der Christlichen Lehre* (very many editions); and *Theologie und Metaphysik*, 2nd edition, 1887, give his main position. Many historical and other works besides.—G. ECKE, *Die theologische Schule A. Ritschl's und die evangelische Kirche der Gegenwart*, 1897.—JAMES ORR, *The Ritschlian Theology and the Evangelical Faith*, 1898, London; and A. E. GARVIE, *The Ritschlian Theology*, 1899, Edinburgh, in both of which the bibliography of the movement is given. The German literature on the subject is very large. (G. E. N.)

Riukiu. See LUCHU.

Riva, a fortified district town near the Italian frontier in Tirol, Austria. It is a lake port and steamship station at the northern extremity of the Lago di Garda. There are two forts on the Monte Brione a little over a mile north-east of the town, and the old castle of La Rocca was reconstructed and extended in accordance with modern requirements in 1850. The Minorite Church (1603), with altar pictures by Guido Reni and other Italian painters, is much frequented as a place of pilgrimage. In addition to its transit trade and the entertainment of visitors, the principal resources of the town are the manufacture of paper, iron wares, and pottery, the cultivation of the silk-worm and the olive tree, and a considerable commerce in timber, planks, and coal. Riva is connected with the Ledro valley by a picturesque road, which passes in a series of tunnels and galleries along the rocky and precipitous west shore of the lake. Population (1890), 6480; (1900), 7550.

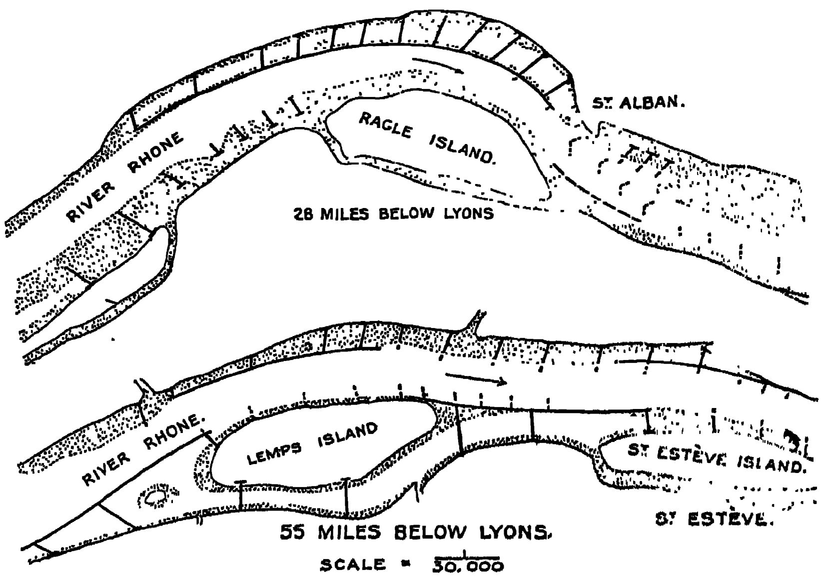
Rivarolo, a town of the province of Turin, Piedmont, Italy, in the Orco valley, 25 miles north of Turin by rail. It is a seat of cotton manufacture, and bicycles are also made and cocoons produced. The town stands picturesquely, and is sometimes called "Little Turin." Population (1899), about 7000.

River Engineering.—Since the article in the *Encyclopædia Britannica* on RIVER ENGINEERING[1] was written in 1884, several interesting works have been carried out or completed, exhibiting distinct progress in the improvement of rivers, and in some instances constituting novel undertakings; while some matters relating to the natural condition of rivers and their improvement, not included in the original article, require to be considered, in order to complete the review of the subject.

Improvement above the Tidal Limit.

When large rivers with a fairly good and regular flow at their low stage need only a moderate increase in depth at certain places to afford the requisite waterway for local inland navigation, the necessary improvement can often be effected by contracting the low-water channel with longitudinal and cross dykes, thereby promoting scour and increasing the depth. Of this the Rhine, the Rhône, the Elbe, the Niemen, and some rivers in North America furnish examples. These works leave the capacity of the river for discharging floods unaffected, or sometimes slightly improved, for the increase of the discharge in the deepened channel fully compensates for any obstruction the dykes may offer in the outer flood-channel. In rivers, also, which, with a rapid flow and inadequate depth, bring down so much detritus in flood-time as to preclude their improvement by canalization, the systematic regulation of the bed and banks has to be undertaken to increase the navigable depth.

The Rhône below Lyons, which has an average fall of 1 in 2080 and a maximum fall in some places of 1 in 250, and brings down large quantities of shingle and gravel, is a notable instance of the latter class of rivers, whose navigable depth at a low stage has been increased to a moderate extent by regulation works. These works, carried out between Lyons and the St Louis Canal close to the mouth of the river, a distance of 201 miles, were commenced in 1878, considerably modified after 1884, and completed for the most part by 1894, when consolidation works chiefly remained to be gradually executed. The expenditure at that period reached about £1,463,000 for the regulation works alone, or £7276 per mile, which may eventually be raised to £8000 per mile by the time the works are completely finished.[2] The works consist of (1) dykes across secondary and old channels, to close them and prevent their reopening during floods, when the main channel formerly tended to wander, and to concentrate the low-water flow in a single fixed channel (Fig. 2); (2) longitudinal



FIGS. 1 and 2.—Regulation Works, River Rhône.

dykes for protecting and easing the concave curves of the banks in the bends, which, being extended somewhat into the channel to reduce the curvature, are connected at the back to the banks by cross dykes to prevent the current during floods from forming a channel behind them (Fig. 1); (3) dipping cross dykes projecting downwards into the water from the banks, or in front of the longitudinal dykes, to concentrate the flow of the river at a low stage and increase its depth, and pointing somewhat up-stream so as to direct the water passing across them into the central channel (Figs. 1 and 2); and, lastly, (4) submerged dykes, the tops of which are kept well below the required navigable depth, placed across the deep pools found below shoals in the centre of the channel. These arrest scour in the hollows, and by moderately raising the water-level up-stream, owing to their checking the flow through the deep pools, improve the depth over the shoals above them, and adjust slightly the irregularities in the surface fall of the river, which is naturally rapid over the shoals and small over the deep portions (Fig. 1). The minimum depth in the navigable channel of the river, at its lowest stage, was increased by the regulation works from 1 foot $3\frac{3}{4}$ inches in 1878, to 2 feet $11\frac{1}{4}$ inches in 1884, and 4 feet $1\frac{1}{4}$ inches in 1893; and it is anticipated that on the final completion of the works, a depth of about 5 feet will be attained, amounting to a gain of $3\frac{5}{8}$ feet of water at the lowest water-level. Before the commencement of the works, navigation on the Rhône below Lyons was impracticable for three months in the year, difficult during four months, and easy for the remaining five months; whereas now, navigation is only liable to be interrupted during a fortnight, is difficult for another

[1] *Encyclopædia Britannica*, 9th edition, vol. xx. pp. 571–581, and Plate V.

[2] *Sixth International Inland Navigation Congress*, The Hague, 1894, "Regulation of Rivers at Low Water," H. Giradon.

fortnight, and is easy for fully-laden vessels during eleven months in the year.

The success of regulation works depends largely upon the degree of uniformity in the flow of a river, and especially on the volume of the minimum discharge and its duration; and consequently, these works are best suited for the lower portions of large rivers, where the regularity of flow attains a maximum, and are not adapted for rivers with a very variable discharge. Thus the Rhône, in spite of its considerable fall, possesses capabilities for regulation in respect of its flow; for its minimum discharge just below the confluence of the Saône at Lyons is four times that of the Seine at Paris. The volume of its flow exhibits a greater regularity than many rivers of similar size, owing to the flow of the main river being regulated by passing through the Lake of Geneva, and the occurrence of the floods of some of its tributaries at different periods of the year. Thus the floods of the Saône, which rises in the Vosges, occur in the winter months; while the Arve, the Ain, and the Isère, coming from the Alps, are subject to floods in the summer from the melting of the snow and glaciers. Regulation works possess the merit of leaving a river entirely open for navigation, while increasing the depth and rendering the passage of vessels easier round the flattened bends; but, on the other hand, they only slightly modify the velocity of the downward flow, which continues to be a serious hindrance to the up-stream traffic in a river with a rapid current like the Rhône.

Dredging. Dredging with bucket-ladder dredgers furnishes a well-known method of gradually improving and maintaining the depth of navigable rivers over long distances; and sand-pump dredgers have been employed with success, for many years past, in gradually lowering the bars of sand obstructing the entrance channels of some of the North Sea ports. The greatly increased efficiency, however, of the powerful sand-pump dredgers constructed within the last few years, especially when provided with cutters, and still more recently with water-jet agitators, has, since 1896, enabled the Mississippi River Commission to cut temporary channels rapidly through the shifting sand-bars which impede the navigation of the Lower Mississippi at its low stage, and thereby to increase the available navigable depth of the river during the low-water season. Centrifugal pumps on the dredger draw up sand mixed with water through the suction pipes lowered down from the dredger on to the sandbank, the amount of sand thus removed from the bar being much increased by churning up the sand by large revolving steel cutters at the orifices of the pipes, or still more effectually by jets of water forcibly ejected through pipes against the sandbank by centrifugal pumps, since the cutters are liable to jam on encountering débris embedded in the bar. The sand thus pumped up is discharged, through floating pipes, some distance off into deep water on the down-stream side of the cut.

Four of these sand-pump dredgers, working on different sections of the Mississippi below Cairo in the autumn of 1897, provided a navigable depth of from 6 to 9 feet over fourteen bars during the low-water season; and the two newest dredgers were able to raise, on the average, 1523 cubic yards and 1850 cubic yards of sand respectively per hour, discharging it to a distance of about 1000 feet.[1] The dredgers start work if possible at the beginning of September, to prepare the channels across the bars beforehand, the lowest stage of the river being reached at the end of October or early in November. A channel which has been opened out maintains its depth fairly well for a certain time; but the dredgers are kept constantly ready, during the low stage, to clear away any obstructions which may make their appearance. Two additional dredgers have been since built; and it is anticipated that these six dredgers, with a seventh about to be constructed, will be able to make and maintain, each autumn, a navigable depth of 9 feet at the lowest stage over all the bars below Cairo, for a width of 250 feet; so that this depth will be always available for navigation, except when the river is closed by ice.

Canalization. Canalization, in converting a river into a succession of nearly level reaches resembling a canal, hinders navigation by the introduction of locks, which occupy time to pass through; and the discharge of the river is also impeded by the weirs needed to maintain the requisite depth of water in the dry season. Canalization, however, provides a more assured navigable depth at the low stage of the river than regulation works, especially when the low-water discharge is liable to become small; and it also generally secures a greater depth, which can often be increased to a moderate extent without difficulty or great expense. Moreover, in spite of delays in the passage of vessels through the locks, canalization is decidedly advantageous for the up-stream traffic, owing to the reduction in the velocity of the descending current by the weirs, except during high floods; and it is also safer for the down-stream traffic with rivers having a somewhat rapid current and a winding course. The time occupied in locking vessels can be much reduced by furnishing the locks with large culverts at the sides for rapidly filling and emptying the lock-chamber, and by adding an intermediate pair of gates, or a small lock, for accelerating the passage of the smaller vessels; while by placing the locks in a side cut, and erecting movable weirs which can be removed from

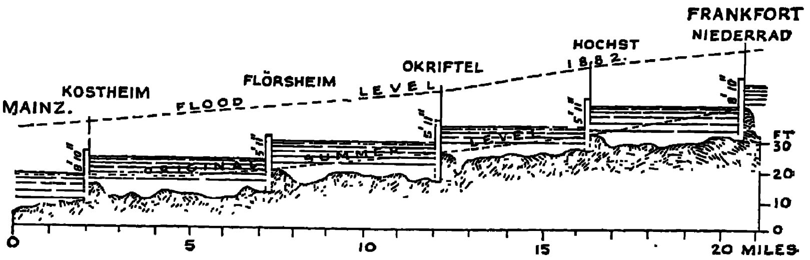


Fig. 3.—Canalization of the Main.

the channel when the river rises in flood-time, the safety of the navigation is ensured, and the river channel is left as unimpeded as possible for the discharge of floods.

One of the most successful and recent of these works is the canalization of the river Main, by the construction of five weirs and locks between Frankfort and the junction of the river with the Rhine opposite Mainz, a distance of about 22 miles, in 1883–1886,[2] and the enlargement of the locks and the provision of an increased depth a few years subsequently. The regulation of the river Main below Frankfort by longitudinal and cross dykes, previously carried out, had only secured a navigable depth of 3 feet at the low stage of the river; so that the traffic on the river had to be conducted by small barges, and, just before the commencement of the works, amounted to only about 12,000 tons a year.

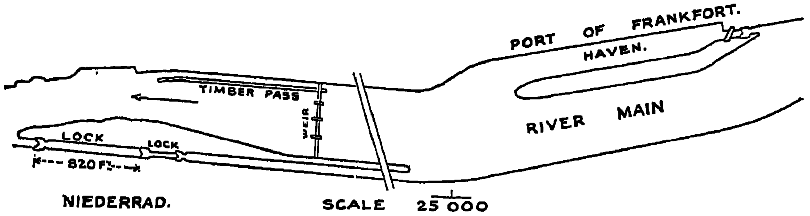


Fig. 4.—Lock and Weir on the Main.

The five movable weirs across the river, with locks in side cuts on the left bank (two with lifts of 8 feet 10 inches, and three with lifts of 5 feet 11 inches, giving an average rise from the Rhine to Frankfort of 35 feet 5 inches at a low stage), increased the navigable depth to 6½ feet at the lowest water-level (Fig. 3); and the traffic consequently rose to about 300,000 tons in 1887, in spite of the competition of two railways connecting Frankfort with the Rhine valley, one on each side of the Main. The general arrangement of the weirs and locks is indicated by a plan of the works highest up the river, 2 miles below Frankfort, given on Fig. 4. The original locks were made 279 feet long between the gates, and 34½ feet wide, in order to be able to receive the steamboats navigating the Rhine, 246 feet long and 32¾ feet broad, partially loaded; and their sills were placed 8½ feet below the water-level retained by the weirs, to allow for a further deepening of the river. The principal weir, stretching from the left bank nearly across the river, is a needle weir[3] of improved type in each case, divided by masonry piers into two to four bays, one of the openings in each weir, from 154 to 193 feet wide, serving as the navigable pass for vessels in flood-time with its sill 10½ feet below the water-level retained by the weirs. A timber pass has been formed alongside the right bank at each weir, by a long embankment in the river shutting off a channel

[1] *Report of the Chief of Engineers*, 1898, Part v. Appendix xx., "Report of the Mississippi River Commission," pp. 3139 and 3162, and plates 4 to 11, and 30 to 38.

[2] "Die Canalisirung des Main von Frankfurt a. M. bis zum Rhein," E. Cuno and P. Gutzmer, *Zeitschrift für Bauwesen*, 1888, p. 19, and plates 14 to 17.

[3] *Encyclopædia Britannica*, 9th edition, p. 574, and Plate V. Fig. 3.

with a bottom width of 39½ feet. This is closed at its upper end by a drum weir [1] of the same width between masonry piers, with its upper paddle retaining a head of water of 5 feet 7 inches, which can be readily lowered for the passage of timber down the channel, and raised again against the full force of the current, by adjusting the water-pressure in the drum, below the sill, on the under paddle by means of sluice-ways in the river pier of the drum weir. These works were carried out by the State at a total cost of £275,000; and no tolls are charged for vessels passing through the locks. A haven has been formed above the weir near Frankfort, by an embankment in the river, about 580 yards in length, parallel to the right bank and raised above flood-level, as a refuge for vessels in winter from floods and floating ice. This also serves in ordinary times for commercial purposes, direct communication with the upper river being provided by an opening at the upper end, which is closed by a pair of gates when necessary (Fig. 4).

The great increase in traffic resulting from the above canalization led to a decision in 1889 to enlarge each of the five locks on the Main, below Frankfort, sufficiently to admit six of the largest barges navigating the Rhine with their tug at one time. A third pair of gates was erected in the cut, 820 feet below the lower gates of the original lock; and the navigable depth was increased to 8½ feet by dredging the bed of the river towards the upper end of each reach. This additional depth has enabled the river to be navigated by the large Rhine steamboats when fully loaded with 1300 tons of cargo, and drawing 7¾ feet. The river traffic, which was 9,388,640 ton-miles in 1887, rose to 22,543,700 ton-miles in 1892, and reached 36,630,830 ton-miles in 1898.

Movable weirs.

An entirely novel type of frame weir was completed on the Lower Seine in September 1885 at Poses, and a second one about 25 miles higher up a year or two later. In all the previous frame weirs, closed with square spars (needles), rolling-up curtains, or panels, erected across French and American rivers, and also in the needle weirs on the river Main, the frames which are hinged on the apron of the weir in a row, and carry a foot-bridge, are laid flat on the bed of the river in flood-time, each partially resting upon the frame previously lowered. They are therefore exposed during the winter months to the action of the flooded river, and the detritus it carries down. At Poses and Port Mort, on the contrary, the frames are suspended vertically from a wide overhead foot-bridge, and rest at their lower ends against a sill in the bed of the river; while the weirs are closed by hinged curtains, let down and rolled up again by aid of a winch travelling on a small foot-bridge formed by a series of brackets hinged to the back of each frame (Fig. 5).[2] The weir is opened by rolling up the curtains, and raising the hinged frames one by one into a horizontal position by chains from the overhead bridge, so that all the movable parts of the weir are raised out of the water in flood-time, quite secure from injury,

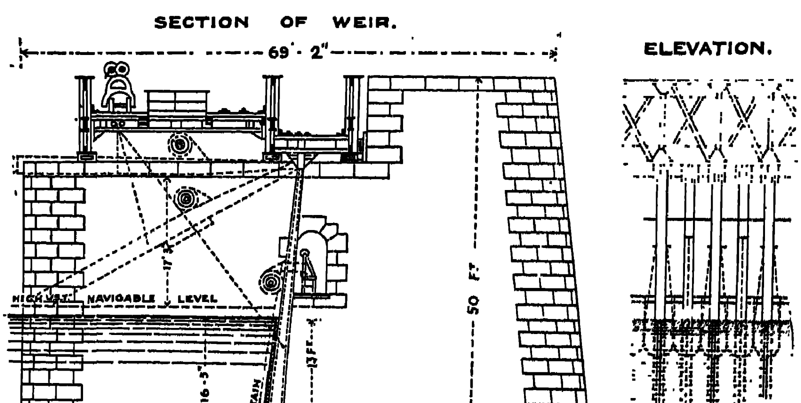


FIG. 5.—Lifting Frame Weir, Poses, River Seine.

and yet ready to be lowered for closing the weir at any time. The foot-bridges across the shallow openings have only to be placed at a sufficient height for the raised frames underneath them to be well above the highest flood-level; but the foot-bridges across the navigable passes, of which there are two at Poses, 106½ feet in width, and five at Port Mort, each about 99 feet wide, have had to be made high enough for the raised frames underneath them to leave a clear headway for vessels of 17¾ feet above the highest navigable water-level (Fig. 5). The merits of this type of weir consist in its ease of working, the security of the movable parts, and its applicability to high weirs; but the high wide piers and the broad foot-bridges necessarily make the system costly.

The drum weirs across the timber passes in the river Main are an extension to deeper channels of the system adopted originally for the shallow portions of the weirs across the river Marne, the depth of water retained by the upper paddle of the Main weirs being 5 feet 7 inches, as compared with 3 feet 7½ inches at the Marne weirs, and the radius of the drum 6 feet 11 inches in place of 4 feet 3 inches. The most notable example, however, of this type is the drum weir, erected at about the same period as the Main weirs, across the navigable pass of the weir constructed for canalizing the river Spree at Charlottenburg.[3] The upper paddle of this weir, 39½ feet wide, retains a depth of 9½ feet of water above it; and the drum in which its lower paddle revolves, on a

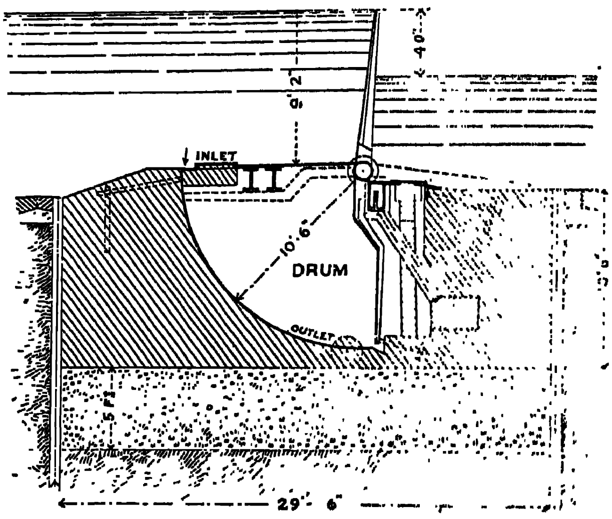


FIG. 6.—Drum Weir, Charlottenburg, River Spree.

horizontal axis common to the two paddles, in opening and closing the weir, has a radius of 10½ feet (Fig. 6). A bridge resting on the abutment of the right bank, and on the river pier of the drum weir, spans the opening closed by the weir, and affords a headway for vessels of slight draught over 11½ feet for nearly the whole width [illegible] high flood-level, which is about 6 feet higher than the normal water-level retained by the weir. The great value of this type of weir is the ease and rapidity with which the weir is not only lowered, but also raised against a very strong current, rendering it peculiarly suitable for regulating the discharge at a weir, and for controlling passes which may have to be frequently and quickly opened and closed. It possesses, however, the serious drawback of the large cost involved in the construction of the drum, which, irrespectively of its foundations, has to be carried down deeper below the sill of the weir than the height of the actual weir formed by the upper paddle. It can therefore be only adopted with advantage where ease and rapidity of working are so essential that the cost is quite a secondary consideration. Accordingly, though drum weirs were first constructed on the river Marne between 1857 and 1867, to provide a movable crest on the top of eleven submerged solid weirs, the system was not extended until much later to the closing of passes under somewhat exceptional conditions in Germany.

A modification, however, of the drum weir for forming a movable crest, 7 feet high, on the top of [illegible] resting upon piles, and raised 11½ feet above the bed of the [illegible] river, a tributary of the Missouri, in connection with its [illegible], has been experimented on with a full-sized model, [illegible] of construction.[4] The weir across the river, adjoining the lock, built

[1] *Encyclopædia Britannica*, 9th edition, p. 575, and Plate V. Fig. 7.

[2] "The River Seine," L. F. Vernon-Harcourt, *Proc. Inst. C.E.* vol. lxxxiv. pp. 234 and 236, and plate 3.

[3] "Die Stauanlage in der Spree bei Charlottenburg," F. Mohr, *Zeitschrift für Bauwesen*, 1886, p. 338, and plates 31 and 32.

[4] *Report of the Chief of Engineers*, 1897, Part vi. Appendix WW, "Report of the Missouri River Commission," pp. 3917 and 3919; and 1898, Part vi. Appendix YY, pp. 3471 and 3516 and plate.

close alongside the left bank, consists of ten bays, each 75 feet in width, separated by masonry piers containing the sluice-ways for connecting the drums with the upper or lower pool. The movable portion of the weir, extending along the crest of each bay, is formed by a sector of a circle, subtending an angle of 67½°, encased all round with close planking, and strengthened internally by iron framing. The sector, which revolves on a horizontal axis along the crest of the solid weir, forms the upper 7 feet of the weir when raised, and, when lowered, fills the drum at the back of the solid weir, which has a radius of nearly 9 feet, and is encased in close planking. A triangular space is left between the underside of the lowered sector and the down-stream vertical face of the concrete weir, through which the water-pressure, developed on opening communication with the upper pool, raises the sector and closes the weir. The completion of the weir was delayed by floods in 1900.

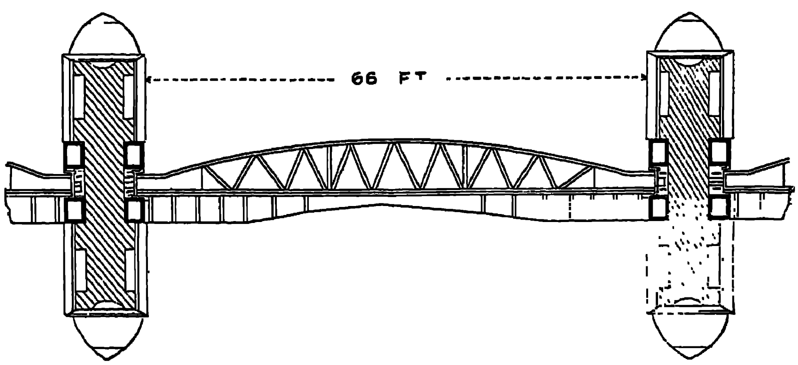


FIG. 9.—Plan of Works at Richmond, Surrey

Richmond weir. The half-tide lifting-gate weir, with overhead foot-bridge, erected across the river Thames at Richmond in 1891–94, may be quite as fairly regarded as a type of movable weir, as the weirs with frames suspended from an overhead foot-bridge at Poses and Port Mort on the Seine. In both cases the overhead bridge forms a necessary fixed adjunct for operating the weir; the river piers carrying the foot-bridge are inevitable obstructions in the channel in flood-time, though of no great importance; and all the movable parts can, in each case, be readily removed from the river, so as to leave the channel unobstructed, with the exception of the piers, and secure the parts themselves from injury during the descent of floods. The openings, indeed, between the piers are wider at the Seine weirs; but, on the other hand, the Richmond weir is much more rapidly opened and closed. It was erected to retain the river at half-tide level between Richmond and the tidal limit at Teddington, so that the unsightly mud-banks which had become exposed at low tide, owing to the considerable lowering of the low-water level resulting from the removal of obstructions and dredging in the channel below, may be always covered with water, without abstracting the whole of the tidal flow and ebb between Richmond and Teddington from the river below. The lifting-gates forming the weir are 12 feet high, and close the three central spans, each 66 feet in width, of the arched double foot-bridge, when the river falls below half-tide level on the down-stream side of the weir (Figs. 7, 8, and 9).[1] The gate, when being lifted, slides in a recess in each pier against a vertical row of free rollers suspended by the loop of a chain attached at one end to the pier and at the other end to the gate, whereby the friction due to the water-pressure against one side of the gate is much reduced. The raising of the gate, weighing 32 tons, is further considerably facilitated by its being counterpoised by weights above (Fig. 8). The discharge of the fresh-water flow of the river, during the lower half of the tide, is provided for by slightly raising the gates above their sills proportionately to the volume of the flow. As soon as the rising tide has reached half-tide level, the gates are lifted out of the water, and on approaching the level of the crown of the arch, are turned by guides in the piers into a horizontal position between the two foot-bridges, so as not to interfere with the view of the river through the arches. Here they remain till the fall of the river again to half-tide level necessitates their being lowered. Each gate can be fully raised in seven minutes by two men on the foot-bridge. The similar weirs erected at Belleek in 1883, and at Ballinasloe in 1885, for controlling the drainage works above them on the rivers Erne and Suck, and enabling works to be carried out to facilitate the discharge of floods, close four openings each, only 30 feet, and 25 feet in width respectively. Their gates are merely raised for the passage of the river water; and the head of water against these weirs, as in all non-tidal rivers, is always on the up-stream side. At Richmond, however, though the head of water against which the much wider gates there have to be raised is usually considerably less than at Belleek and Ballinasloe, the water-pressure may be on the down-stream side with a rising tide. On this account, free rollers have had to be provided on both sides of the gates; and the complete raising and lowering of the Richmond weir gates is a daily operation, except during floods and at night.

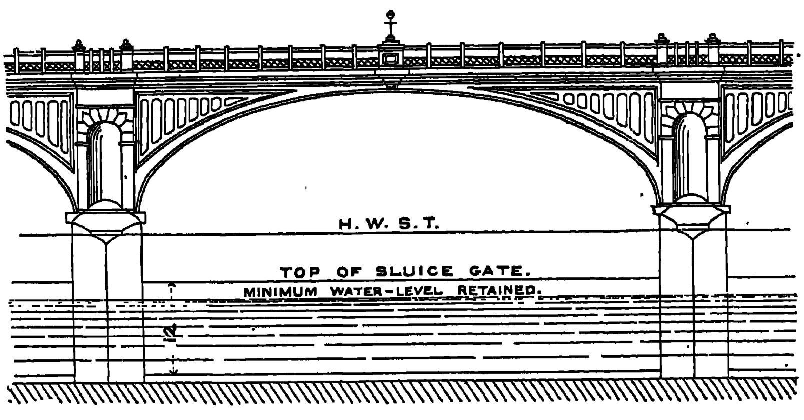


FIG. 7.—Lifting-gate Weir and Foot-bridge at Richmond, Surrey.

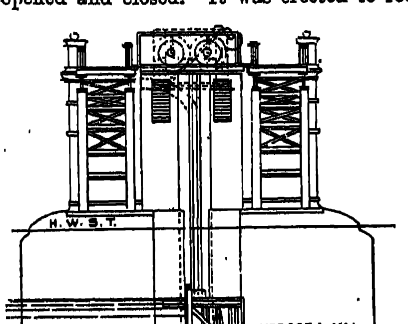


FIG. 8.—Mechanism of Lifting-gate, Richmond.

Outlets of Tideless Rivers.

The success which resulted at the Sulina mouth of the Danube, and at the South Pass outlet of the Mississippi, from the concentration of the discharge by the formation of parallel jetties, extending beyond these outlets towards their bars, which were considerably lowered by the induced scour over the shoals, has been previously described.[2] The period, however, which has elapsed since the jetty works were carried out enables a more accurate view to be formed of the prospects of the continuance of the improved depth over the bars in front of these outlets, and to determine whether an extension of the jetties is likely to be required in the near future, either at the navigable outlet of the Danube, or the Mississippi. The prolongation of the current of a sediment-bearing river farther out into a tideless sea, by extending parallel jetties beyond its outlet, does not merely lower the bar in front of the outlet by scour, but also enables the issuing current to convey the materials with which it is charged into deeper water. Here the continual accumulation of deposit takes much longer to rise to a sufficient height to impede navigation,

[1] *Engineering*, vol. lxi. p. 47, and plate.

[2] *Encyclopædia Britannica*, 9th edition, vol. xx. pp. 580–581, and Plate V. Figs. 19 to 23.

and sometimes brings the suspended matter within the influence of a littoral current which occasionally flows across in front of the outlet at a short distance from the shore. The rate of advance of a delta depends upon the volume and density of the materials brought down by the river, the depth of the sea in front of the outlet, and any disturbing influences which may be encountered in the sea outside, such as a littoral current or wave-action.

Sulina Outlet of Danube. The Sulina jetties extending the outlet of the Sulina branch of the Danube beyond the coast into the Black Sea, which increased the depth in the navigable channel over the bar from 10 feet to 20 feet by the scour alone of the concentrated current, maintained this latter depth up to 1894, when dredging with a bucket-ladder dredger was carried out in the shoal parts of the channel between and beyond the jetties. The available depth was thus increased to 24 feet by the autumn of 1895, in spite of deposits which necessarily occurred from the alluvium brought down by the floods of the river. Notwithstanding, however, the remarkable maintenance of the depth obtained by works completed about 1870, and the facility with which the depth has been increased by dredging, a comparison of the charts of 1856 and 1894 shows that though the inevitable accumulations of deposit have not hitherto affected the available depth of the navigable channel, their influence on the depth of the sea at some distance in front of the Sulina outlet is clearly manifested by the steady advance seawards of the 5-fathom line, which amounted to an average of 59 yards a year between 1856 and 1894.[1] The shoaling, indeed, is somewhat slow, owing to the lightness of the alluvium brought down by the Danube, and to this alluvium being brought under the influence of a southerly littoral current, and it has mostly taken place in greater depths than the shallowest part of the navigable channel; but the deposits, which have been considerable in depths of between 3 and 5 fathoms, will, in course of time, raise the shoals to a height inconvenient for navigation, and necessitate an extension of the jetties. Moreover, it has been calculated that the Sulina mouth will, in about 170 years, come within the zone of the large deposits of the rapidly advancing Kilia outlets to the north of Sulina.

South Pass outlet of Mississippi. The parallel jetties, 1000 feet apart, extending from the outlet of the South Pass of the Mississippi into the Gulf of Mexico, which increased the maximum available depth at the outlet from 8 feet in 1875 to 31 feet in 1880, have not been able to maintain the stipulated depth of 26 feet, for a width of 200 feet, and a central depth of 30 feet quite continuously, either in the jetty channel itself, or outside to deep water in the gulf. Up to the middle of 1898 there had been a

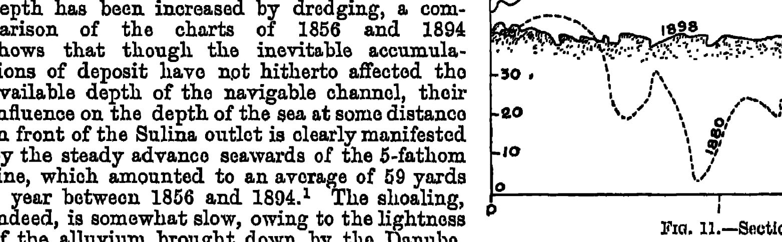


Fig. 10.—Plan of Jetties, South Pass Outlet, Mississippi River.

deficiency of depth in the jetty channel on 309 days, and outside on 44 days, during a period of about 17½ years.[2] Efforts have been made to secure the required depth in the jetty channel by narrowing the channel to a width of about 650 feet by inner jetties, with some projecting spurs effecting a further reduction in width of about 50 feet (Fig. 10), and also by dredging, which has, moreover, been employed to a small extent for deepening the outer channel. In the year 1897–98 dredging was carried on during 50 days in the jetty channel, and 5 days in the channel outside, and the proper depth appears to have been maintained during the year, except for 4 days in the jetty channel; but in the previous year there was a deficiency of depth during 133 days in the jetty channel, and during 4 days outside. The jetty works, accordingly, which produced such a large increase in depth at the outlet of the South Pass, have been unable to maintain the depth for twenty years after their completion. The changes which have occurred at the outlet are indicated by the plan showing the lines of soundings in front of the outlet in 1883 and 1898 (Fig. 10); and by longitudinal sections of the jetty and outer channels, in 1875 before the commencement of the jetty works, in 1880 after their completion, and in 1898 (Fig. 11). Deposit from the river is evidently taking place in front of the outlet, being shown upon the plan by the advance of the lines of soundings since 1883, and by the relative depths on the section in 1880 and 1898. The greatest advance occurred at the 70-feet line of soundings, amounting to 2154 feet between 1877 and 1897, and averaging 108 feet a year; whilst the 20-feet line of soundings shows the least advance of 655 feet, or an average of 33 feet a year. In a fan-shaped area of 1½ square miles, extending out about 5300 feet from the

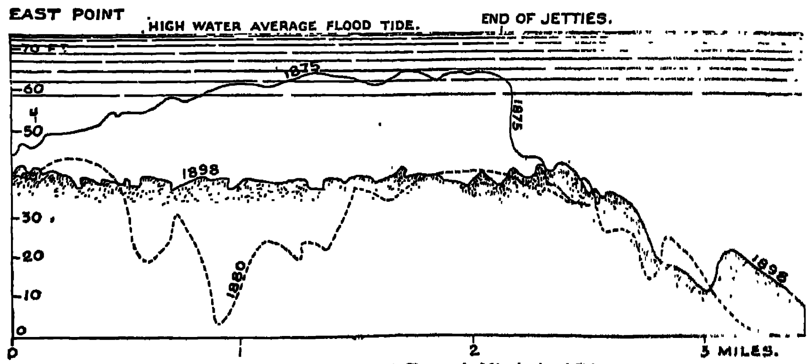


Fig. 11.—Section of Outlet Channel, Mississippi River.

extremities of the jetties, there has been an average reduction in depth all over of 17½ feet between 1876 and 1899, the accretion being slight near the jetty channel, except on the western side, and greatest in the outer zone.[3] The outer 30-feet channel is already somewhat narrow, and is deflected to the east of the jetty channel; and considering the large quantities of alluvium which are being deposited in the outer channel about a mile beyond the jetties (Fig. 11), it seems probable that though the central 30 feet in depth may be maintained for some little time longer by the aid of dredging, an extension of the jetties will be necessary to carry a channel of the required depth across the bar in process of formation again beyond the outlet.

Outlets of Volga. Great difficulties have been experienced in the attempts to improve the depth at the outlets of the two main branches of the Volga delta, owing to the great width of the shoals obstructing these channels, the shallowness of the Caspian Sea in front of the mouths of the Volga, resulting in the rapid advance of the delta, and the exposed position of the outlets. Many years ago an endeavour was made to improve the outlet of the smaller Kamysiak branch, by concentrating the discharge in one of its outlet channels by a discontinuous line of fascine mattresses on each side, and closing the minor outlets of this branch, and also by dredging to a small extent. These works, however, gave little permanent increase in depth, owing to the discontinuity of the training or jetty works, the injuries they are exposed to from waves and ice, and the shallowness of the foreshore in front of the outlet. Subsequently, the larger Bakhtemir branch was deepened by dredging its shoals along a total length of 5⅜ miles, increasing the available depth at the ordinary water-level from about 4 feet to 8 feet, which latter depth has been maintained for several years; but a further increase of even 1 foot in depth would necessitate dredging through 17 miles of shoals. Accordingly, in order to obtain a deeper channel than 8 feet between Astrakhan and the Caspian, it is proposed to revert to the Kamysiak branch.[4] This possesses an available depth of 14 feet between Astrakhan and its bar, which is only about 1½ miles across; its outlet is much nearer 3 fathoms depth in the Caspian than the Bakhtemir outlet; and its discharge being less, the advance of the delta at its outlet is less than at the other outlet. With a [illegible], it is anticipated that the depth on the Kamysiak bar [illegible]

[1] "The Sulina Mouth of the Danube," C. H. L. Kühl, *Proc. Inst. C.E.* vol. xci. p. 329, and plates 3 and 4; and "The Survey of the Delta of the Danube in 1894," *Proc. Inst. C.E.* vol. cxxii. pp. 339–341.

[2] *Report of the Chief of Engineers*, 1898, part ii. appendix i., "Improvement of the South Pass of the Mississippi River," pp. 1447 and 1451, and plates 1 and 2.

[3] *Report of the Chief of Engineers*, 1898, pp. 1459 and 1460; and 1900, p. 2237, and charts 1 and 2.

[4] "Les embouchures du Volga," V. E. de Timonoff, *Vme. Congrès International de Navigation Intérieure.*

from $4\frac{1}{2}$ feet to 14 feet, and maintained without difficulty, so as to provide an available depth of 14 feet between Astrakhan and the sea.

When a considerable increase in depth is required across the bar of one of the deltaic outlets of a tideless river, it must be obtained by the construction of parallel jetties extending out towards the bar, whereby the concentrated current scours a channel through the bar. A small additional increase in the depth of the outlet channel thus formed may sometimes be obtained, or the original depth maintained, by dredging across narrow shoals which occasion a reduction in the available depth. Eventually, however, the continual deposits of alluvium brought down by the river in the sea in front of the outlet will lead to the reappearance of the bar farther out, which, owing to the volume of the accretions in the sea formed by large sediment-bearing rivers, can only be prevented from impeding navigation by a prolongation of the jetties, resulting in the formation of a deep channel across the bar for another period. Where the sea is shallow in front of a deltaic outlet, and the river current feeble, the conditions are not favourable for an improvement of depth by parallel jetties; but, provided the shoals obstructing the outlet channel are not very wide, and the proportion of sediment brought down not very great, a moderate increase in depth may be obtained by large and continuous dredging operations.

The Improvement of Tidal Rivers.

Since the size and depth of tidal rivers mainly depend on the volume of tidal water entering the river, especially when the tidal rise is large and the fresh-water discharge small, the maintenance or, where practicable, an increase of the tidal volume constitutes a primary consideration with regard to any proposed improvement works in the tidal portions of rivers.

The tidal condition of any river is very well shown graphically, by a series of simultaneous tidal lines, obtained from simultaneous observations of its varying height, taken at several stations along the river, at suitable intervals, throughout a whole tide; for when these respective sets of heights are plotted at their relative distances apart, and joined by lines, these simultaneous tidal lines represent the actual surface of the river at the particular times when the observations were made (Fig. 12). The passage of a tide up and down a river is thereby clearly indicated, and any irregularities in the flow are manifested; while the lines enable the volume of

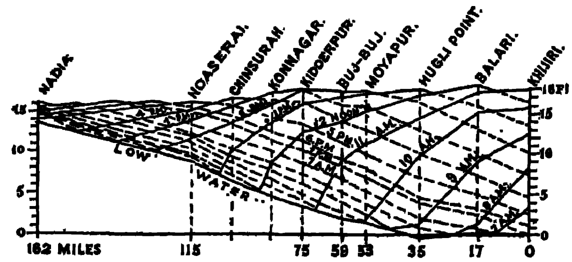


FIG. 12.—Simultaneous Tidal Lines, River Húgli.

tidal water entering a river to be calculated. Simultaneous tidal lines of the river Húgli, derived from tidal observations made throughout a spring tide during the dry season, at several stations along the river, from near the mouth of the estuary up to Nadia, only about 5 miles below the tidal limit, a distance of 162 miles, are given in Fig. 12, in which the vertical scale has been made very much larger than the horizontal to magnify adequately the variations in the water-level at different periods of the tide. The full lines in the diagram show the successive levels of the flood tide, and the dotted lines the levels of the ebb tide.

Tidal bores.

The appearance of a nearly vertical face at the upper end of the simultaneous lines representing an incoming tide, as visible (Fig. 13) to some extent opposite Moyapur, and more marked at Konnagar and Chinsurah, indicates that the flood tide encounters obstructions to its progress along this portion of the river, leading to the formation of a *bore*. This phenomenon occurs when the flood tide at the

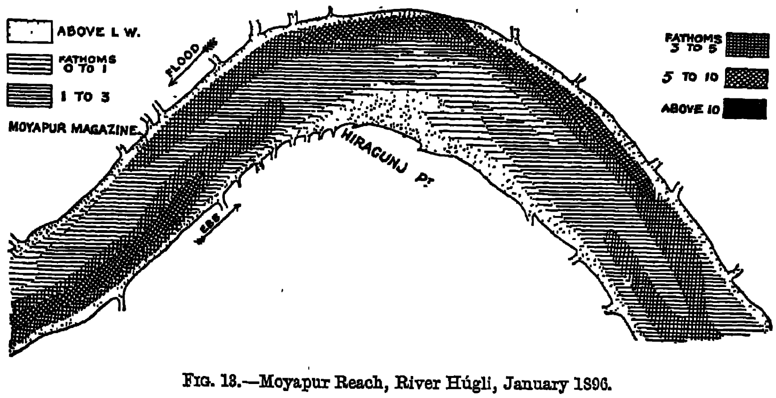


FIG. 13.—Moyapur Reach, River Húgli, January 1896.

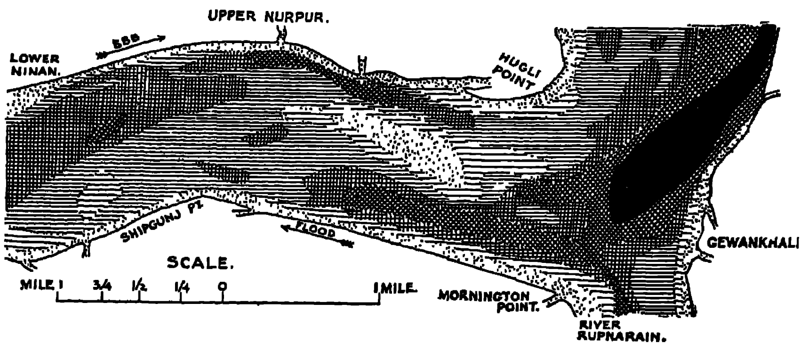


FIG. 14.—James and Mary Reach, River Húgli, April 1890.

height of springs, especially when raised by a narrowing river and impelled by wind, in flowing rapidly up the channel is checked by shoals, till the tide rising behind gains a sufficient head to overcome the frictional resistance and impel the water over the shoal. Under these conditions, the earliest part of the flood tide travels up the river like a breaking wave with an almost vertical face, producing on its passage an instantaneous reversal of the current and a sudden rise of the river. Bores of 6 to 7 feet in height have been often observed on the Severn, the Seine, and the Húgli; whilst bores of 10 to 15 feet high are said to have passed up the Amazon and the Tsientang-kiang. By lowering the obstructive shoals by training works or dredging, the passage of the flood tide is facilitated, and the bore consequently reduced in height; and at the same time the navigable channel is improved, and the tidal condition of the river ameliorated.

Navigable channels.

Tidal rivers in their natural condition have a winding course, accompanied by irregularities in depth; and the gradual erosion of the concave banks at bends often effected by the current, which is followed by accretion in front of the convex banks, aggravates these defects. The main current of the river, flowing in a direct line, when not impeded by any obstacle, impinges against the concave bank opposing its course at a bend, where, being guided and deflected by this bank, it scours out and maintains a deep channel close alongside the bank. At the termination of the concavity of the bank at the end of the bend, the current being no longer controlled, passes in a straight direction diagonally across the river to the following concave bank facing its path at the next bend. Deep channels are consequently always found alongside the concave banks of a winding river; but the main current being perfectly free in crossing over from one concave bank to the next on the opposite side, spreads out and varies somewhat in direction, in accordance with changes in its velocity and obstacles encountered, so that its scouring influence becomes irregular and much reduced at the crossing, and the navigable channel is shallow, and liable to shift somewhat between the bends. Where scour occurs at the concave bank, the further deterioration of the river should be prevented

by protecting these banks from erosion with suitable materials, or by putting out dipping cross dykes to direct the force of the current away from the bank into a more central channel. In rivers above the tidal limit, the shoals in the channel between the bends can be lowered by narrowing the river at these places, so as to direct and concentrate the current at the crossing, and thereby increase its scour, and deepen the channel.

The improvement of the navigable channel between bends in a tidal river is a more complicated problem, because in this case an adequate narrowing of the channel between the bends would check the influx of the tide; and the flood and ebb tides, flowing in opposite directions, tend to follow a different course along opposite banks between the bends, and to form, consequently, two distinct channels. The main currents, accordingly, of the flood and ebb are liable to act in antagonism; and where they pass alongside opposite banks, the gradual erosion of both these banks leads to a widening of the river, and an increasing divergence of the channels formed by the flood and ebb currents respectively. The result is the growth of a central shoal between the channels at the crossing, which reduces the available depth for vessels (Figs. 13 and 14). The ebb tide and the fresh-water discharge, constituting the descending current, necessarily follow the same course as the downward current of a non-tidal river, and generally form the navigable channel, especially when the fresh-water discharge is large; whereas the ascending flood tide takes a somewhat straighter course, and tends to form blind channels in the shoals between the bends, nearer the convex banks than the ebb-tide channel. Eventually, however, the two main currents of ebb and flood both come, at different points, into the deep channel alongside each concave bank.

The divergent channels formed by the ebb and flood tides, in cases where the flood tide has the predominance during a portion of the year, owing to the smallness of the fresh-water discharge in the dry season, are very clearly exhibited on the low-water charts in the dry season of the two worst crossings on the river Húgli below Calcutta, given in Figs. 13 and 14.[1] At the Moyapur crossing (Fig. 13), the main current of the ebb tide forms a deep channel along the concave right bank almost down to Hiragunj Point; and when the right bank, becoming convex, turns away from the direction of the ebb current, this current disperses, and passing over a shoal which it is no longer concentrated enough to scour, it finally reaches the opposite bank near the centre of the bend, whence, being guided by the concave left bank, it runs in a deep channel along this bank to the next change of curvature. The main flood-tide current, on the other hand, coming along the right bank from the bend below, after forming some blind channels towards this side, passes on to the left bank, over a shoal projecting from the point near the centre of the bend, which it follows in a deep channel to the change of curvature above, where the current is dispersed and the deep channel ceases. In the James and Mary reach (Fig. 14), the main ebb current follows the concave left bank till the curving away of this bank towards Húgli Point leaves the current undirected, which results in the spreading out of the current and the consequent disappearance of the deep channel in passing on towards the opposite bank. The main flood-tide current runs up from below along the right bank opposite Húgli Point, at right angles to the ebb-tide channel which it silts up more or less at the extremity in the dry season; and passing round the sharp concave bend of the right bank, it is at length dispersed on approaching Shipgunj Point in the centre of the bend; and the deep channel formed by its scour alongside the right bank terminates in a shoal. The extent of the deep ebb- and flood-tide channels, and the depth over the dividing shoal, vary according to the changes in the relative scouring power of the ebb and flood currents at the different seasons of the year, and the volume and duration of the floods passing down in the rainy season; but the gradual widening of the two reaches, by erosion along both banks, has led to a reduction in the depth over the crossings at the worst periods, and to the appearance in the middle of the James and Mary reach, since 1865, of a sandbank which dries at low water of spring tides in the dry season, and by its growth has still farther separated the ebb- and flood-tide channels.

In winding tidal rivers, where the descending current predominates, and forms a continuous low-water channel which serves as the navigable channel, the diverging action of the flood tide in forming blind channels between the bends, may be mitigated by widening and deepening the ebb-tide channel at the place where the flood-tide channel diverges, and on the side to which it deviates. In this way the influx of the flood tide into the enlarged ebb-tide channel is facilitated, and its flow diverted from the blind channels without impeding its progress up the river, and, consequently, without reducing the tidal capacity, upon the preservation of which the maintenance of tidal rivers largely depends.

Tidal rivers in tropical countries are subject to much greater variations in their conditions of flow than those in temperate regions; for during the rainy season the downward current overpowers the tidal influx in the upper tidal part, the rise of tide at some distance from the outlet being merely due to the backing-up of the fresh-water discharge, and the deep channel corresponds to that formed by the current of a non-tidal river. During the dry season, on the contrary, the fresh-water discharge becomes so insignificant that the rivers depend almost wholly for their maintenance on the flow and ebb of the flood tide. Moreover, the fresh-water discharge is obliged to obtain an outlet to the sea; whereas the flood tide only flows up a river where space is available for its reception; and therefore for those rivers whose maintenance depends on the flood tide for a portion of the year, no

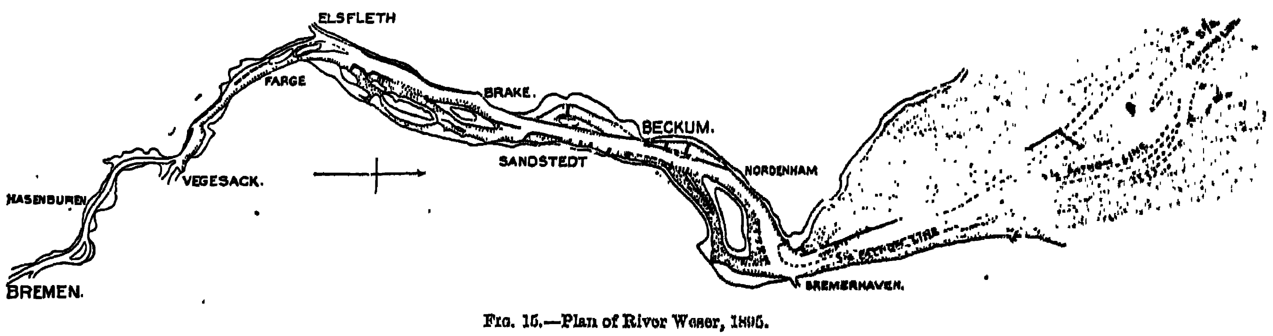


FIG. 15.—Plan of River Weser, 1895.

works should be undertaken which might impede its influx, and every effort should be directed to facilitating its progress. The improvement, accordingly, of winding rivers under these conditions, such, for instance, as the Húgli, which depends on the tidal flow and ebb for its maintenance during about two-thirds of the year, should aim at guiding the descending current by a very low concave training wall, forming a somewhat projecting continuation of the concave bank alongside which this current flows, into the flood-tide channel on the opposite side at a crossing, as proposed for lowering the shoals at Moyapur, and the James and Mary reach.[2] By this arrangement, the freshets in the rainy season would scour out a channel across the shoal at the crossing, and maintain the down-stream part of the flood-tide channel along the opposite bank, which they otherwise would silt up; and thus whilst the incoming flood tide, on the subsidence of the freshets, would not be impeded by the low training wall, submerged at, or even below, the lowest low water, on the land side of the ebb-tide channel, it would find a continuous channel prepared for it by the freshets whereby its progress up the river would be facilitated; and thus both the tidal condition and the navigable depth of the river would be improved.

Regulation of the Weser.

Occasionally the systematic regulation of a tidal river of moderate size has been undertaken between a town of importance on its banks and its outlet into the sea or its estuary, with the object of improving its navigable condition for sea-going vessels, instead of confining the improvement works to special obstructions in the channel, which is all that can be attempted in large rivers. Two instances of the regulation of tidal rivers, by aid of training works and dredging, are furnished by the works on the river Weser between Bremen and Bremerhaven, carried out for the most part between 1887 and 1891, though the channel has been subsequently further deepened by dredging, and on the river Nervion, on a smaller scale, between Bilbao and the sea from 1878 to 1891.

The river Weser, draining an area of 18,600 square miles, and with an average tidal rise at its outlet into its estuary at Bremerhaven of nearly 11 feet, had formerly a very irregular channel,

[1] *Report on the River Húgli*, L. F. Vernon-Harcourt, Calcutta, 1897, plan 6, fig. 3, and plan 7, fig. 2.

[2] *Ibid.*, pp. 89 to 94, and plan 6, fig. 3, and plan 7, fig. 4.

obstructed in many places along the lower 31 miles by islands, and by shoals emerging at low water, which so impeded the influx of the flood tide that the tidal limit was reached at Bremen, 42 miles above Bremerhaven, the available navigable depth up to Bremen being only 9 feet. The river has been trained from Bremen downwards, by 22¾ miles of training walls, and 9½ miles of cross dykes and dams, into a single straightened channel increasing regularly in width seawards.[1] Thus the flood tide is freely admitted up the river; and uniformity of flow is obtained, so as to avoid the formation of shoals by a reduction at places in the velocity of the current (Fig. 15). The low-water channel was made as small as practicable consistently with providing for the discharge of the low-water flow, in order to maintain its depth and regulate its flow; and where necessary it has been trained by low-water training walls of fascine mattresses, backed by materials dredged from the channel. The high-water channel has been left as large as possible, in order to maintain the tidal capacity, and thus by reinforcing the scour of the ebb to preserve the depth of the low-water channel. By these works, together with over 40 million cubic yards removed by dredging, the navigable depth up to Bremen has been increased to 16½ feet (Fig. 16), the volume of tidal water entering and leaving the river has been materially augmented by the lowering of the low-water line, the tidal limit has been extended about 5 miles above Bremen, the discharge of floods has been accelerated, and the liability of the river to be blocked by ice has been diminished owing to the increased tidal flow and ebb. The navigable depth is eventually to be increased to 22 feet by dredging.

The river Nervion has similarly had its channel straightened and deepened between Bilbao and its mouth, a distance of nearly 8 miles, by training works. These works have enlarged the width from 210 feet at Bilbao to 525 feet at the outlet (Fig. 17); have facilitated the influx of the tide, which has an average rise of 9 feet at the mouth of the river; and have increased the navigable depth in the channel up to the port of Bilbao by about 7 feet, thereby providing a minimum depth of 12 feet at the lowest low water.[2]

Improvement of outlets.

It has previously been stated that a bar often obstructs the outlets of tidal rivers, because the heaping-up action of the sea, aided by the drift of sand and shingle along the coast under the influence of the prevailing winds, tends to form a continuous beach across their mouth;[3] and some account has been given of the jetties constructed at the outlets of certain tidal rivers for lowering their bars.[4] The works, however, carried out for improving the outlets of the Weser, the Nervion, and the Mersey possess certain novel features rendering them worthy of notice.

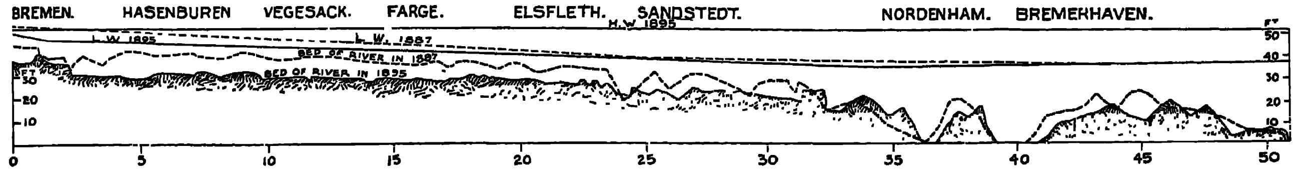


Fig. 16.—Longitudinal Section of the River Weser.

The river Weser on passing Bremerhaven emerges into a wide estuary encumbered by sandbanks rising above low water; but the channel in the estuary, instead of being carried through the estuary between two training walls, is guided by a single fascine mattress training wall forming a continuation of the left bank of the river at low-water level, 3⅝ miles long. This, with the adjacent shore line opposite, provides an expanding outlet for the river through the upper part of the estuary. Secondary and side channels farther down the estuary have been closed, in order to concentrate the scour in the main channel; and the outlet channel is to be further deepened by dredging, aided, if necessary, by an extension of the training wall (Fig. 15).

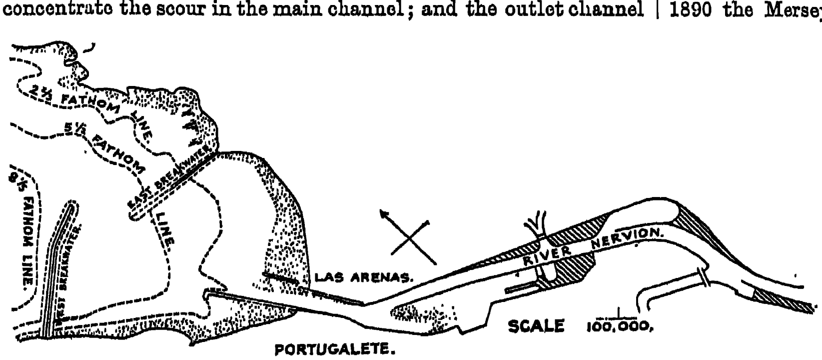


Fig. 17.—Plan of Outlet, River Nervion

As the outlet of the river Nervion was fully exposed to the waves of the Bay of Biscay, the sea had heaped up a bar across it, with an available depth of only 4½ feet over it at the lowest tides. This bar has been removed by the scour of the river guided between two jetties carried out from the shore on each side of the outlet, and by the concave prolongation of the western jetty, aided by dredging, so that a depth of 15⅝ feet has been secured in the outlet channel (Fig. 17). In order to prevent the obstruction of the improved outlet by drift during north-westerly storms, and to provide a sheltered approach to the river for vessels on that very exposed coast, two breakwaters are being constructed projecting from the coast on each side of the mouth of the river, and converging together so as to provide a harbour in which vessels will be fully protected,[5] and from which they can pass into the river in perfect safety (Figs. 17 and 18).

The bar of the river Mersey is about 11 miles seawards of the actual mouth of the river at New Brighton; and this fact, combined with the configuration of the adjacent coast and the exposure of the site, prevented any attempt from being made to lower the bar by the concentrated tidal scour which would be produced by carrying out longitudinal or converging solid jetties or breakwaters from the shore to the site of the bar. Accordingly, up to 1890 the Mersey bar remained in its natural condition, with a depth in the main channel across it of only 10 to 11 feet at low water of spring tides, under ordinary conditions, thereby causing delay to vessels of large draught in getting up to Liverpool. In 1890, however, two sand-pump dredgers were tried for the first time for lowering the bar. This system had been successfully employed in a considerable deepening of the approach channel across a sandy foreshore of the open sea, at Dunkirk since 1876, and at Calais since 1881, and had effected an increase in the depth of the approach to Ostend harbour from 6½ feet at low water of spring tides in 1880 up to 20½ feet in 1884; whilst the dredging of Gedney's Channel at the entrance to New York harbour, undertaken in 1885, had eventually increased the navigable depth from 24 feet up to 30 feet at low water for a width of 1000 feet. These sand-pump dredgers, which were able to raise and load themselves with 500 tons of sand in between 20 minutes and 1 hour, according to the conditions, increased the minimum depth in the channel across the Mersey bar from 11 feet in 1890 to 18 feet at low water of spring tides by the beginning of 1892; but the dredging

Fig. 18.—Section of West Breakwater, River Nervion.

done by them in 1892 and 1893 only widened the channel, without increasing its depth.[6] In 1893, however, a large specially-built sand-pump dredger was set to work, with hoppers capable of holding 3000 tons of sand, which the sand-pump is able to fill in

[1] "L'Amélioration des Fleuves dans leur partie maritime, &c.," L. Franzius, *Congrès International de Navigation Intérieure*, Paris, 1892; and "River, Harbour, and Canal Works in Germany," L. Franzius and G. H. de Thierry, *Proc. Inst. C.E.* vol. cxxxv. p. 224, and plate 5, figs. 4 and 5.

[2] *Memoria que manifesta el Estado y Progreso de las obras de mejora de la Rio de Bilbao*, 1879–91. E. de Churruca, Bilbao, 1899.

[3] *Encyclopædia Britannica*, 9th edition, vol. xx. pp. 575–576.

[4] *Ibid.* p. 577, and plate 5.

[5] *Memoria que manifesta el Estado y Progreso de las obras de mejora de la Rio de Bilbao*, 1879–91. E. de Churruca, Bilbao, 1899.

[6] "Dredging Operations on the Mersey Bar," A. G. Lyster, International Maritime Congress, London, 1893, *Proc. of Section I.* p. 50.

between half and three-quarters of an hour;[1] and a second similar dredger was added in 1895, to aid or replace the first in the event of a breakdown, though work is generally carried on in the bar channel with only one of the dredgers. By means of this increase of the dredging plant, the depth in the bar channel was increased in two years, by the middle of 1895, from a minimum of 18 feet to 23 feet, and from an average of 20½ feet to 24½ feet over a width of 1500 feet[2]; and these depths were further increased by the middle of 1899 to a minimum of 27 feet, and an average of 28 feet for the same width, by the removal, since 1890, of over 41 million tons of sand from the bar and inner shoals, 29 million tons of which were raised in the last four years of the period.[3] These dredging operations have enabled vessels of large draught to cross the bar at any state of the tide. A greater depth of channel could be obtained if necessary, though it would involve the removal of an increasing amount of sand for each increment of depth gained. The deepening of the bar channel has caused an additional volume of tidal water to be drawn into it from other outlets in the estuary, which will assist in maintaining the channel; but dredging will always be necessary to preserve the depth attained.

Working models and experimental channels have been occasionally employed for investigating the movements of water, and their effects on an unstable bed.

Probably the first model exhibiting the ebb and flow of tide in an estuary was the one made of the inner Mersey estuary in 1885, with the object of indicating that the slight regulation in places of the Cheshire shore of the inner estuary between Runcorn and Eastham, proposed at that time for the Manchester ship-canal, and subsequently carried out closer inshore, would produce no appreciable effect on the tidal condition of the estuary. After the water-level had been raised and lowered many times in succession at the outer extremity of the model, producing the effect of a number of tides, a very fair resemblance in miniature to the channels and banks of the inner Mersey estuary at low water was obtained in the sandy bed of the model.[4] In 1886 a working model of the Seine from its tidal limit to the sea beyond its estuary was constructed, with the object of ascertaining whether the accretion caused by training walls in a tidal estuary encumbered with sand could be reproduced in a model, and the effects, accordingly, of the various schemes which had been proposed for the prolongation of the Seine training works in its estuary could be determined. After various substances had been tried for forming the bed of the model, an extremely fine clean sand mixed with peat was employed. A previous condition of the Seine estuary, as recorded on a chart of 1834 before any training works had been commenced, was eventually very fairly reproduced in the model, in which the tidal flow and ebb, with a period of 25 seconds and a range of 0·71 inch, were effected by the tipping of a hinged tray of suitable size fixed to the outer end of the model, at the proper angle for the current produced to correspond with the direction of the tidal propagation at the entrance to the Seine. The fresh-water discharge was supplied from a little cistern at the upper end of the model.[5] The well-known bore, moreover, of the Seine, which attains its maximum at Caudebec, and also the reverse current, or second tide, which occurs just before high water at Havre, were clearly visible when the model was worked. The lines of the existing training walls in the Seine estuary were then inserted, in the form of strips of tin in the model; and the accretion caused by them in the Seine estuary having been reproduced after the action of a large number of miniature tides, the various lines proposed for the extension of the training works seawards were successively introduced, and their several effects on the estuary recorded on low-water charts. On the completion of these experiments with the Seine model at the end of 1888, similar investigations were made with a model of the Mersey, extending from the tidal limit right out into Liverpool bay beyond the bar. These furnished interesting results as to the effects of training works in the inner and outer parts of an estuary very different in form from that of the Seine.[6]

Model experiments.

These investigations appear to prove the feasibility of testing the effects of training works in a sandy estuary by means of working models. Engineers will thus be enabled to avoid works which might result in the deterioration of a tidal estuary, and to select with confidence beforehand the particular scheme which affords the best prospects of a successful issue.

Additional information about river engineering and subjects connected with it will be found in the following books and papers: L. F. VERNON-HARCOURT. *Rivers and Canals*, 2nd edition, 1896.—*Civil Engineering as applied in Construction*, 1902, Part iii. pp. 325–383.—"The River Seine," *Proc. Inst. C.E.* vol. lxxxvi. p. 210, and vol. cxlv. p. 303; "Canal and River Works in France, Belgium, and Germany," *Proc. Inst. C.E.* vol. xcvi. p. 182; "The Training of Rivers," *Proc. Inst. C.E.* vol. cxviii. p. 1; "Maritime Navigation Works in Belgium," *Proc. Inst. C.E.* vol. cxxxvi. p. 282. "Delta of the Danube," *Proc. Inst. C.E.* vol. cxxii. p. 336. "La Canalisation des Rivières et les divers Systèmes de Barrages Mobiles," *Congrès International de l'Utilisation des Eaux Fluviales*, 1889, p. 174. "Report on the River Húgli," Calcutta, 1897.—Major S. S. LEACH, U.S.A. "Inland Navigation in the United States," *Proc. Inst. C.E.* vol. cxxix. p. 247.—B. F. THOMAS. "Movable Dams," *Trans. Am. Soc. of C.E.* vol. xxxix. p. 431.—A. GUÉRARD. "Mouth of the River Rhône," *Proc. Inst. C.E.* vol. lxxxii. p. 305.—C. H. L. KÜHL. "Sulina Mouth of the Danube," and "Sulina Branch of the Danube," *Proc. Inst. C.E.* vol. xci. p. 329; and vol. cvi. p. 238.—*Annual Reports of the Chief of Engineers U.S. Army*.—P. GUILLEMAIN. *Rivières et Canaux*. Paris, 1885.—E. LAVOINNE. *La Seine maritime et son Estuaire*. Paris, 1885.—L. FRANZIUS. *Der Wasserbau*. Berlin, 1890.—W. H. WHEELER. *Tidal Rivers*. 1893.—"Reports and Proceedings of International Navigation Congresses," Brussels, 1885; Vienna, 1886; Frankfort-on-the-Main, 1888; Manchester, 1890; Paris, 1892; The Hague, 1894; Brussels, 1898; and Paris, 1900. "Reports of the Committee appointed to investigate the Action of Waves and Currents on the Beds and Foreshores of Estuaries by means of Working Models," *Brit. Assoc. Reports*, 1889, p. 327, and plates 1 to 9; 1890, p. 512, and plates 1 to 18; and 1891, p. 386, and plates 2 to 14. (L. F. V.-H.)

Rivers, Anthony de Wydeville, or WOODVILLE, 2ND EARL OF (1442–1483), an enlightened statesman and patron of literature, and author of the first book printed on English soil, was the son of Richard de Wydeville (1408?–1469) and his wife, Jacquetta de Luxembourg, duchess of Bedford. His father was raised to the peerage in his son's infancy, and was made an earl in 1466. Anthony, who was knighted before he became of age, and fought at Towton Wydeville in 1461, married the daughter of Lord Scales, and became a peer *jure uxoris* in 1462, two years after the death of that nobleman. Being Lord of the Isle of Wight at the time, he was in 1467 appointed one of the ambassadors to treat with the duke of Burgundy, and he exalted his office by challenging the famous Bastard to single fight in what was one of the most famous tournaments of the age. In 1469 Anthony was promoted to be Lieutenant of Calais and Captain of the King's Armada, while holding other honorary posts, and, his father having been beheaded after the battle of Edgecot, he succeeded in August of that year to the earldom. In 1473 he became guardian and governor to the young prince of Wales, and for the next few years there was no man in England of greater responsibility or enjoying more considerable honours in the royal service. It is now that for the first time we become aware of Lord Rivers' literary occupations. His mother, the Duchess, died in 1472, and his first wife in 1473; in 1475 and the following year he went on pilgrimage to the holy places of Italy; from this time forth there was a strong tincture of serious reflection thrown over his character; he was now, as we learn from Caxton, nominated "Defender and Director of the Siege Apostolic for the Pope in England." Caxton had in 1476 rented a shop in the Sanctuary at Westminster, and here had set up a printing-press. The first MS. which he undertook in London was one sent to him by "the noble and puissant lord, Lord Antone, Erle of Ryvyers," consisting of a translation "into right good and fayr Englyssh" of Jean de Teonville's French version of a Latin work, "a glorious

[1] "Dredging Operations on the Mersey Bar," A. Blechynden, *Proc. of Section III.* p. 52.

[2] "Physical and Engineering Features of the River Mersey," G. F. Lyster, *Brit. Assoc. Reports*, 1896, pp. 555–556.

[3] "Sand-pump Dredgers," A. G. Lyster, *Proc. Inst. C.E.* vol. cxxxviii. p. 394.

[4] "On certain Laws relating to the régime of Rivers and Estuaries, and on the possibility of experiments on a small scale," Professor Osborne Reynolds, *Third International Inland Navigation Congress*, Frankfort, 1888, 6th question.

[5] *Proc. Royal Society*, vol. xlv. p. 504, and plates 2 to 4.

[6] *Proc. Royal Society*, vol. xlvii. p. 142; "Rivers and Canals," 2nd edition, vol. i. p. 337, and plate x.; and "Amélioration des Fleuves dans leur partie maritime," &c., L. F. Vernon-Harcourt, *Congrès International de Navigation*, Paris, 1892.

fair mirror to all good Christian people." In 1477 Caxton brought out this book, as *Dictes and Sayengis of the Philosophers*, and it is illustrious as the first production of an English printing-press. To this succeeded the *Moral Proverbs* of Christine de Pisan, in verse, in 1478, and a *Cordial*, in prose, in 1479. The original productions of Lord Rivers, and, in particular, his *Balades against the Seven Deadly Sins*, are lost. In 1478 a marriage was arranged between him and the Princess Margaret, sister of King James III. of Scotland, but it was mysteriously broken off. Rivers began to perceive that it was possible to rise too high for the safety of a subject, and he is now described to us as one who "conceiveth well the mutability and the unstableness of this life." After the death of Edward IV., he became the object of Richard III.'s peculiar enmity, and was beheaded by his orders at Pontefract on the 25th of June 1483. He was succeeded by his son Richard, the third and last earl of the Wydeville family, who died in 1491. Lord Rivers is spoken of by Commines as "un très-gentil chevalier," and by Sir Thomas More as "a right honourable man, as valiant of hand as politic in counsel." His protection and encouragement of Caxton were certainly of inestimable value to English literature, and in the preface to the *Dictes* the printer gives an account of his own relations with the statesman which illustrates the dignity and modesty of Lord Rivers in a very agreeable way. The latter was also one of the purest writers of English prose of his time.

Riverside, a city of California, U.S.A., capital of Riverside county. It is near the southern base of San Bernardino range, on Santa Ana river, and on the Southern California and the Southern Pacific railways, in the southern part of the state, at an altitude of 873 feet. It occupies a level site, has a good water supply and drainage, and is beautifully built up in detached cottages and villas, with ample grounds, containing subtropical plants and trees. The town, which is in a region devoted to the production of oranges, lemons, and other subtropical fruits, and has a large trade in these products, was founded in 1870 by people from New England. Population (1890), 4683; (1900), 7973, of whom 1525 were foreign-born and 195 negroes.

Riviera, the narrow belt of coast which lies between the mountains and the sea all round the Gulf of Genoa in the north of Italy, extending from Nice on the west to Spezia on the east. It is usually spoken of as Riviera di Ponente ("the coast of the setting sun"), the portion between Nice and the city of Genoa; and as Riviera di Levante ("the coast of the rising sun"), the portion from Genoa to Spezia. All this district, being open to the south, and sheltered from the north and east winds, enjoys a remarkably mild climate (winter mean, about 49° Fahr.); so much so that the vegetation in many places partakes of a subtropical character (*e.g.*, the pomegranate, agave, prickly pear, date, palm, and banana). Large numbers of flowers, especially roses, violets, hyacinths, &c., are grown near Nice, Mentone, Bordighera, and other towns, and sent to the London and Paris markets. Bordighera is particularly noted for its noble groves of date-palms, one of the few places in Europe where these trees grow. The uncommon mildness of the climate, conjoined with the natural beauty of the coast scenery—the smother of greenery, the vineyards climbing up the hills, the steep sea-crags, the ruined towers, and in the background the range of the Maritime Alps, often rugged, often snow-capped—attracts thousands of invalids and convalescents to spend the winter in the chain of towns and villages which stretch from the one end of the Riviera to the other. Proceeding from west to east, the following are the places to which visitors principally resort: Nice, Monaco, Monte Carlo, Mentone, Ventimiglia, Bordighera, Ospedaletti, San Remo, Porto Maurizio, Diano Marina, Alassio, Borgio Verezzi, Arenzano (in the Riviera di Ponente), and Nervi, Rapallo, Santa Margherita, Chiavari, Spezia, and San Terenzo (Lerici) in the Riviera di Levante. The Riviera labours, however, under the grave drawback of being liable to earthquakes. In the 19th century there were four such visitations—in 1818, 1831, 1854, and 1887. A railway runs close along the shore all through the Riviera, the distance from Nice to Genoa being 116 miles, and the distance from Genoa to Spezia 55 miles. In the latter stretch the line burrows through the many projecting headlands, which ripple the coast, by means of more than 80 tunnels. Several distinguished men have been born along the Riviera di Ponente—Columbus, Popes Julius II. and Sixtus IV., the Roman emperor Proculus, the Genoese admiral Andrea Doria, the great soldier Masséna, the poet Chiabrera, Paganini the violinist, and Gambetta. Genoa, Sestri Ponente, and Savona, on this same coast, are places of exceptional industrial activity, especially in shipbuilding and other iron industries (see Liguria). The pearl of the eastern Riviera is the stretch (6 to 7 miles) between Rapallo and Chiavari. Lord Byron and Shelley both lived and wrote on the shores of the Gulf of Spezia —and Dickens wrote *The Chimes* at Genoa. Spezia itself is the seat of the chief arsenal and shipbuilding yards of the Italian navy. Francis I. of France was detained for some time at Portofino (peninsula of Rapallo) after being taken captive at Pavia by the Emperor Charles V. in 1525; and in the same neighbourhood is a burial-place of the house of Doria. Lavagna was the ancestral seat of the Fieschi family, known as having produced one Pope, Innocent IV., and from Schiller's play. The women of Rapallo and Santa Margherita are famous lace-makers.

Riviere, Briton (1840- ——), English artist, was born in London on 14th August 1840. His father, William Riviere, was for some years drawing-master at Cheltenham College, and afterwards an art teacher at Oxford. He was educated at Cheltenham College and at Oxford, where he took his degree in 1867. For his art training he was indebted almost entirely to his father, and early in life made for himself a place of importance among the artists of his time. His first pictures appeared at the British Institution, and in 1857 he exhibited three works at the Royal Academy, but it was not until 1863 that he became a regular contributor to the Academy exhibitions. In that year he was represented by "The Eve of the Spanish Armada," and in 1864 by a "Romeo and Juliet." Subjects of this kind did not, however, attract him long, for in 1865 he began, with a picture of a "Sleeping Deerhound," that series of paintings of animal-subjects which has since occupied him almost exclusively. Among the most memorable of his productions are "The Poacher's Nurse" (1866), "Circe" (1871), "Daniel" (1872), "The Last of the Garrison" (1875), "Lazarus" (1877), "Persepolis" (1878), "In Manus Tuas, Domine" (1879), "The Magician's Doorway" (1882), "Væ Victis" (1885), "Rizpah" (1886), "An Old-World Wanderer" (1887), "Of a Fool and his Folly there is no End" (1889), "A Mighty Hunter before the Lord" (1891), "The King's Libation" (1893), "Beyond Man's Footsteps" (1894), now in the National Gallery of British Art; "Phœbus Apollo" (1895, see Plate); "Aggravation" (1896), "St George" (1900), and "To the Hills" (1901). He has also painted portraits; and at the outset of his career made some mark as an illustrator, beginning with *Punch*. He was elected an

Associate of the Royal Academy in 1878, and R.A. in 1881, and received the degree of D.C.L. at Oxford in 1891.

See Sir WALTER ARMSTRONG, "Briton Riviere, R.A.; His Life and Work," *Art Annual*, 1891.

Rivoli, a town in the province of Turin, Piedmont, of Italy, a summer resort of Turin, nine miles west of that city. It has a royal castle, in which King Victor Amadeus II. died a prisoner in 1732; and carries on the manufacture of silks, linens, and woollens. There is also a school of agriculture. Population, about 6000.

Rivoli Veronese, a village in the province of Verona, Venetia, Italy, on a hill on the right bank of the Adige, thirteen miles north-west of Verona. Here, on the 14th of January 1797, Napoleon defeated the Austrians under Alvinczy (Baron von Barberek). A famous street in Paris commemorates the victory, and the village gave the title of Duke to Marshal Masséna.

Road-Making.—Stimulated by the growing demands of vehicular traffic and encouraged by a more liberal expenditure of public money, the art of road-making made substantial progress during the latter part of the 19th century. Questions of foundation being for the time settled, attention was concentrated on the superficial layer, its cost and rate of wear. A perfect pavement would have a surface smooth to the wheel and rough to the hoof. These qualities are not so incompatible as they may seem. In most countries rough pavements have been made smoother, with benefit to both horse and vehicle, and the smoothest might be roughened materially without affecting the rolling wheel. If this process can be carried far enough for safe foothold, the desired roadway will be attained. Foothold should be provided not only at certain places where the shoe may or may not strike or to which it may slide, but wherever the foot may fall. So the modern roadmaker has relied more upon the surface and less upon the joint. Roads of macadam, asphalt, wood, and brick have gained much by recent experiments.

Macadam roads.

If the ideas of the inventor are strictly followed, macadam, when the fine network of joints is thinly masked with hardened mud worn from the stone, comes near to a perfect surface. But stones that will pass through a ring of a given size may be twice as much in length, and unless their form is about that of a cube not exceeding 1¼ inches on its longest side, they cannot be rammed or rolled into the regular mosaic characteristic of the true macadam. The best modern roads are of hand-broken stone dressed slightly on the surface with stone chips, while the mass of the road-metal is kept free from any kind of binding. Some roadmakers, however, have found the large irregularly-shaped stones from the machine so difficult to consolidate that they have had to reconsider the question of binding. The engineer of Central Park, New York, found that, with the greatest care and attention to rolling, such stones would not consolidate properly without admixture; indeed they became more intractable the more they were abraded by rolling. Mr Deacon of Liverpool has advocated a binding composed of large chips of trap rock or else of silicious gravel from the size of three-quarters of an inch down to that of a pin's head, together with about one-fourth part of macadam sweepings obtained in wet weather. This will enable the roller to consolidate the road-metal in a third of the time required for broken stone alone. The harder materials here suggested differ essentially from the sand and dirt formerly used for binding, since they fill up all the vacant spaces and cannot be washed down. Foundations of large and rough hard-core should be rolled down to a surface close enough to keep the finer pieces of road-metal from dropping down, so as to create hollows which, though they may escape the roller, will be detected by the laden wheel and by the pounding of the heavy hoof. But there is no foundation equal to sand, which has the property of spreading pressure over an enlarged area. A 12-inch bed of sand rolled down to 8 inches has been recommended, but military engineers have found that a layer of so little as 3 or 4 inches is sufficient as a foundation for macadam in very bad ground that has been rolled, or on an embankment that has had time to settle.

Tar macadam.

Broken stone mixed with some bituminous composition has been found very suitable for suburban roads, and for towns where the nature of the traffic requires smooth roadways reasonably free from noise and dust. In its simplest form, tar macadam is made from a good hard limestone broken into the usual sizes, the fine chips being used for top-dressing. In a shed a large hearth is formed of stone flagging, under which the flues of a furnace are constructed, and upon the hearth the broken stone is spread in a layer just as thick as the heat may be able to penetrate, to dry off the moisture and make the stones distinctly hot. The load of an ordinary barrow is tipped on an iron plate and gas tar is poured over it (from 8 to 12 gallons per cubic yard), while a couple of men with shovels turn it over exactly as they would turn concrete. No more tar should be used than is required completely to blacken the whole surface of every stone; and when this has been done, the stone can be thrown upon the heap, where it may be kept for one or two months, under cover, to allow the volatile oils to evaporate. Fine siftings are treated in the same way. When it has been properly seasoned, the mass should assume a greenish lustre; and when cut into by a shovel, the particles will cling together and creep down slowly so that the heap is said to be "alive." In that state it may be used. The tar ought to be boiled; and if too thin, a little pitch may be added to it, though not enough to make the heap consolidate. A mixture of tar with pitch and creosote oil is used by more precise makers, one formula being 12 gals. tar, ½ cwt. pitch, and 2 gals. creosote oil to a ton of stone. But those ingredients differ considerably in their chemical composition, and the proportions have to be varied according to experience. Moreover, as regards the tar and pitch used in the manufacture of pavements, the varieties that come directly from a vegetable source are liable to melt in hot and to become brittle in cold weather; coal tar is only moderately proof against these extremes.

Tar macadam must be put down in dry weather. If the material seems too dry, hot tar may be applied as before, but only as an expedient, and with great economy, so that the pavement may not soften in the sun. Upon a well-rolled foundation of hard material a layer of the coarser macadam should be put and rolled, then a layer of the smaller grade. For a road of light traffic a coat of the fine siftings may be put down and heavily rolled to a finished surface. For a road of heavier traffic the second coat should be dressed before rolling with tarred stone of a gauge of three-quarters of an inch to an inch and a quarter, and rolled first with a roller of not more than 10 or 12 cwt., then with one of 30 cwt. After the traffic has been turned on the road for a few days it should again be rolled as heavily as may be necessary to restore any parts that have been disturbed. But such roads are often consolidated by steam-rollers of 10 or 15 tons. For refacing an old road the prongs attached to a steam-roller will easily lift the old layer. Small depressions may be well tarred and levelled up with fine stuff, and the whole surface may be dressed every three years with tar and a fresh coat of fine chips. If the surface of the road is irregular, water will hang upon it, and frost may cause it to become slippery. The lack of affinity between granite

and bitumen prevents the use of tar macadam upon roads of heavy traffic.

Rocks like granite and syenite may be used in combination with Portland cement. The ingredients are mixed in about the proportion of four parts of broken stone that has first been well wetted, one and a quarter or two parts of clean sharp sand, and one of cement put on in two layers, the second being rolled by hand to the required shape and to a good surface. It should remain for two or three weeks to dry and set. Want of elasticity may be urged against concrete macadam, and it is productive of dust, but in some cases it has proved satisfactory.

Concrete macadam.

Smooth rounded gravel is unsuitable for roads unless a large proportion of it is broken, and about an eighth part of ferruginous clay added for binding. Rough pit gravel that will consolidate under the roller may be applied in two or more layers, but each must be of similar composition, or the smaller stuff will work downwards. A gravel road should be always under inspection, and repairs should be done without delay. A track for equestrian exercise should be made of hoggin or fine gravel, that will remain soft when raked or harrowed and watered. It should be well drained. A foundation of rough hard core will let the hoggin pass down into it, so that the hard core will appear at the surface. The best material is rough chalk sufficiently rolled to stop the gravel while draining off the surface water.

Gravel roads.

In Great Britain compressed asphalt for carriage-ways has came into greatly extended use, its perfect suitability for vehicles of all kinds, and its noiselessness under the wheel, being set against its slipperiness, especially when not quite clean. While the road is kept clean, a very slight depression is made by the horse-shoe, which for foothold is a great advantage. The noise made on asphalt by horse-traffic is about the same as that made on hard wood, and is not much more than is necessary for the safety of foot-passengers. In American cities asphalt has been adopted in a totally different form. All asphalt pavements are composed of a very large proportion, perhaps five parts in six, of a hard non-bituminous material. In America it is found cheaper to get the purer bitumen of the island of Trinidad, and to procure in the localities the bulky material required for admixture—a coarse angular sand with a little pure carbonate of lime. An asphaltic cement is made from refined asphaltum. Of this, from 12 to 15 per cent. is used with 70 to 80 per cent. of sand and 5 to 15 per cent. of limestone dust. These materials are heated and stirred together into a stiff mastic paste to form the wearing surface of the road. Upon the concrete foundation is first spread a layer of fine bituminous concrete called "binder," 1½ inches thick, to unite the wearing surface to the concrete foundation. Upon the binder the asphalt is laid to a thickness of 2 inches, being spread with iron rakes and brought to its finished surface by the steam roller. Obviously this is a process requiring great judgment and experience; but the system has become established in America, to the exclusion of European methods. Its great recommendation is the freedom from slipperiness that is said to result from the admixture of sharp sand, and this freedom is really the one quality in which asphalt pavement is seriously deficient. This system has been introduced into England.

Asphalt roads.

The great advance in the use of wood for roadways is due chiefly to the introduction of Australian hard woods, which have to a large extent supplanted fir and pine. The softer woods, which afford reasonably good foothold and are comparatively noiseless, wear rapidly under heavy traffic, and are very liable to decay. Moreover, the wood actually used has been of mixed qualities, and when a block fails, those near it suffer; thus holes are formed, so that the pavement has to be renewed before its time. English oak and beech, which are perhaps too hard, have been used with varying results; but the Australian woods of the genus Eucalyptus have been most extensively tried, and with the most satisfactory results. Those which are best known are jarrah and kauri, but tallow wood, black-butt, blue-gum, red-gum, and spotted-gum, with others, have been tried. Of these, one or two are too dense and hard to afford foothold, others are not easily procured, but jarrah and kauri are used extensively. When cut from the matured heart-wood they are uniform in quality, hard enough for durability, and rough enough to afford fairly good foothold. A very large quantity of wood has been used in London under the name of American red-gum. In substance it comes between the soft and hard woods above mentioned. Wood blocks for paving must be cut with the utmost precision as to the depth of 5 or 6 inches and the breadth of 3 inches. The usual length of 8 or 9 inches should also be kept well enough for bond. A long block is liable to tilt. As to depth, although a slight depression may be of little account, the least projection in a block will be immediately noted as a jolt by the swift-moving wheel. The laying and jointing of wood blocks on concrete is still a matter of experiment. They may be set on a half-inch bed of sand, which is supposed to, though it is doubtful whether it actually does, make the pavement elastic to the tread. If the blocks are not accurately gauged, the sand enables the paviour to adjust them to a uniform surface. But the practice most approved is to pave directly upon the smoothly finished concrete, trusting for elasticity to the wood. On the revival of wood-paving it was thought necessary, for foothold, to leave wide joints filled with small gravel grouted with cement; but this is mischievous. The cement breaks up, and when the blocks shrink, the filling-in is driven downwards, and when they again get wet, they have less room to expand, the side kerbs are driven back, and the foot-pavements are displaced, so as to require relaying. To guard against this, a space of about 2 inches has been left between the pavement and the kerb, to be temporarily filled with clay or sand, which can be cleared out as the pavement expands. But cement has no affinity for wood, and its use, together with the wide joints that were thought necessary to give foothold, has been abandoned. They permitted the edge of the block to be beaten down below the centre, so as to produce a succession of ridges, having much of the character of a "corduroy" road. Asphalted felt placed in the joints has not succeeded. A method very successfully adopted is to leave the end joints slightly open, and to place strips or laths one-tenth of an inch thick between the courses, so that hot pitch can be poured down to fill the joint and cover the surface. The roadway is then strewn with fine sharp gravel. Hard wood blocks so laid expand very slightly, so that a space of an inch and a quarter is sufficient between the kerb and the two courses of blocks that are usually laid parallel to it; this, when filled with pitch, is more than enough to allow for expansion. Paving has been laid with close joints, small vessels of hot pitch being provided, into which each paviour dips the blocks more or less completely before laying them; but wood blocks are more commonly laid dry, a little pitch being brushed over the surface. The gradual abandonment of the wide joints once considered necessary for foothold will be noticed. Soft wood seems to wear under very heavy traffic about five times as fast as hard wood.

Wood pavement.

Since about 1885 brick as a paving for carriage-ways has been adopted to a considerable extent, chiefly in the form of shale bricks, in American cities. The clay is a

hydrated silicate of alumina, containing about 24 per cent. of alumina with 15 per cent. of iron, lime, soda, potash, and magnesia. Lime is injurious, but alkalis to the extent of 3 per cent. are needed to ensure a slight degree of vitrification. Various tests are used for absorption and abrasion. That for abrasion is made by rolling half bricks in an iron barrel or rattler in company with pieces of cast-iron for a given time, and noting the effect on the surfaces, but particularly on the angles, which should be tough enough to resist chipping. Comparisons are also made with test pieces of granite that are mixed with the bricks. To guard against chipping, the best made bricks are pressed over again, and the upper angles rounded to a radius of three-eighths of an inch. Upon a foundation of concrete or well-rolled ballast a cushion or bed of coarse sand from half an inch to three inches thick is laid, and on this the bricks are set. They are then rolled till level, or are heavily rammed, a plank being interposed between the bricks and the rammer. No channel-courses are used. Pitch is poured in at the joints, but by no means on the surface, as that would make them slippery. Brick roadways have stood well under hard wear for fourteen years. Although in the United Kingdom bricks are produced unequalled for hardness and finish, no serious attempt has been made to introduce a tough brick for roadways that will neither chip nor wear smoothly. In various experiments with bricks that seemed most suitable they stood hard traffic for about a year. Clay of absolutely uniform character, and kilns that will ensure perfect equality in firing, are requisite. Slag bricks, made to interlock in the form of a double hexagon, the surface being grooved to a small pattern, have stood good tests for wear and foothold on a perfectly level surface. Many attempts have been made to use compositions, into which asphalt or cement usually enters, for making blocks or slabs, square or hexagonal, that can be laid down on a concrete foundation. A mosaic of macadam set in an iron frame is fixed by running molten slag into the back of the block. Small square pieces of oak are formed into blocks, end-grain upwards. Staffordshire blue bricks, made with holes to hold wooden plugs, have been used with some success. Broad blocks not firmly fixed down usually become loose and tilt when subjected to traffic.

Brick pavements.

Bricks made of cork, granulated and mixed with fibre and asphalt, are also used; they are set in pitch, and seem to be suitable for rather steep gradients. They are comparatively noiseless. For a perfectly noiseless pavement, such as is specially required where a carriage entrance under bedrooms is used by night, no substance is equal to indiarubber. For this purpose it is made in inch sheets about 3 feet wide and as long as the width of the roadway; it is fixed over concrete and secured by iron clips. This arrangement carries the whole of the passenger traffic to St Pancras Station, London, and also a considerable amount of traffic passing under the Euston Square Station Hotel.

Noiseless pavements.

In opening up a new country, roads, temporary or permanent, must be made with such materials as may happen to be at hand. The plank road often used in American forests makes an excellent track for all kinds of traffic. Upon that side of the space devoted to the road, which the heavy traffic leading to a town will use, two parallel rows of sills 15 to 20 feet long, 12 inches wide, and 4 deep, are laid longitudinally flatwise 4 feet from centre to centre, the earth being well packed and rammed to the level of their faces. The joints are not opposite; a short piece of sill is put either under or by the side of each joint. Cross boards about 8 feet 3 inches long and 3 inches thick are laid down loosely, so that groups of four boards together will project on alternate sides of the road 3 or 4 inches, forming a shoulder to enable vehicles to get on to the track at any point. The remainder of the road space is formed as an earthen track, 12 feet wide, for light vehicles. Its slope outwards may be 1 in 16, that of the plank road 1 in 32. If the soil is too bad for the earthen track, short lengths of plank road of double width are made at intervals to form passing places. The cross boards are spiked down on five sills, and are sprung so as to give a fall both ways.

Plank roads.

The log road is formed across swamps by laying young trees of similar length close together. This is ridiculed as a "corduroy" road, but it is better than the swamp. Good temporary roads may be made by laying down half logs roughly squared upon the ground, close together or with spaces between of a couple of inches, into which earth is well rammed. They may be 8 or 9 feet long, alternate logs being made to project a foot on each side for convenience of driving on and off the track.

Log roads.

When fuel is available, good roads can be formed of burned materials. Clay is burned into ballast for foundations, or for a temporary track. In American forests charcoal roads have been largely used. Logs from 6 inches to 2 feet in diameter are piled along the whole route, the stack being 9 feet broad at the base, 6 feet high and 2 feet broad at the top. Dry materials for lighting are intermixed, and the stack is covered up with sods and earth from the side ditches. When burned, the charcoal is simply raked down so as to form a 15-foot road of a well-rounded section. These roads are dry and hard, and otherwise satisfactory.

Charcoal roads.

The mode of carrying a road across a bog upon a foundation of faggots or brushwood is well known. In India the native roads have been made equal to heavy traffic by laying branches of the Mimosa across the track. And in the great plains, where the soil, when dry, would otherwise be made deep in dust, this is entirely prevented by laying across the track a coarse reed or grass like the Pampas grass, and covering it with 3 or 4 inches of loam.

In carrying traffic over a clay soil a covering of 3 or 4 inches of coarse sand will entirely prevent the formation of the ruts which would otherwise be cut by the wheels; and if the ground has already been deeply cut up, a dressing of sand will so alter the condition of the clay that the ridges will be reduced by the traffic, and the ruts filled in.

Sand.

See BOULNOIS, *Carriage-Ways and Footways*; AITKEN, *Road-Making and Maintenance*; MAXWELL, *Construction of Roads*. Modern American works are: BYRNE, *Highway Construction*; GILLMORE, *Roads, Streets, and Pavements*; and TILLSON, *Street Pavements*. See also Capt. W. W. ROBINSON, R.E., *Road Making in Western India*. Original papers in the *Proceedings of Assn. of County and Municipal Engineers*, *Inst. of Civ. Eng.*; HELE-SHAW in *Proc. of Mech. Eng.*, *Journal of Sanitary Institute*. (T. BI.)

Roanne, chief town of arrondissement and an important railway junction, department of Loire, France, 50 miles north-north-west of St Étienne, on the railway from Paris to St Étienne. The making of knitted articles gives employment to about 3000 women and girls in the surrounding districts. There are besides extensive engineering workshops, iron and copper foundries, numerous dyeworks, and pottery and tile works. Population (1881), 24,274; (1901), 33,775.

Roanoke, a city of Virginia, U.S.A. Though within the limits of Roanoke county, it is not subject to county government. It is situated on the Roanoke river, in the south-western part of the state, at an altitude of 907 feet. It has an excellent water system and sewerage. Situated on the main line of the Norfolk

and Western Railway, at the junction of two branches, its industries are connected with the manufacture of iron and steel. It has blast furnaces, rolling mills, foundries, locomotive and car works, and other manufactures. Formerly known as the town of Big Lick, it was chartered under its present name in 1884. Population of Big Lick (1880), 669; of Roanoke (1890), 16,159; (1900), 21,495, of whom 539 were foreign-born and 5834 negroes.

Roberts, Frederick Sleigh, Earl (1832–——), British Field Marshal and Commander-in-Chief, K.G., second son of General Sir Abraham Roberts, G.C.B., was born at Cawnpore, India, on 30th September 1832. Educated at Eton, Sandhurst, and Addiscombe, he obtained a commission in the Bengal Artillery on 12th December 1851. In the following year he was posted to a field battery at Peshâwar, where he also acted as aide-de-camp to his father, who commanded the Peshâwar division. In 1856 Roberts was appointed to the Quartermaster-General's department of the Staff, in which he remained for twenty-two years, passing from one grade to another until he became Quartermaster-General in India. On the outbreak of the Mutiny in 1857, Roberts, at first, was staff officer to the movable column operating against the mutineers in the Punjab, successively commanded by Colonels Neville Chamberlain and John Nicholson, but, towards the end of June, he joined the Delhi Field Force, and was Deputy Assistant Quartermaster-General with the artillery during the operations against Delhi. He was wounded in the fight of the 14th July, but was sufficiently recovered in September to take command as a regimental officer of the left half of No. 2 Siege Battery during the siege. He rejoined the headquarters staff for the assault, and took part in the storm and subsequent seven days' fighting in the city. He then accompanied Colonel Greathed's column to Cawnpore, and during September and October was present at the actions of Bulandshahr, Aligarh, Agra, Banthira, and Kanoj. He served under Sir Colin Campbell at the second relief of Lucknow in November, at the battle of Cawnpore on the 6th December, and the subsequent pursuit and defeat of the Gwalior Contingent near Sheorajpur. Roberts distinguished himself at the engagement of Khudaganj, on the 2nd January 1858, by capturing, in single-handed combat, a standard from two sepoys, and also by cutting down a sepoy about to kill a sowar. For these acts of gallantry he was recommended for the Victoria Cross. He was present at the reoccupation of Fatehgarh on the 6th January, the storm of Mianganj in February, the siege and capture of Lucknow in March, and the action at Kursi on the 22nd of that month, after which he went home on sick leave. For his services in the Mutiny war he was seven times mentioned in despatches, received the medal with three clasps, the Victoria Cross, and on his promotion to captain in October 1860, a brevet majority. On the 17th of May 1859 he married, at Waterford, Miss Nora Bews, and on his return to India was entrusted with the organization of the Viceroy's camps during the progresses through Oudh, the North-West Provinces, the Punjab, and Central India in 1860 and 1861. In December 1863 he took part, under Major-General Garvock, in the Umbeyla campaign among the mountains to the north of Peshâwar, and was present at the storm of Lalu, the capture of Umbeyla, and the destruction of Mulka, receiving for his services the medal and clasp.

FIELD MARSHAL EARL ROBERTS, K.G.
(From a photograph by Elliott and Fry, London.)

In 1867 Roberts was appointed Assistant Quartermaster-General to Sir Donald Stewart's Bengal Brigade for Abyssinia. He showed judgment in embarking each unit complete in every detail, instead of despatching camp equipage in one ship, transport in another, and so on, as was customary. He arrived at Zula, Annesley Bay, in the Red Sea, the base of the expedition, on 3rd February 1868, and remained there as senior base staff officer during the four months' campaign. At its close he superintended the re-embarkation of the whole army. His duties were so well performed that Sir Robert Napier sent him home with his final despatches. He was three times "mentioned," and received a brevet lieutenant-colonelcy and the war medal. He returned to India the following year as First Assistant Quartermaster-General. In the autumn of 1871 he made the arrangements for the expedition into Lushai, between south-east Bengal and Burma, fitted out two columns under Brigadiers-General Bourchier and Brownlow, and himself accompanied the first. A road, over 100 miles long, was cut through dense gloomy forests in stifling heat, and the column was attacked by cholera; but the object of the expedition was successfully accomplished, and Roberts, who was present at the capture of the Kholel villages and the action in the Northlang range, and commanded the troops at the burning of Taikum, was mentioned in despatches and made a Companion of the Bath. On his return in March 1872, he became Deputy Quartermaster-General in Bengal, and in 1875 Quartermaster-General and Colonel. He settled the details of the great camp of exercise at Delhi on the occasion of the visit of the Prince of Wales in January 1876, and attended H.R.H. at the manœuvres. He also superintended the arrangements for the great durbar at Delhi on 1st January 1877, when Queen Victoria was proclaimed Empress of India.

In 1878 Roberts was appointed to the command of the Frontier Field Force at Abbottabad, in Hazara; but in the autumn, on the repulse of the Chamberlain Mission by the Afghans, and the formation of three columns to advance

into Afghanistan by the Khaibar, the Bolan, and the Kuram passes, he was given the command of the Kuram Field Force, with the rank of Major-General. Concentrating his column at Thal, he advanced to Kuram towards the end of November, and having formed an advanced base there, moved on to Habib Kila. Under cover of preparations for a front attack on the Peiwar Kotal, he reconnoitred that formidable position, and on the night of the 1st December moved part of his force to attack the Spingawi Kotal, in order to turn the Afghan left flank, leaving the remainder of the force to feign a front attack on the Peiwar, and to guard the camp. After a very difficult night march the Spingawi Kotal was carried at daybreak on the 2nd, and, later, the Afghans on the Peiwar Kotal, threatened in rear, abandoned the position. The next morning Roberts occupied the Peiwar, and on the 6th advanced to Ali Khel. He reconnoitred the Shutargardan and the Sapari passes, and made a strong reconnaissance through Khost, in which some fighting took place, and at the end of January returned to Hagir Pir, in Kuram, where his force remained in occupation. In July, Major Cavagnari, the British envoy to the new Amir, Yakub Khan, passed through Kuram on his way to Kabul, and, shortly afterwards, Roberts left his Kuram command and went to Simla to take his seat on the Army Commission, where he strongly advocated the abolition of the three Presidency armies, and the substitution for them of four army corps, a measure which was carried out sixteen years later. While he was at Simla, news arrived on 5th September of the murder of Cavagnari and his companions at Kabul. The Peshawar Valley Force had been broken up; Sir Donald Stewart was still at Kandahar, but most of his troops had started for India; Roberts, therefore, had the only force ready to strike rapidly at Kabul. It was hastily reinforced, and he hurried back to Kuram to take command, as a Lieutenant-General, of the Kabul Field Force (7500 men and 22 guns). By the 19th September a brigade was entrenched on the Shutargardan, and as Roberts advanced, the Amir Yakub Khan came into his camp. An Afghan force of 8000 men blocked the way in a strong position on the heights beyond Charasia, and on 6th October Roberts repeated the tactics that had done him such good service at the Peiwar in the previous year, and sending Brigadier-General T. D. Baker with the greater part of his force to turn the Afghan right flank, threatened the pass in front with the remainder. By the afternoon Baker had seized the position, and the enemy, severely defeated, were in full retreat. Kabul was occupied without further opposition.

The city was spared, but punishment was meted out to those convicted of complicity in the murder of the British Mission. Yakub Khan abdicated on the 12th October, and was eventually deported to India. The troops occupied the Sherpur cantonments; but in November a religious war was proclaimed by the Mullahs, and early in December, in order to prevent a threatening combination of Afghan tribes against him, Roberts moved out two columns to attack them in detail. After considerable fighting around Kabul, the numbers of the enemy were so great that he was forced to concentrate his troops again at Sherpur, the defences of which had been greatly improved and strengthened. Sherpur was invested by the enemy, and early on the 23rd December was attacked by over 100,000 Afghans. They were driven off with great loss; and on making a second attempt to storm the place, were met by Roberts, who moved out, attacked them in flank, and defeated them, when they broke and dispersed. Roberts now recommended the political dismemberment of Afghanistan, and negotiations were carried on with the northern tribes for the appointment of an Amir for the Kabul district only. On the 5th May Sir Donald Stewart arrived with his column from Kandahar and assumed the supreme command in Afghanistan, Roberts retaining, under Stewart, the command of the two Kabul divisions, and organizing an efficient transport corps under Colonel R. Low, which was soon to be of inestimable value. On the 22nd of July Abdur Rahman was proclaimed Amir of Kabul; and Roberts was preparing to withdraw his troops to India by the Kuram route, when news arrived that a British brigade had been totally defeated at Maiwand on the 27th July, and that Lieutenant-General Primrose was besieged in Kandahar. Roberts was ordered to proceed thither at once with a specially selected column of 10,000 troops and his new transport corps. He started on his famous march on the 9th August and arrived at Kandahar on the morning of the 31st, having covered 313 miles in twenty-two days. On the following day he fought the battle of Kandahar and gained a complete victory. His services in the Afghan campaigns of 1878 to 1880 are recorded in eight *Gazettes*, and were recognized by the thanks of both Houses of Parliament, of the Government of India, and of the Governor-General in Council. He was created K.C.B., G.C.B., and a baronet, received the medal with four clasps, and the bronze star, and was given the command of the Madras army.

Before proceeding to Madras, Roberts went home on furlough, and when the news of the disaster at Majuba Hill in South Africa arrived in London at the end of February 1881, he was appointed Governor of Natal and Commander-in-Chief in South Africa. He arrived at Cape Town to find that peace had been made with the Boers, and that instructions were awaiting him to return home. The same year he attended the autumn manœuvres in Hanover as the guest of the German Emperor. He declined the post of Quartermaster-General to the Forces in succession to Sir Garnet Wolseley, and returned to India, arriving at Madras in November. The following year he visited Burma with the Viceroy, and in 1885 attended the meeting between Abdur Rahman and Lord Dufferin at Rawalpindi at the time of the Pendjeh incident, in connexion with which he had been nominated to the command of an army corps in case of hostilities. In July he succeeded Sir Donald Stewart as Commander-in-Chief in India, and during his seven years' tenure of this high position instituted many measures for the benefit of the army, and greatly assisted the development of frontier communications and defence. At the end of 1886, at the request of the Viceroy, he took personal command for a time of the forces in Burma, and organized measures for the suppression of dacoity. For his services he received the medal, was created G.C.I.E., and promoted Supernumerary General. In 1890 he did the honours of the army to Prince Albert Victor at a standing camp at Muridki, and in 1891 his attention was occupied with the Zhob and Hunza Naga frontier campaigns. On the 1st January 1892 he was raised to the peerage as Baron Roberts of Kandahar and Waterford. In 1893 he left India for good, and the G.C.S.I. was bestowed upon him. He was promoted to be Field Marshal in 1895, and in the autumn of that year succeeded Lord Wolseley in the Irish command and was sworn a Privy Councillor. At Queen Victoria's Diamond Jubilee in 1897 he was created K.P.

After the disastrous actions in the Boer war in South Africa in December 1899 at Magersfontein, Stormberg, and Colenso, where his only son was killed, Lord Roberts was sent out as Commander-in-Chief. He arrived at Cape Town on the 10th January 1900, and after organizing his force, advanced with sound strategy on Bloemfontein, the capital of the Orange Free State, and soon changed the aspect of affairs. The sieges of Kimberley and Ladysmith were raised, and the Boer General, Cronje, flying towards the capital, was overtaken at Paardeberg and, after a fine defence, compelled to surrender, with 5000 men, on

the anniversary of Majuba Day, the 27th February 1900. Roberts entered Bloemfontein on the 13th March, and after six weeks' preparation, advanced on Pretoria, the capital of the Transvaal. Mafeking was relieved on the 17th May, and Pretoria occupied on the 5th June. The two Boer states were annexed, and the war gradually assuming a guerilla character, Roberts handed over the command to Lord Kitchener, and returned to England to fill the office of Commander-in-Chief of the Army in succession to Lord Wolseley.

He arrived in the Solent on the 2nd January 1901, and the same day, at Osborne, had an audience of Queen Victoria, who handed him the insignia of the Order of the Garter. The next day he was received at Paddington by the Prince and Princess of Wales, and drove in procession to Buckingham Palace, where he was entertained as the guest of the Queen. He again had an audience of the Queen at Osborne on the 14th January on his elevation to an earldom, the last audience given by Her Majesty before her death, which took place eight days later. When the German Emperor came to London for the Queen's funeral, he decorated Lord Roberts with the Order of the Black Eagle. Earl Roberts received the thanks of both Houses of Parliament and a grant of £100,000 for his services in South Africa. He is the author of *The Rise of Wellington*, 1895, and *Forty-one Years in India*, 1897, which has passed through more than thirty editions.

Robertson, George Croom (1842–1892), Scottish philosopher, was born at Aberdeen on 10th March 1842. In 1857, when only fifteen, he gained a bursary at Marischal College, and graduated as M.A. in 1861, with the highest honours in classics and philosophy. In the same year he won a Fergusson scholarship of £100 a-year for two years, which enabled him to pursue his studies outside Scotland. He first went to University College, London; thence to Heidelberg, where he worked at German; and to Berlin, where he studied psychology and metaphysics; also physiology under du Bois-Reymond, and heard lectures on Hegel, Kant, and the history of philosophy, ancient and modern. He then spent two months at Göttingen; and in June 1863 went to Paris. In the same year he returned to Aberdeen and helped Professor Bain with the revision of some of his books. In 1864 Croom Robertson was appointed to help Professor Geddes with his Greek classes, but he gave up the vacations to philosophical work. In 1864 he wrote an article on German philosophy for the *British and Foreign Evangelical Review*, and one on Kant and Swedenborg for *Macmillan's Magazine*. In 1866 he was appointed Professor of Philosophy of Mind and Logic at University College, London. This post he retained until ill-health compelled him to resign, a few months before his death in 1892. Professor Robertson lectured on logic, deductive and inductive, systematic psychology, and ethical theory. He was a most industrious worker and accumulated large stores of materials, but left little published work. He had projected a comprehensive work on Hobbes; but this was never completed, though part of the materials were used for an article in the *Encyclopædia Britannica*, and another portion was published as one of Blackwood's "Philosophical Classics." Together with Professor Bain, he edited Grote's *Aristotle*; and he was the editor of *Mind* from its foundation, in 1876, till 1891. He was keenly interested in German philosophy, and took every opportunity of making German works on English writers known in the United Kingdom. In philosophy his affinities were chiefly with the school represented by Mill and Bain, but he was widely acquainted with the philosophical literature of all schools. He was associated with his wife (a daughter of Mr Justice Crompton) in many kinds of social work; he sat on the Committee of the National Society for Women's Suffrage, and was actively associated with its President, John Stuart Mill. He warmly supported the admission of women students to University College.

Robilant, Count Nicolas Carlo Felice (1826–1888), Italian soldier and diplomatist, was born at Turin on 8th August 1826. Entering the army as artillery lieutenant in 1845, he was wounded at the battle of Novara, where he lost a hand. In 1860 he took part in the campaign in the Marches, and during the war of 1866 was chief of staff of the 3rd Army Corps. After serving on the Italo-Austrian Frontier Commission, and acting as Prefect of Ravenna at a critical moment in 1869, he was sent to Vienna in June 1871, first as minister and afterwards as ambassador. While approving of the *rapprochement* between Italy and the Central Powers, he opposed the visits of Victor Emmanuel II. to Vienna and Berlin in 1874, and that of King Humbert to Vienna in 1881, since he desired that the Triple Alliance should only be concluded after the Austrian Emperor should have recognized Italian Unity by returning at Rome the visit of the Italian Sovereign to the Austrian capital. Reluctantly accepting the portfolio of Foreign Affairs in 1886, he displayed tact and firmness during the Bulgarian crisis of that year; and before leaving the Foreign Office, after the disaster to Italian troops at Dogali, in Abyssinia, he succeeded (March 1887) in renewing the Triple Alliance on terms more advantageous to Italy than those of the original treaty, and in supplementing it by an understanding with Great Britain in regard to Mediterranean affairs. After his fall from power he re-entered the regular army, but was selected by Crispi for the post of Ambassador to London, where he died on 17th October 1888. (H. W. S.)

Rochdale, a municipal, county (1888), and parliamentary borough of Lancashire, England, on the Roch, 196 miles north-west of London by rail. The corporation acquired powers in 1900 to purchase the tramways and to replace them by electric lines. The electric light has also been recently introduced. Several new mills, board schools, and other buildings have been erected. Specially noticeable are the technical school (1893), costing £15,000; a school of art (1889), and a Roman Catholic orphanage. There is a statue of John Bright (1891). The Equitable Pioneers Society (1844), pioneer of co-operation, numbers over 11,000 members, with a capital of over £350,000. A handsome new co-operative store, belonging to the Rochdale Provident Co-operative Society, was opened in 1900. In 1891, 5699 males and 8353 females were engaged in the cotton, 1860 males and 2107 females in the wool and worsted, and 591 males and 395 females in the silk manufacture; and 1423 persons in the making of machines. Area of parliamentary borough, 4185 acres; population (1881), 68,866; (1891), 71,401. Till November 1900 the municipal and county borough was coincident with the parliamentary borough; it was then, however, extended to include the urban district of Castleton, and now has an area of 6454 acres with a population in 1901 of 83,112.

Rochefort, chief town of arrondissement, department of Charente Inférieure, France, 20 miles south-south-east of Rochelle, on the railway from Nantes to Bordeaux. Manufactures include tiles and drain pipes, preserved foods, artificial fuel, and steam saw and planing mills. Large quantities of wine are produced in the districts around Rochefort and Tonnay-Charente, amounting in 1899 to 28,963,700 gallons. The third floating basin of the commercial port was completed in 1890; it has an area of 15 acres, with 3692 feet of quayage, and a depth, spring

and neap tides respectively, of 29½ and 25½ feet. Exclusive of coasting trade, the number of vessels entered at Rochefort and Tonnay-Charente in 1900 was 151 of 117,284 tons; cleared, 130 of 105,359 tons. The total movement, including coasting trade, amounted to 339,582 tons. At TONNAY-CHARENTE (4 miles to the north), in the same year, the total tonnage, including coasting trade, amounted to 218,225. A "bridge with suspended carrier" has been constructed across the Charente between Rochefort and the sea, at a height which admits of the tallest ships passing underneath at any time. The "carrier," suspended some 150 feet below the bridge, but above the highest water-line, conveys persons, animals, goods, and vehicles from side to side, a distance of 300 or 400 yards. This bridge was completed at a cost of about £28,000. Population (1881), 21,608; (1901), 31,613. Tonnay-Charente: population (1901), 4640.

Rochefort, Victor Henri, Marquis de Rochefort-Luçay (1830-——), French journalist and politician, generally known as Henri Rochefort, the son of a Legitimist noble, was born 30th January 1830, at Paris. He was successively in early life a medical student, a clerk in the Hôtel de Ville, a successful playwright, and a journalist. When one of the writers of the *Charivari*, his articles led to his appointment as sub-inspector of Fine Arts in Paris, but this post he resigned in 1861. In 1863 he joined the staff of the *Figaro*, at a salary of 30,000 francs; but his severe comments on the Second Empire brought the paper into collision with the authorities, and led to his retirement. His articles were collected and published in three volumes, entitled *Les Français de la Décadence*. Rochefort now founded *La Lanterne*; but it was seized on its eleventh appearance, and in August 1868 the editor was fined 10,000 francs, with a year's imprisonment. The publication was afterwards rigorously suppressed. Rochefort fled to Belgium; and after two unsuccessful candidatures, he was returned to the Chamber of Deputies by the Ultra-Democrats of the first *circonscription* of Paris. After a brief arrest on crossing the frontier, he took his seat. He attacked the Imperial régime violently in the Chamber; and in 1869 started a new paper, the *Marseillaise*, in which Victor Noir and Pascal Grousset were collaborators. The attacks in this journal on Prince Pierre Bonaparte led to the killing of Victor Noir by the Prince; the paper was seized, and early in 1870 Rochefort and Grousset were fined, and committed to prison for six months. Upon the downfall of the Empire in September 1870 Rochefort was released by the mob, and for a short time he became connected with the Government of National Defence; but was compelled to resign on account of his open sympathy with the first Communistic outbreaks. When the Commune was established in March 1871 Rochefort at first supported its terrible excesses in the *Mot d'Ordre*, but finding its tyranny insupportable, he fled from Paris in disguise on 11th May. Arrested by the Versailles Government, he was condemned by martial law to imprisonment for life, and notwithstanding Victor Hugo's efforts to procure his release, he was transported to New Caledonia. In November 1872 he was temporarily released to enable him to legitimize his children by marrying their mother, who was dying. Then he was reconveyed to New Caledonia, whence he escaped in 1874 in an open boat. He made his way to San Francisco, and thence to London and Geneva, where he contributed to the Parisian press, and attempted to revive *La Lanterne*, but without success. After being severely wounded in a duel, —a form of hostility in which he was always conspicuous, —he took advantage of the general amnesty to return to Paris, where he founded a new journal called *L'Intransigéant*. He resumed his assaults upon all the French Governments in turn. He also attacked with special incisiveness the Tunis expedition, which he declared to be a mere stock-jobbing affair; and he secured a triumphant acquittal in an action for libel brought against him by M. Roustou, the Resident at Tunis, who had been the chief promoter of the annexation. During the Boulangist fever he was a staunch partisan of the General, whom he accompanied to England in 1889, having escaped through Belgium from France. Rochefort remained in exile in England for some years, and was always hospitably received there. In January 1895 a French Amnesty Bill was passed by the Chamber, and Rochefort, with many other proscribed persons, took immediate advantage of it and returned to Paris. He played a prominent part against ex-Captain Dreyfus during his second trial at Rennes. In 1900, during the course of the South African war, he initiated a movement in France on behalf of the Boers, and no words in his vocabulary were too insulting for the country which had so long given him refuge.

Rochelle, La, chief town of department Charente Inférieure, France, 293 miles south-west of Paris, on the railway from Nantes to Bordeaux. The new Parc Charruyer lies outside the fortifications west of the town. Local institutions include an academy of belles-lettres and science. Shipbuilding, the manufacture of briquettes, chemicals, sardine- and tunny-preserving, and petroleum-refining are among the principal industries. The maritime commerce, included with that of LA PALLICE, is very important. La Pallice, the new port of La Rochelle, inaugurated 1890, is situated nearly 4 miles to the south-west on the ocean, and is defended by a fort. At La Pallice petroleum refineries and chemical manure works have been established, and it has a repairing shipyard. Its importance, however, centres in its magnificent port, entirely artificially excavated, which, sheltered by the islands of Ré and Oléron, affords excellent and safe anchorage in all weathers. The outer part, protected by two jetties, respectively 1420 and 2054 feet in length and each terminated by a lighthouse, has an area of 29 acres and depth 16½ feet below lowest tide level. Ships drawing up to 16 feet can enter at any time, and those drawing from 16 to 26 feet during six hours daily. At the extremity of the breakwater is a wharf 680 feet long where ships may discharge without entering the basin. A lock 770 feet long and 72 feet wide connects with the inner basin, which has an area of 27 acres, with 5900 feet of quayage, a minimum depth of 28 feet, and depths of 29½ feet and 36 feet at high neap and spring tides. Connected with the basin are two graving docks, respectively 616 and 364 feet in length, with depths ranging between 23 and 30 feet. The number of vessels entered at La Pallice in 1900 was 205, of 317,080 tons; cleared 200, of 305,220 tons. At La Rochelle basin 207 vessels entered, of 139,695 tons; cleared 169, of 123,267 tons. Including coast trade, the total movement for the two ports amounted to 2,215,210 tons. The total value of the imports at La Rochelle was, in 1899, £2,556,000, and of the exports, £1,020,000, chiefly brandy (5103 tons). Belonging to the port in 1899 were 253 vessels of 23,520 tons, mostly small sailing ships. In 1900, 198 sailing boats, manned by 743 persons, were engaged in the fisheries. The fish market of La Rochelle is the most important on the west coast. The value of fish sold in 1900 was £154,240. Population (1881), of La Rochelle, 17,234; (1901), 28,578.

Rochester, an episcopal city and municipal and parliamentary borough, Kent, England, in the Medway parliamentary division of the county, on the Medway, 33 miles

east of London by rail. The restoration of the west front of the cathedral (Norman style) was commenced in 1888 by Dean Hole, and was completed about 1898, costing, with other work, £7358. The church of St Nicholas was restored in 1892. A museum was opened in 1894 in the basement of the corn exchange, and a handsome Elizabethan mansion has been acquired by the corporation for museum purposes, as a memorial of Queen Victoria's Diamond Jubilee. In 1888, 9680 vessels entered the port with 704,207 tons of cargo, and 9290 cleared with 659,233 tons. In 1901, 1540 vessels entered with 386,879 tons, and 1567 vessels cleared with 392,872 tons. The population of the municipal and parliamentary borough was in 1891, 26,290; in 1901, 30,622. The parish of Strood lies mainly within the borough, and is connected with the city by a bridge. Population (1901), 14,432.

Rochester, a city of Minnesota, U.S.A., the capital of Olmstead county. It is on the Zumbro river, and on the Chicago and North-Western and the Winona and Western railways, in the south-eastern part of the state, at an altitude of 991 feet. It contains one of the state insane asylums, and is in the midst of a fertile farming region, with grain elevators and flour-mills, utilizing the water-power furnished by the river. Population (1890), 5321; (1900), 6843, of whom 1680 were foreign-born.

Rochester, a city of Strafford county, New Hampshire, U.S.A. It is on Salmon Falls and Cocheco rivers, and at the junction of several branches of the Boston and Maine Railroad, in the south-eastern part of the state, at an altitude of 226 feet. It has fine water-power, and manufactures of boots and shoes, woollen goods, and other articles. Rochester was settled in 1728, incorporated as a town in 1737, and received a city charter in 1891. Population (1890), 7396; (1900), 8466, of whom 1651 were foreign-born.

Rochester, a city of New York, U.S.A., the capital of Monroe county. It is on both banks of the Genesee river, in the north-western part of the state. The plan of the city is irregular, with broad, well-shaded streets, a large proportion of which are paved, mainly with asphalt. It has a fine water-supply and is well sewered. It is the seat of Rochester University, which in 1899 had a faculty numbering 15 and was attended by 213 students. Rochester is a lake port, the river being navigable to this point. It is also a railway centre of great importance, being entered by seven railways, the Buffalo, Rochester, and Pittsburg, the Erie, the Lehigh Valley, the New York Central and Hudson River, the Rochester and Lake Ontario, the Western New York and Pennsylvania, and the West Shore, which afford internal communication in all directions. Rochester is a manufacturing city of much importance, aided by water-power derived from the falls. In 1900 it contained 2616 manufacturing establishments, with a total capital of $49,086,212. These employed 33,408 hands and paid $13,832,122 in wages. The raw materials had a value of $31,557,122, and the finished product of $69,129,820. The principal of these products, with their values, were as follows:—

Boots and shoes	$6,933,111
Men's clothing	11,138,220
Flouring and grist mill products	3,010,539
Foundry and machine-shop products	4,036,479
Malt liquors	2,748,290
Tobacco	3,040,331
Furniture	2,069,972

The assessed valuation of real and personal property was, in 1900, $115,570,890, the net debt of the city was $10,574,431, and the tax-rate was $24.29 per $1000. The total municipal receipts, apart from loans, were $4,336,506, and the expenditures for maintenance and operation, $3,645,343. Population (1890), 133,896; (1900), 162,608, of whom 40,748 were foreign-born and 601 negroes. Of 45,395 males 21 years of age and over, 1327 were illiterate (could not write).

Rockaway, formerly a village of Queens county, New York, U.S.A., but since 1st January 1898 a part of the borough of Queens, one of the five boroughs of which New York City is composed. It is a summer resort, situated on a sandbar on the south coast of Long Island.

Rockford, a city of Illinois, U.S.A., the capital of Winnebago county. It is situated in 42° 15′ N., 89° 5′ W., on Rock river, which furnishes a fine water-power, in the northern part of the state, at an altitude of 714 feet. The city has an excellent water-supply from artesian wells and from the river; its business streets are paved with brick, wood, and asphalt, and many of its residential streets are macadamized. It is upon four railways, the Chicago, Burlington, and Quincy, the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Illinois Central, which give it a large trade. In manufactures, the census of 1900 reported that the city contained 450 establishments, with a total capital of $14,126,834, employing 6620 hands, and with a product valued at $12,586,116. The principal articles of manufacture were furniture, knitted goods, foundry and machine-shop products, and agricultural implements. In 1900 the assessed valuation of property, real and personal, was $5,266,804, a very low assessment. The net debt of the city was $565,134, and the rate of taxation was $60.75 per $1000. Population (1890), 23,584; (1900), 31,051, of whom 9337 were foreign-born and 212 negroes. Of 8856 males 21 years of age and over, 129 were illiterate (could not write).

Rockhampton, a town of Queensland, Australia, in the county of Livingstone, on the Fitzroy river, about 420 miles north-west of Brisbane. It has frequent communication by steamer with the principal Australian ports, and is the outlet for a wide agricultural district, which produces also gold and copper. The value of the exports in 1899 amounted to £2,390,000. Much of the trade is carried on through the ports of Alma and Broadmount, near the mouth of the river, both available for ocean steamers. The Central Railway starts from this town. Population (1891), 11,629; (1901), 15,461. North Rockhampton is a separate municipality on the opposite side of the river. Population (1901), 2865.

Rock Hill, a city of York county, S.C., U.S.A. It is situated on the Southern and the South Carolina and Georgia railways, in the northern part of the state. Population (1890), 2744; (1900), 5485, of whom 33 were foreign-born and 1706 negroes.

Rock Island, a city of Illinois, U.S.A., the capital of Rock Island county. It is situated in 41° 32′ N., 90° 31′ W., on the east bank of the Mississippi, in the western part of the state, at an altitude of 570 feet at the river bank. The city has a water-supply pumped by the Holly system, is sewered, and is divided into seven wards. It has five railways, the Chicago, Rock Island and Pacific, the Chicago, Burlington, and Quincy, the Chicago, Milwaukee, and St Paul, the Davenport, Rock Island, and North-Western, and the Rock Island and Peoria. The city has a large trade by rail and river, and, aided by ample water-power derived from the Rock Island Rapids, it has important manufactures, including flour, lumber, glass, and agricultural implements. Rock Island is the seat of Augustana College, a Lutheran institution, opened in 1860, which in 1899 had a faculty numbering 27 and was attended by 458 students. Popu-

lation (1890), 13,634; (1900), 19,493, of whom 4412 were foreign-born and 282 negroes.

Rockland, a city and seaport of Maine, U.S.A., the capital of Knox county. It is on the shore of Penobscot bay, and on a branch of the Maine Central Railroad, in the southern part of the state. It is divided into seven wards, and has a water-supply and sewer system. The principal industries are the quarrying of granite, the burning of lime, and shipbuilding. Owing to its strength and durability, Rockland granite is used for building in various parts of the country. Population (1890), 8174; (1900), 8150, of whom 610 were foreign-born.

Rockland, a town of Plymouth county, Massachusetts, U.S.A. It is an inland town in the south-eastern part of the state, on a branch of the New York, New Haven, and Hartford Railroad. It contains an area of 11 square miles, well settled, mainly with rural population. There is a village bearing the same name as the town. Population (1890), 5213; (1900), 5327, of whom 796 were foreign-born.

Rockport, a town of Essex county, Massachusetts, U.S.A. It is at the eastern point of Cape Ann, in the north-eastern part of the state, on a branch of the Boston and Maine Railroad. It has an area of seven square miles of broken, rocky country, bordered by a rugged coast-line. It contains several villages, Rockport, Ocean View, and Pigeon Cove, which are popular seaside resorts. Rockport is widely known for its granite quarries. Population (1890), 4087; (1900), 4592, of whom 1290 were foreign-born.

Rockville, a city of Tolland county, Connecticut, U.S.A. It is on the Hockanum river, and on the New York, New Haven, and Hartford Railroad, in the northern part of the state, at an altitude of 403 feet. It possesses excellent water-power, which has been put to use in manufactures. These consist largely of envelopes and woollen and silk goods. Rockville was separated from Vernon town and chartered as a city in 1889. Population (1890), 7772; (1900), 7287, of whom 2548 were foreign-born.

Rodin, Auguste (1840-——), French sculptor, was born in 1840, in Paris, and at an early age displayed a taste for his art. He began by attending Barye's classes, but did not yield too completely to his influence. From 1864 to 1870, under pressure of necessity, he was employed in the studio of Carrier-Belleuse, where he learnt to deal with the mechanical difficulties of a sculptor. Even so early as 1864 his individuality was manifested in his "Man with a Broken Nose." After the war, finding nothing to do in Paris, Rodin went to Brussels, where from 1871 to 1877 he worked, as the colleague of the Belgian artist Van Rasbourg, on the sculpture for the outside and the caryatides for the interior of the Bourse, besides exhibiting in 1875 a "Portrait of Garnier." In 1877 he contributed to the Salon "The Bronze Age," which was seen again, cast in bronze, at the Salon of 1880, when it took a third-class medal, was purchased by the State, and placed in the gardens of the Luxembourg. Between 1882 and 1885 he sent to the Salons busts of "Jean-Paul Laurens" and "Carrier-Belleuse" (1882), "Victor Hugo" (see Plate) and "Dalou" (1884), and "Antonin Proust" (1885). From about this time he chiefly devoted himself to a great decorative composition six metres high, which was not finished for twenty years. This is the "Portal of Hell," the most elaborate perhaps of all Rodin's works, executed to order for the Musée des Arts Décoratifs. It is inspired mainly by Dante's *Inferno*, the poet himself being seated at the top, while at his feet, in under-cut relief, we see the writhing crowd of the damned, torn by the frenzy of passion and the anguish of despair. The lower part consists of two bas-reliefs, in their midst two masks of tormented faces. Round these run figures of women and centaurs. Above the door three men cling to each other in an attitude of despair. After beginning this Titanic undertaking, and while continuing to work on it, Rodin executed for the town of Damvillers a statue of "Bastien-Lepage"; for Nancy a "Monument to Claude le Lorrain," representing the Chariot of the Sun drawn by horses; and for Calais "The Burgesses of Calais" surrendering the keys of the town and imploring mercy (see Plate). In this, Rodin, throwing over all school tradition, represents the citizens not as grouped on a square or circular plinth, but walking in file. This work was exhibited at the Petit Gallery in 1889. At the time of the secession of the National Society of Fine Arts, or New Salon, in 1890, Rodin withdrew from the old Society of French Artists, and exhibited in the new Salon the bust of his friend "Puvis de Chavannes" (1892), "Contemplation" and a "Caryatid," both in marble, and the "Monument to Victor Hugo" (1897), intended for the gardens of the Luxembourg. In this the poet is represented nude, as a powerful old man extending his right arm with a sovereign gesture, the Muses standing behind him. In 1898 Rodin exhibited two very dissimilar works, "The Kiss," exhibited again in 1900, a marble group representing Paolo Malatesta and Francesca di Rimini, and the sketch in plaster for a "Statue of Balzac." This statue, a commission from the Society of Men of Letters, had long been expected, and was received with vehement dissensions. Some critics regarded this work, in which the poet was represented in his voluminous dressing gown, as the first-fruits of a new phase of sculpture; others, on the contrary, declared that it was incomprehensible, if not ridiculous. This was the view taken by the society who had ordered it, and who "refused to recognize Rodin's rough sketch as a statue of Balzac," and withdrew the commission, giving it to the sculptor Falguière. Falguière exhibited his model in 1899. In the same Salon Rodin, to prove that the conduct of the society had made no change in his friendship with Falguière, exhibited a bust in bronze of his rival, as well as one of "Henri Rochefort." In 1900 the city of Paris, to do honour to Rodin, erected at its own expense a building close to one of the entrances to the Great Exhibition, in which almost all of the works of the artist were to be seen, more especially the great "Portal of Hell," still quite incomplete, the "Balzac," and a host of other works, many of them unfinished or mere rough sketches. Here, too, were to be seen some of Rodin's designs, studies, and water-colour drawings. He has also executed a great many etchings and *sgraffiti* on porcelain for the manufactory at Sèvres. His best known etching is the portrait of Victor Hugo. Rodin's works may be found in some private collections, and at the Luxembourg he is represented by a "Danaïd" (in marble), a "Saint John" (in bronze, 1800), "She who made the Helmet" (bronze statuette), and the busts of "J. P. Laurens" and of "A Lady." In the Musée Galliera is a very fine bust of Victor Hugo. Rodin has exerted a marked influence on many contemporary artists.

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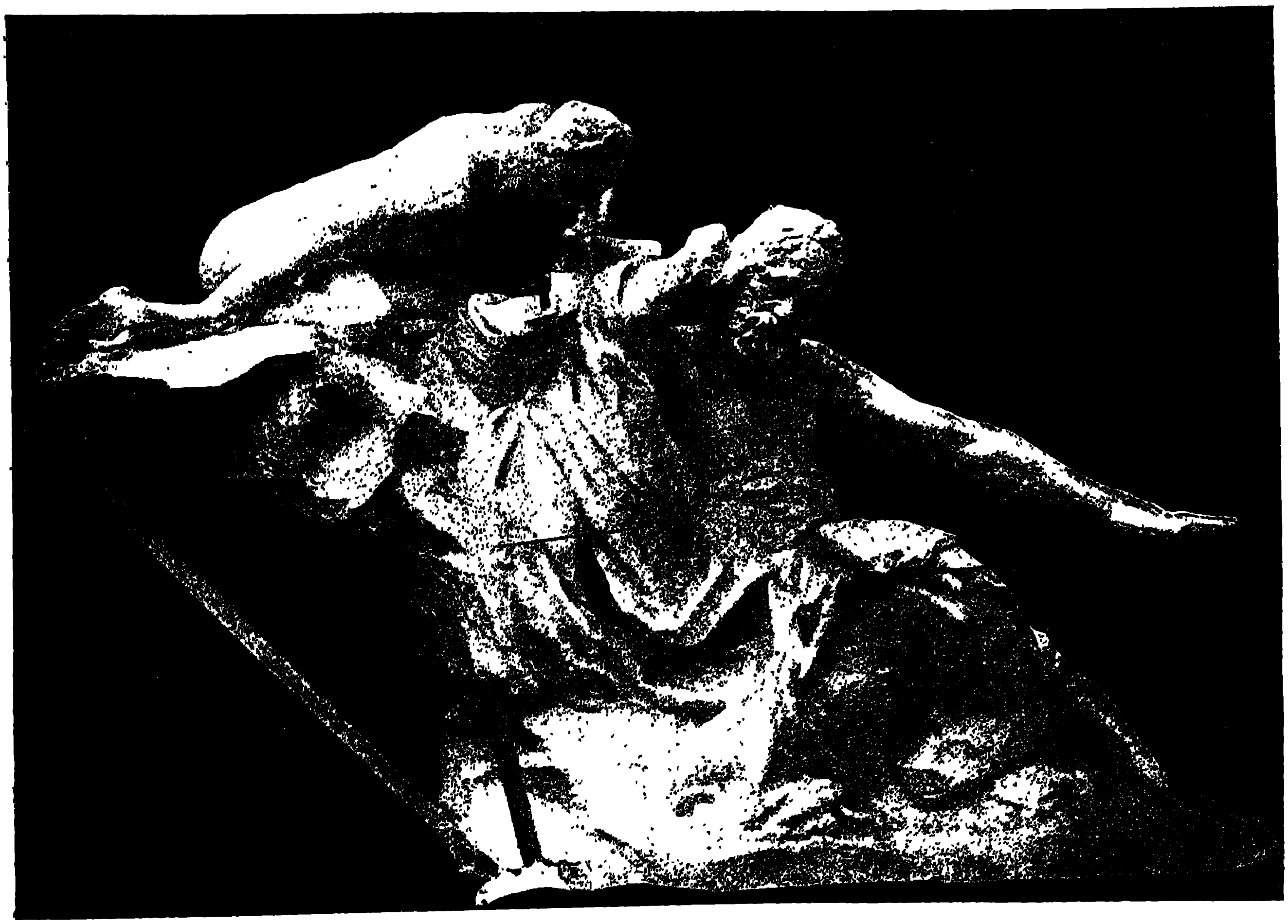
Rodosto, a town of European Turkey, is an open roadstead on the Sea of Marmora, about 85 miles west of Constantinople, of which it is practically a commercial dependency. It is the administrative centre of a district producing and exporting barley, oats, spelt, and canary seed, and largely planted with mulberry trees, on which

"The Burgesses of Calais." By Auguste Rodin.



Victor Hugo. By Auguste Rodin.

are fed silkworms of the "Baghdad" breed. White cocoons to the amount of 394 cwt. were exported to western Europe in 1901, besides a large quantity of silkworms' eggs to Russia and Persia. Being financially dependent on the capital, Rodosto suffered heavily during the commercial crisis which paralysed the trade of Constantinople in the years 1896–99, and a considerable area of land fell out of cultivation. This period of depression was followed, however, by two years of exceptional abundance. Population (1890), 19,558; (1902), 35,000.

Roebuck, John Arthur (1802–1879), British politician, was born at Madras on 28th December 1802. After the death of his father, a civil servant, his mother's second marriage transferred him to Canada, where he was chiefly brought up. He came to England in 1824, was called to the Bar, became intimate with the leading Radical and utilitarian reformers, was elected M.P. for Bath in 1832, and took up that general attitude of hostility to the Government of the day, be it what it might, which he retained throughout his life. At all times conspicuous for his eloquence, honesty, and recalcitrancy, he twice came with especial prominence before the public—in 1838, when, although at the time without a seat in Parliament, he appeared at the bar of the Commons to protest in the name of the Canadian Assembly against the suspension of the Canadian constitution; and in 1855, when, having overthrown Lord Aberdeen's ministry by carrying a resolution for the appointment of a committee of inquiry into the mismanagement in the Crimean War, he presided over its proceedings. In his latter years his political opinions became greatly modified, but with one interruption he retained his seat for Sheffield, which he had gained in 1849, until 1879, when he died with the reputation of an intrepid, pugnacious, perfectly disinterested and thoroughly impracticable senator.

Rofreit. See Rovereto.

Rogers, James Edwin Thorold (1823–1890), political economist, was born at West Meon, Hampshire, in 1823. He was educated at King's College, London, and Magdalen Hall, Oxford. After taking a first-class degree in 1846, he was ordained, and was for a few years a curate in Oxford. Subsequently, however, he resigned his orders. For some time the classics were the chief field of his activity. He devoted himself a good deal to classical and philosophical tuition in Oxford with success, and his publications included an edition of Aristotle's *Ethics* (in 1865). Simultaneously with these occupations he had been diligently studying economics, with the result that in 1859 he was appointed professor of statistics and economic science at King's College, London, a post which he filled till his death. From 1862 to 1867 he also held the position of Drummond professor of political economy at Oxford. During that period he published (in 1866) the first two volumes of his *History of Agriculture and Prices in England*, a minute and masterly record of the subject and the work upon which his reputation mainly rests. Two more volumes were published in 1882, a fifth and sixth in 1887, and he left behind him at his death copious materials for a seventh and eighth. In 1868 he published a *Manual of Political Economy*, and in 1869 an edition of Adam Smith's *Wealth of Nations*. In 1875 he collected and edited the *Protests of the Lords*. An intimate acquaintance with Cobden and John Bright led Rogers to take an active part in politics: he represented Southwark in Parliament from 1880 to 1885, and Bermondsey from 1885 to 1886, as a Liberal. In 1888, on the death of Professor Bonamy Price, who had succeeded him at Oxford as professor of political economy, he was re-elected to the post, and held it till his death. Previously (in 1883) he had been appointed lecturer in political economy at Worcester College, Oxford. His latter years were mainly spent at Oxford, where he died on 12th October 1890. He was celebrated in society as a wit and humorist. Of his miscellaneous economic and historical writings, which were numerous, the most noteworthy is his *Six Centuries of Work and Wages*, published in 1884.

(R. F. S.)

Rogier, Charles Latour (1800–1885), Belgian statesman, descended from a Belgian family that had settled in the department of the Nord in France, was born at St Quentin on 17th August 1800. His father, an officer in the French army, perished in the Russian campaign of 1812; and the family moved to Liége, where the eldest son, Firmin, held a professorship. Charles, after being called to the Bar, founded, in collaboration with his lifelong friends, Devaux and Lebeau, the journal *Mathieu Laensberg* (afterwards *Le Politique*), which by its ardent patriotism and its attacks on the Dutch administration soon acquired a widespread influence. When the insurrection of 1830 broke out at Brussels, Rogier put himself at the head of 300 Liégeois, and inscribing on his banner the motto, "Vaincre ou mourir pour Bruxelles," marched upon the capital. Here he took his place at once among the leaders of the revolutionary party. His influence saved the town-hall from pillage on 19th September. On the 24th a *commission administrative* was formed, of which Rogier became president. The energetic measures of this body and of its successor, the *gouvernement provisoire*, soon freed the greater part of the country from the Dutch troops. Rogier was sent as delegate of the provisional Government to Antwerp, where the citadel still held out for Holland. He succeeded in arranging an armistice, and then, in the exercise of the absolute power with which he was invested, organized afresh the entire administration of the city. He sat for Liége in the National Congress, voted for the establishment of a hereditary monarchy, and induced the Congress to adopt the principle of an elective second chamber. In the long-drawn debates on the bestowal of the crown, he ranged himself on the side of Louis Philippe: he first supported the candidature of Otto of Bavaria, and on the latter's rejection declared for the Duc de Nemours. Finally, when Louis Philippe declined the crown on behalf of his son, Rogier voted with the majority for Leopold of Saxe-Coburg. In June 1831 he was appointed governor of the province of Antwerp, a post rendered exceptionally difficult by the continued presence of Dutch troops in the citadel. The ability he displayed was so marked that in October 1832 he was made minister of the interior in the Goblet-Devaux cabinet. In the following June he intervened with characteristic courage in a quarrel in the Chamber of Deputies between Devaux and the Opposition leader Gendebien, claimed a prior right to give satisfaction, and fought a duel, in which he was severely wounded. During his term of office he carried, in the teeth of violent opposition, a law that established in Belgium the first railways on the continent of Europe, and thus laid the foundation of her industrial development. Owing to dissensions in the cabinet, he retired in 1834, together with Lebeau, and resumed the governorship of Antwerp. On Lebeau's return to power in 1840, Rogier became minister of public works and education. The proposals that he made in the latter capacity were defeated by the determined opposition of the Clerical party, and on the resignation of the ministry in 1841, Rogier gave his support to a compromise on the subject of education, which passed into law in 1842. He led the Liberal party in Opposition till 1847, when he formed a cabinet in which he held the ministry of the interior. He at once

embarked on a programme of political and economical reform. He took effective steps to remedy the industrial distress caused by the decay of the Flemish linen trade. The limits of the franchise were extended; and as the result of the Liberal policy of the Government, Belgium alone escaped the revolutionary wave that spread over the Continent in 1848. He passed a law in 1850 organizing secondary education under the control of the State, and giving the clergy only the right of religious instruction. The Clerical party, though unable to defeat this measure, succeeded in shaking the position of the cabinet; and it was finally undermined, after the *coup d'état* of 1851, by the hostility of the French Government, which found its political exiles welcomed by the Liberal cabinet at Brussels. Rogier retired in October 1852, but was brought back into office by the Liberal reaction of 1857. He again became president of the council and minister of the interior in a cabinet of which Frère-Orban was the most conspicuous member. The first important measure passed by the ministry was one for the fortification of Antwerp. In 1860 the fear of French designs on the independence of Belgium led to a movement of reconciliation with Holland, and inspired Rogier to write the only one of his numerous poems that is likely to survive, his national anthem, "La Nouvelle Brabançonne." Some of the ministers resigning in 1861, on the question of recognizing the kingdom of Italy, the cabinet was reconstructed, and Rogier exchanged the ministry of the interior for that of foreign affairs. In this capacity he achieved a remarkable triumph of diplomacy in freeing the navigation of the Scheldt, and thus enabling Antwerp to become the second port on the mainland of Europe. Defeated at Dinant, he sat for Tournai from 1863 till his death. His younger and more energetic colleague, Frère-Orban, gradually overshadowed his chief, and in 1868 Rogier finally retired from power. He continued, however, to take part in public life, and was elected president of the extraordinary session of 1878. From this time his age, his devoted patriotism, and the unassuming simplicity of his life made him the idol of all classes. The fiftieth anniversary of the kingdom of Belgium in 1880, and two years later that of his entry into parliament, were the occasion of remarkable demonstrations in his honour. He died at Brussels on 27th May 1885, and his remains were accorded a public funeral. (H. SY.).

Rohilkhand, or ROHILCUND, a division of British India, in the North-Western Provinces. It comprises the six districts of Bijnor, Moradabad, Budaun, Bareilly, Shahjahanpur, and Pilibhit. Area, 19,908 square miles; population (1891), 5,343,674, being 489 persons per square mile. It also includes the native state of Rampur. In 1897–98 the Rohilkhand system of canals irrigated 122,767 acres; the gross receipts were Rs.1,89,414, giving a net return of 3·67 per cent. on a capital outlay of Rs.17,73,000.

See Sir JOHN STRACHEY, *Hastings and the Rohilla War.* Oxford, 1892.

Rohlfs, Friedrich Gerhard (1831–1896), traveller, was the son of a physician, and was born at Vegesack, near Bremen, 14th April 1831. After the ordinary course at the gymnasium of Osnabrück, he entered the Bremen corps in 1848, and took part as a volunteer in the Schleswig-Holstein campaign, being made an officer after the battle of Idstedt, July 1850. He then for several years devoted himself to the study of medicine at the universities of Heidelberg, Würzburg, and Göttingen; but yielding to his natural inclination, he travelled over nearly all Europe, and then proceeded to Algeria, where he acted as military surgeon during the French campaign of 1855–60, and was appointed for his bravery Chevalier of the Legion of Honour. Having studied the language and customs of Algeria, Rohlfs went to Morocco in 1861, and presenting himself as a Mussulman, gained the favour of the enlightened Sherif of Wezzan, and was thus enabled to travel over the length and breadth of the country. He then explored the western portion of the Sahara and the entire extent of the Wed Draa, being the second European (the first being René Caillié) to visit Tafilet. Between that town and Kanatsa he was robbed by his guides and left for dead, 1862; but two marabuts charitably succoured him, and quickly recovering health, he again set forward in 1864 to Tuat, which he was the first European to reach and describe. Returning by Ghadames and Tripoli, he spent a few months in Germany, and then went back to Tripoli, intending to explore the highlands of the Ahaggar; but being prevented by a war among the Tuaregs, he went to Muzzuk, where he remained until 1866, and then entered Bornu, when he explored and mapped the oasis of Kawar. Rohlfs then passed through Mandara and its ancient capital Mora, and struck out for the coast of the Gulf of Guinea. Passing through Gugeba and Gongola, he crossed the Sokoto mountains, descended the Benue to Lakodja, and ascending the Niger to Rabba, proceeded on horseback to Lagos, and landed at Liverpool, 2nd July 1867. In the following year he accompanied the Abyssinian expedition, and traversed the Cyrenaica, reaching Egypt by way of the oasis of Siwa, 1869. Rohlfs then returned home, married, and settled down in Weimar. He did not rest long, however, for in 1873–74 he carried out an expedition to the desert of Libya for the Khedive. Commissioned by the German African Society, he proceeded to Wadai in 1878, but was driven back by the natives. In 1880 he accompanied Dr Stecker in the German exploring expedition to Abyssinia; but after delivering a letter from the Emperor to the Negus, he returned to Europe. In 1885 Prince Bismarck appointed him consul at Zanzibar; but he was shortly recalled, and did not again visit Africa. Rohlfs published accounts of each of his expeditions, as well as several works on Africa and its people. His death took place at Rüngsdorf, near Bonn, 2nd June 1896. (G. F. R.)

Rohtak, a town and district of British India, in the Delhi division of the Punjab. The town is a railway station, 42 miles north-west of Delhi. Population (1881), 15,699; (1891), 16,702; municipal income (1897–98), Rs.23,758. Cotton turbans are manufactured. The municipal high school cost Rs.22,000.

The district of ROHTAK has an area of 1797 square miles. Population (1891), 590,475; (1901), 630,711, showing an increase of 7 per cent. Land revenue and rates (1897–98), Rs.11,25,828, the incidence of assessment being R.0.13.5 per acre; cultivated area, 548,493 acres, of which 182,968 were irrigated, including 117,531 from Government canals; number of police, 433; number of schools (1896–97), 103, attended by 5087 boys, being 10·3 per cent. of the boys of school-going age; death-rate (1897), 32·64 per 1000. The principal crops are millet, pulse, wheat, barley, cotton, sugar-cane, and indigo. The district is traversed by the line of the Southern Punjab Railway from Delhi to Jhind, and also touched on by the Rewari Firozpur branch of the Rajputana Railway; total length, 52 miles. Part of it is watered by the Western Jumna canal. It is peculiarly exposed to drought, suffering in the famine of 1896–97 (when the maximum number of persons on relief was 12,781 in June 1897), and again in 1899–1900.

Roman, a town in Rumania, situated on the left bank of the river Moldava, near its junction with the

Sereth, is the chief place of the district of the same name. It is the seat of an Orthodox bishopric created in 401 by Alexander the Good. There are several fine churches, including the cathedral. Population (1895), 15,687; (1900), 14,019, of whom 6099 were Jews.

Roman Catholic Church.—The history of the Catholic Church since 1880 roughly coincides with the history of the Pontificate of Leo XIII., who came to the throne in 1878. It may be considered, therefore, in the present outline from that standpoint.[1]

As regards his own position at Rome, Leo XIII., like his predecessor, has kept up the protest against the invasion of his temporal sovereignty. The principal occasions on which he has spoken to this effect were his first Encyclical, which announced his accession and indicated the policy of his reign; the Allocution to the Cardinals of 4th August 1881, on the occasion of the insults offered to the remains of Pius IX. during their transfer from St Peter's to San Lorenzos without the Walls; and his Allocution of 2nd March 1884, on the occasion of the practical confiscation, under the guise of conversion, of the property of the Congregation de Propaganda Fide, the great central missionary agency of the Catholic Church. A recent clear account of the grounds on which the Pontifical protest is based may be read in Archbishop Ireland's Pastoral Letter (given by the *Tablet* for 11th January 1901), which cites the interesting analogy of the District of Columbia kept free from incorporation in the states of the Union in order to guard the independence of the Federal Government. So far from being animated by any temporal ambitions, as has been alleged, the Pontiffs declare that they must ever claim the restitution of the small temporal sovereignty which Providence has assigned them, precisely because without it it is impossible for them to discharge adequately their spiritual office as rulers of the universal Church. It is a continual charge made by their enemies against the Popes, that their action on the local Church administration in the different countries is the action of a "foreign Power." There would be some justification of the charge, or at least of the suspiciousness out of which it springs, if the Popes consented to be the subjects of any one temporal ruler; and it is only by their persistent protests against the subjection in which it is sought to place them that they have hitherto been able to avoid the difficulty. Again, the Popes require to surround themselves with various institutions through which, as central agencies, they may control and guide the work of the Church in its different departments throughout the world. Such are the Sacred Congregations, particularly the Holy Office, the Congregation of Bishops and Regulars, the Propaganda, the Mother-Houses of the Religious Orders. Unless the Pope can maintain these institutions in due freedom and with the necessary resources to enable them to do their work in the spirit, in the manner, and with the effectiveness which he judges desirable, the ill effects must be felt not in Rome only, but in every country. Once more, the region which is the headquarters of the Pontifical government should, above all others, be one in which the Church is free to display fully and publicly the characteristic features of Catholic life. It is certainly not one in which it ought to be exposed to anti-Christian restrictions and persecutions. Yet in regard to all these matters the Pope, if not a temporal ruler himself, must be at the mercy of the ruler under whom he is placed; a ruler whose government may be favourable to the Church's best interests, but may equally well be actively hostile to them. It is obviously with the view of showing that these liabilities are not merely theoretical that Leo XIII. has timed his recurrent protests as he has done.

Roman question.

If in Rome the necessity of securing for the Holy See its perfect liberty of action and immunity from suspicion in the exercise of a spiritual office affecting the whole world renders it impossible for the Popes to acquiesce in the invasion of their temporal jurisdiction, in other countries the same insistence on a particular form of government or objection to political change is by no means essential to Catholicism. Men who are Catholics by creed will have also their political opinions like other men, with whom they will divide off into parties, differing among themselves; and again, like other men, may take action in accordance with their political opinions. But as Catholics they have no complaint against any government solidly established in their midst on account of its form, as monarchical or republican, but only if it attempts to penalize the practice of their ancient religion, or their endeavour to bring up their children in the same. When this is done, they find themselves in the necessity of choosing whether they will obey God or comply with the laws imposed on their country, and it is obvious on which side lies their conscientious duty. On the other hand, where no attempt is made thus to interfere with their worship of God, there is no class of citizens on whose peaceful submission to their civil rulers greater reliance can be placed. The truth here stated is important, as explaining the contrasts between the Catholics and their respective governments in the three principal European countries.

In Great Britain, speaking generally, there is no longer a Catholic question, and the Catholics in consequence live in perfect contentment with the national institutions, and cause no anxiety to their rulers. In Ireland, indeed, there is dissatisfaction and agitation, but this is due partly to some serious religious grievances, but mainly to causes which are political and social, not religious.

In Germany, when the Pontificate of Leo XIII. began, a disastrous conflict between the Imperial Government and the Church was in progress. It was called the Kulturkampf, as professing to be undertaken on behalf of civilization and culture; but it had originated in the belief, instilled into the Government by interested persons, that the Vatican Decrees on Infallibility were issued for a political purpose. The May Laws—so called because passed through the Reichstag in May 1873—besides suppressing the religious orders, gave the entire control over the education, appointments, and tenure of office of the clergy into the hands of the State: they forbade also all disciplinary control over the clergy by any foreign ecclesiastical authority—in other words, by the Holy See. Compliance with such laws as these would have meant co-operation in a speedy conversion of German Catholicism into a schism and a heresy. The Catholics had therefore no other course left open to them save to continue as best they could their own system under the rule of the Holy See, and offer to the May Laws a resolute and as far as possible an organized passive resistance. This they did with the aid of the Centre or Catholic party in the Reichstag, but the consequences to themselves were terrible. Before many years were over five bishops, together with numbers of their clergy, were in prison, whilst several sees were vacant, and innumerable parishes left without other pastors than the few priests who went about in secret. At length it became evident even to the authors of the Kulturkampf that the effects of their campaign were the exact opposite of what they had desired: that they, by alienating a perfectly peaceful section of its subjects, were weakening instead of

Germany.

[1] See also the article VATICANISM for a treatment of some of these questions from a rather different point of view.—ED.

strengthening the bonds of the empire, and that this result was the more sad as they had been entirely misled as to the character of the Vatican Decrees, and were fighting against a purely imaginary danger. Thus by the time Leo XIII. came to the throne an opportunity had been created which, with his diplomatic instincts, he did not fail to perceive and use. In announcing his election to the German Emperor he took occasion to hope that the peace which had formerly prevailed throughout the empire between the Church and the Government might before long be restored; and in another letter to the Archbishop of Cologne he expressed his intention of working for that happy end to the extent of his power. The friendly overtures were received in a corresponding spirit; and although nothing was altered at the time, the *rapprochement* grew, and by 1886 had led to the withdrawal of the more obnoxious clauses of the May Laws, though some still remain. The consequences have been seen proportionately in the revived attachment of the Catholics for the empire and its rulers. It would, however, be an error to suppose that all traces of unfairness to this portion of the German people have been removed.

France. Whilst in Germany the relations between the Church and the State improved, in France they went from bad to worse, and all because the ruling party had not learnt the lesson taught it by the two neighbouring kingdoms. It was the Second Republic, and the Third Republic in its earlier stage, which conceded to the French Catholics their most valuable rights and liberties; and had the same tolerant spirit continued, probably the republican form of government would have been in general favour among them. But in 1879 the anti-religious party came into power, and the governmental principle which Gambetta had proclaimed shortly before was henceforth to prevail—"*le Cléricalisme voilà l'ennemi.*" The Ferry Ministry, which was under his domination, brought before the Chambers in 1879 two Bills framed with the express purpose of rendering impossible the Catholic education of the young. Of these the first and most important, besides suppressing the charters of the recently established and flourishing Catholic universities, declared all members of religious congregations unauthorized by the State incapable of giving public or even private education of any kind—a declaration aimed chiefly at the Jesuits, who had numerous schools throughout the country. The Senate refusing to pass the latter portion of the Bill, M. Jules Ferry resolved to accomplish his purpose in a more arbitrary way. In March 1880 he issued two ministerial decrees to the same effect as the rejected Bills. By the first the Jesuits were ordered to quit all their houses within the space of three months; and the other congregations of both sexes, under pain of incurring the same proscriptions, were ordered to apply within six month for an authorization, which it was intended in most cases to refuse. That these measures were illegal was made manifest by the fact that more than five hundred magistrates gave up office rather than enforce them; but they were none the less ruthlessly carried into effect, and the work of Catholic education was for the time in ruins. Gradually, however, thanks to the enormous energy of the French Catholics and the comparative tolerance of some of the cabinets which succeeded M. Ferry's, a tolerance due to the realization that the decrees had only proved sources of national division, the Catholic schools were re-established under lay proprietorship, but with staffs partly composed of members of the teaching congregations. Their numbers increased considerably, and they were preferred to the State schools by a growing number of parents, including those from whose political proclivities one would have least expected it. Hence the return of 1902 to the policy of M. Ferry, but with the aid of laws much more drastic than his decrees. Side by side with these endeavours to withdraw secondary education from the influence of the Church went on the process of "laicizing" the primary schools, orphanages, hospitals, and other State institutions—that is, of substituting staffs of lay officials for the brothers and nuns of the different congregations to whose care they had been previously entrusted. This process could only be gradual, in proportion as lay teachers and nurses were obtainable to fill up so many posts, but by the end of the 19th century the transformation was practically complete. Other measures tending in the same direction were the imposition of military service on candidates for the priesthood, and the serious diminution of the budget for the maintenance of the bishops and parochial clergy, which budget, by the terms of the Concordat, the State had pledged itself to provide annually, in exchange for the Church property then made over to it at its desire. These assaults of its adversaries on the Catholic Church in France were aided by the political divisions in the Catholic party, split up into Legitimists, Orleanists, Bonapartists, and Republicans, and thereby rendered incapable of any sustained action on a common principle. The evil seems to have been a matter of concern to Leo XIII. from the beginning of his Pontificate, and in February 1892 he wrote his famous *Encyclical to the French People*, exhorting them to lay aside political aims, over which they are so much at variance, and accept the form of government under which they were actually living, a form which in itself was not unlawful or incompatible with their religion on the one hand or with national progress on the other. He bade them unite to form a Catholic party on this basis, and use their constitutional rights to work for the restoration of their religious liberties and the pacification of their country. He addressed himself "not only to the Catholics, but to all upright and reasonable Frenchmen," appealing to them on the ground that only thus could domestic peace return to the nation under a durable social bond. The policy recommended in this Papal letter was not without its influence on the course of the religious movement in France. It was resented, indeed, in some circles, but was accepted and obeyed by the bishops and clergy generally, and gradually made its way among the Catholic body. The future alone can reveal to us whether it is destined to achieve a wider success; but at least it bears witness that the Holy See will always do its best to remove all needless causes of strife, and may help to dispel the delusion that the free development of Catholic life and work is a danger, and not rather a support, to any Government which will leave it unharassed. On the other hand, it is writ large on the page of modern French history that a policy of religious persecution tends only to cleave a nation in two, by parting off its sons into hostile camps, to the great detriment of the national welfare.

Encyclicals. A special feature of the history of the Pontificate of Leo XIII. is the series of Encyclicals by which that Pontiff endeavoured to guide Catholic thought on various subjects of importance. Among them the following have been the most notable: *The Æterni Patris* of 1879, in which an impulse was given to philosophical study, and the philosophy of St Thomas of Aquinas was indicated as the basis on which it should rest; the *Immortale Dei*, of 1st November 1885, on the Constitution of Christian States, in which the teaching of catholic philosophy on the origin, character, and limits of civil government was expounded; the *Libertas*, of 20th June 1888, which distinguishes between true and false liberty; the *Rerum Novarum*, of 15th May 1891, in which the right of personal property is vindicated, and the respective

rights and duties of employers and employed are set forth; the *Providentissimus Deus*, of 18th November 1894, which encourages Biblical studies, and declares what it is necessary for a Catholic to hold about inspiration. With these Encyclicals may be counted the *Letter*, of 18th August 1883, addressed to Cardinals Luca, Pitra, and Hergenroether, on the importance of a solid study of Church history. They were to prepare the Vatican Library for the use of scholars of all nations, without distinction of religious belief. Important use has been made of this permission, and the different Governments sent their representatives to search for documents bearing on the history of their respective countries. Of Leo XIII.'s letters of an administrative character three may be mentioned as having attracted much attention. The *Romanos Pontifices*, of 9th May 1881, settled within what limits the religious communities should henceforth be exempt from, or subject to, the jurisdiction of the bishops. It was originally issued to terminate certain controversies which had arisen in England, but has since been extended to other countries where the Church is similarly on a missionary footing. The *Officiorum et Munerum*, of 22nd February 1897, recast the Rules of the Index, with a view to adapting them better to the conditions of the modern period. The *Testen Benevolentiæ*, of 22nd January 1899, condemned a set of opinions which, having been advocated chiefly in America, had most unfortunately and inappropriately come to be called Americanism. Another class of Apostolic Letters was inspired by Leo XIII.'s ardent wish for the reunion of Christendom. In 1894, on 2nd July, appeared the *Præclara Gratulationis*, addressed to "the rulers and nations of the world." It was universal in its scope, but contained an urgent appeal to the Orientals, exhorting them to desire and work for the reconciliation of East and West. It was followed shortly afterwards by the establishment of a Roman Commission "for the reunion of Christendom," which was to sit regularly and work for that end. It was followed also in the same year by the *Orientalium dignitas*, or Apostolic Constitution for the Eastern Churches, which sought to remove the false impression that submission to the Holy See meant the abandonment of the ancient Eastern rites for those of the Latin Church. With this end in view it enforced the restrictions even previously enjoined, which compelled converts from the Eastern schismatic communions to attach themselves to corresponding Uniat Churches, and use their rites only. Shortly after the *Præclara Gratulationis*, namely, on 14th April 1895, appeared the Letter *ad Anglos*. It was likewise an appeal to work for reunion, and was intended to remove any impression which might exist that the Pope was animated by other than cordial and sympathetic feelings for English Protestants. This letter was succeeded on 29th June 1896 by the *Satis cognitum*, an exposition of the grounds on which the Holy See bases its duty of claiming supreme jurisdiction over the Church; and on 13th September 1896 by the Bull *Apostolicæ Curæ*. The latter was the outcome of a fresh inquiry into the validity of Anglican orders, which Leo XIII. had instituted to satisfy the desire of those who thought that previous inquiries had not been thorough enough to command confidence. This Bull declared the orders in question to be altogether null and void.[1]

Catholicism in England.

The Clergy.—On the accession of Queen Elizabeth a considerable portion of the clergy and people conformed to the new laws concerning Roman Catholicism, but the bishops, with the exceptions of Kitchin of Llandaff, Stanley of Sodor and Man, some 180 or more of the "dignified clergy," and an unknown number of the lower clergy, remained steadfast in the old faith and refused to take the oath of supremacy. Accordingly, the bishops were all at once dispossessed of their sees, and either imprisoned or placed under detention. The clergy likewise were gradually removed from their benefices. Thus the old machinery for ecclesiastical administration was destroyed, and the faithful found themselves without regular pastors. A portion, however, of the dispossessed priests contrived to live in concealment, and minister as best they could to the spiritual wants of those whom they could reach. Dodd says of them in his *History* (vol. ii. p. 141): "There was not a province through all England where several of Queen Mary's clergy did not reside, and were commonly called the old priests. They served as chaplains in private families. Their names and residences I have frequently met with in the manuscripts in composing this work. Again, several Catholic clergymen found such friends as to be permitted to enjoy sinecures, without being disturbed by oaths and injunctions." But these "old priests" must die out soon, and the old faith with them, unless new arrangements could be made for a continuous supply to take up and extend their work. The need was foreseen, and the "foreign seminaries" were established to provide for it. These were Douay College, founded by Dr (later Cardinal) Allen in 1568; the English College at Rome, remodelled for the purpose in 1576; St Alban's College, Valladolid, founded in 1589; and the establishments founded shortly after at Seville and Lisbon. Thither resorted young men of zeal and capacity to receive their ecclesiastical education, who were afterwards sent back as missionaries to their own countrymen. In distinction to the Marian clergy, they were called the "seminary priests," and were a special object of aversion to the Government, which had been counting on the inevitable extinction before long of the Marian clergy. Accordingly, it was made a capital offence for them to enter the country, and likewise for any person to harbour them under his roof for a night. Nevertheless they braved the danger, and came over regularly in yearly detachments, until by 1596 we learn, from a letter of Father Holt, there were about three hundred of them at work in the country. Many of them, however, paid the price of their zeal, suffering long and painful imprisonments not unaccompanied by the application of torture, whilst nearly two hundred shed their blood for their faith on the scaffold. The seminary priests were secular clergy, but they were supplemented in their work by members of two of the religious orders, the Jesuits and Benedictines. The Jesuits began to come in 1580, when Parsons and Campion were sent over, to be followed by regular supplies, which continued all through. At the beginning of the 16th century the Benedictines were also coming—that is to say, the Benedictines from abroad, who by this time were provided with some English subjects. The old English congregation of this order had died out with the Marian priests, except that there was just one former monk of Westminster, Father Sigebert Buckley, still surviving, who in 1607 admitted to profession twelve English-speaking Benedictines from abroad, and thus preserved the unbroken continuity of that congregation up to the present day. Some others of the religious orders appeared in small numbers, but took no part in the permanent missionary work of the country till much later. Still, some insight into the ultimate proportions between the different sections of the clergy may be had from the report to Propaganda of the Vicars-Apostolic towards the close of the period of the Penal Laws. According

[1] See also the article Anglican Orders.

to these reports, in 1773 there were then on the mission in England "121 Jesuits, 44 Benedictines, 37 Franciscans, 8 Dominicans, 7 regulars of other orders, and 175 secular priests." Besides the clergy actually working in the country, there were others belonging to the same categories retained on the Continent to carry on the schools there established for the education of youth, schools for them in England being forbidden under heavy penalties. Of these schools, one was at Douay in connexion with the seminary, and under the charge of the secular clergy; another, under the charge of the Jesuits, was at Saint Omer; and there were also establishments under the charge of the Benedictines at Douay, Paris, and Dieulwart. Mention should also be made of the English convents for Englishwomen wishing to lead the life of nuns, some of which also received young girls for their education. Such were the Bridgettines of Lisbon (the lineal representatives of the nuns of Sion House, Isleworth, who went into exile at the accession of Elizabeth); the Benedictines at Brussels, Cambrai, and Ghent; the Poor Clares at Gravelines; the Franciscans at Nieuport and Bruges; the Carmelites at Antwerp; the Sepulchrines at Liége; and the Augustians at Louvain. An effect of the French Revolution was to send all these houses of prayer and education back to England, where now they all have their representatives.

Ecclesiastical Administration.—The principle of authority pervades the Catholic system, and it would be accounted impossible for the clergy to engage in missionary work except in so far as they were commissioned and supervised by a competent ecclesiastical superior. When, therefore, the older system of administration broke down through the dispossession of the Marian bishops and those who held under them, it was necessary for the Holy See to substitute some other arrangement. The first measure of reconstruction was the granting of apostolic faculties (that is, faculties issued directly by the Apostolic See) to Drs Harding and Sander by Pius V. in 1566. These included the power to subdelegate; and a similar power was granted to de Quadra, the Spanish ambassador, who was a bishop. When Douay College was founded, Dr Allen was empowered by the Holy See to grant missionary faculties for the whole of England to the priests sent forth from the college. The next step in the development of the post-Reformation administration was the appointment in 1599 of an archpriest to reside in the country and exercise jurisdiction over the secular clergy, the regulars being still left under their own superiors for this purpose. As this arrangement curtailed the liberty of action which the seminary priests had till then enjoyed, it was not received without protest, and led to the "Archpriest controversy." George Blackwell, the first archpriest, was succeeded in that office by George Birkhead and William Harrison, the latter of whom died in May 1611. It was felt to be a great misfortune that the ruler of the missionary clergy should not be in episcopal orders; but the rigour of the persecution had hitherto made that appear impracticable, as a bishop would have been specially watched, and could not have hoped to avoid a speedy capture, as also to draw down a still fiercer persecution on the rest. On the death of Harrison, however, it was thought safe to make a further advance. The marriage of Prince Charles with the Catholic princess, Henrietta Maria, led to negotiations with the French Court, which insisted as a condition of the marriage that some relief from persecution should be extended to the English Catholics. Nothing definite was indeed settled, but advantage was taken by the Holy See of the passing disposition to mitigate the enforcement of the existing laws, and Dr William Bishop was appointed Vicar-Apostolic with episcopal orders. This prelate died almost immediately, but was succeeded by Dr William Smith, appointed, like his predecessor, titular Bishop of Chalcedon and Vicar-Apostolic over the whole of England. Bishop Smith's tenure of office was very brief. He became involved in what came to be called after him the "Bishop of Chalcedon controversy," over the question of the apostolic faculties of the regular clergy. As this drew attention to his presence in the country, he had to fly across the Channel, and took up his abode in Paris, where he remained till his death in 1665. He had also incurred the displeasure of the Pope by the position he had taken up in the aforesaid controversy, and was deprived of his office of Vicar-Apostolic. After him, and until 1685, the government of the clergy on the English mission was assumed by the Chapter, a body instituted by the first Vicar-Apostolic immediately after his own appointment. Their action in thus assuming to rule over the clergy was based on the common law of the Church, which entrusts the government of a diocese during the time of vacancy to the cathedral chapter; but as a Vicar-Apostolic has no right to a chapter, and the Holy See had never given the necessary formal approval to this English Chapter, the state of things ensuing was irregular, and amounted to a sort of anarchy. Three Papal envoys were sent over during the reign of Charles I.—Panzani, Con, and Rosetti—to reduce matters to order again. They were accredited to Queen Henrietta Maria, and probably would have succeeded in their task, only that the great Rebellion then broke out, during which nothing further could be done. After the Restoration, Monsignor Airoldi, the Papal Nuncio at Brussels, was sent over to resume the work, being accredited to Queen Catherine of Braganza; but nothing was accomplished till the reign of James II. James at once opened negotiations with Innocent XI., which led to the appointment of a new Vicar-Apostolic, Dr Leyburn, who was consecrated on 9th September 1685. He was appointed in the first instance, like his predecessors, Vicar-Apostolic over the whole country; but the area was too large for one man, and was divided in 1687 into two districts, and again in the following year into four, called respectively the London, the Midland, the Northern, and the Western districts. This arrangement was able to persist in spite of the renewal of persecution after the Revolution, and continued into the 19th century. In 1840 the growing needs of the Catholic body made necessary the subdivision of the four vicariates into eight, but even this was intended only as a temporary measure. Vicars-Apostolic are delegates of the Pope. Their indefinite powers are most suitable for regions where the Church is on a missionary footing, but they are not bound to their flocks by the same intimate ties as bishops in ordinary, and cannot become such effectual centres of pastoral work. Hence it is that there had been for some time a movement among the English Catholics for a restoration of the hierarchy, that is, of bishops in ordinary set over dioceses of their own, and formed into an ecclesiastical province under an archbishop. Probably the Holy See would have granted this sooner, only that it was most anxious to avoid offending English susceptibilities; and probably it would have delayed the measure still longer, could it have foreseen the fierce outburst of bigotry which it occasioned—contrary to the assurances received from English statesmen that the Government would view the matter with indifference. But it was well that it came when it did, for it was sadly wanted, and the English people soon discovered that it was a measure without political significance of any kind, but merely an arrangement for the better regulation and development of their spiritual life among the adherents of the ancient faith. The Bull *Universalis Ecclesiae*, restoring the hierarchy, was dated 29th September 1850. It

mapped out the country into twelve dioceses, a number which has since been increased by subdivision to fifteen. Care was taken in the selection of the sees to avoid all the names held at the time by the Anglican bishops, and in this desire the seat of the archbishop was placed at Westminster, not London. To give more impressiveness to the new order, a cardinal, Dr Wiseman, was appointed to be the first Archbishop of Westminster, and the precedent has been followed in the case of his two successors.

Statistics.—At the beginning of the reign of Elizabeth, even after her first penal laws had begun to tell, the adherents of the old faith were roughly estimated at about half the population of the country. By the end of her reign her repressive policy had achieved a practical success. There are no means of arriving at any figures, but it may be near the mark to conjecture that the Catholics then formed one-tenth of the whole. In the 17th century they continued to decrease, the persecutions following on the Gunpowder Plot and the Great Rebellion being specially disastrous to them. They increased again under James II., but the more skilfully contrived penal laws of William and Mary caused them to undergo another considerable fall. By the third quarter of the 18th century this fall had reached its ebb. A return to the House of Lords in 1780 gave the total number for England and Wales as 69,376, but this must have been a serious understatement. At all events, the turn of the tide began soon after, for Bishop William Gibson, who in 1819 computed the Lancashire Catholics alone at 50,000, stated that "within the last thirteen or fourteen years the mass of Catholics has been very great, in consequence of the abolition of the penal laws"; he means by the Acts of 1788 and 1791. During the 19th century, under the reign of tolerance introduced by the Emancipation Act of 1827, the number rose considerably, and is set down in the *Catholic Directory* for 1901 as about a million and a half. The contributory factors to this increase are (1) the natural growth of population, (2) the Irish immigration, and (3) the converts. The Irish immigration dates back in some measure to the end of the 18th century, but assumed large dimensions after the great famine of 1845. It was soon, however, superseded by emigration to the United States and the colonies, an emigration which drew off many of those who had previously immigrated into England. It is these Irish immigrants and their descendants who form the mass of the Catholic poor, particularly in the large towns, although this class has its numerous representatives of English birth in north Lancashire, as well as sprinklings in other parts of the country. In the upper and middle classes, in which, however, the absolute numbers are small, the English element probably predominates over the Irish, a fact largely due to the influx of converts during the last fifty years. As each reception of a convert is entered in the register of the church where it takes place, the means exist of computing their number with exactness. The average thus established during the later years of the 19th century was between eight and nine thousand a year. For the past it is more difficult to say, but in 1837, before the Oxford Movement began to influence the figures, we find Bishop Griffiths reporting to the Holy See that "last year 518 Protestants were converted to the Catholic faith in the London district," *i.e.*, in London and the home counties.

Against the growth of the Catholic population through the above-mentioned causes has to be set what is usually called the "leakage." This is a subject which has engaged much attention. Apart from neglected children who are picked up by Protestant institutions, there are apparently few Catholics who pass over to the religious practices of other denominations. But the number of those who neglect the practice of their own religion, and lapse into an indifferentism which either in themselves or their children tends to become permanent, must be very considerable, and perhaps balances, or even more than balances, the accessions to the Catholic population from other causes. This conclusion is established partly by actual observation, partly by inference from the number of baptisms and marriages. For the particulars on this point see Morris's *Catholic England in Modern Times* and Mr Britten's Catholic Truth Society's tract entitled *The Leakage.* The causes of the leakage are not difficult to recognize. The prevalent tone of thought and literature, so anti-dogmatic and agnostic, accounts for much. So too does the want of earnestness about their eternal destiny, which is to be expected in a proportion of the adherents of every religion, and naturally disposes them to abandon a religion whose tenets are disliked by the majority in the country where they live. But the most potent cause of all is the absence of proper parental control over the children of the poor in the period of life following on their school-days, an absence largely due to parental neglect, but largely also to the difficulty of exercising such control under the conditions of modern labour.

Catholic Institutions.—The growth of Catholic churches, chapels, and institutions since the establishment of the hierarchy has been very striking. In 1851 there were 826 priests and 586 churches in England and Wales; in 1880 there were 1962 priests and 1175 churches in the same area; in 1901 there were 2837 priests and 1536 churches. Some, too, of these churches are really fine buildings, as St George's Cathedral, Southwark; the Brompton Oratory; the Dominican Church at Haverstock Hill; the churches at Arundel, Norwich, and Cambridge. The Westminster Cathedral is recognized as destined to rank among the architectural monuments of London. Besides the growth in clergy and churches is the increase in colleges, monasteries, and convents. In 1851 there were only 12 monasteries and some 40 or 50 convents, most of which were in their infancy. Now there are some 80 monasteries, and convents innumerable, some 150 of which latter are engaged in the work of teaching. The number of colleges has also received accessions, whilst the few which are in the first rank have developed to considerable proportions. Some of these latter, as St Edmund's (Old Hall, Herts), Ushaw, and Stonyhurst, have already kept the centenaries of their abode on English soil, on the occasion of which some interesting books were written containing valuable information for the historical inquirer. It would have been impossible for a body so small and poor as the Catholics in England to provide for the educational needs of their children of the poorer class without aid from the public funds. Accordingly, since 1848, when the opportunity was first offered, the Catholic elementary schools have taken their place among the voluntary schools under Government. A great development has followed. In 1849 there were 89 schools, containing 8445 children, under Government inspection. By 1884 their numbers had grown to 828 schools and 169,115 children in average attendance, and by 1900 to 1049 schools and an average attendance of 251,768 children. The certificated teachers during the same interval grew from *nil* in 1848 to 2409 in 1886, and 2732 in 1900. To keep up the supply of these teachers there are three training colleges, one at Hammersmith for the male teachers, and two at Mount Pleasant, Liverpool, and West Hill, Wandsworth, for female teachers, to which another has been added at Glasgow for the female teachers in Scottish schools. A joint pastoral of the Catholic bishops in 1898 states that the Government grants earned by the

Catholic schools in 1897 amounted to £391,107, and the Government grants earned since 1848 to £6,013,513; also, that "between 1863 and 1895 the Catholic voluntary schools had subscribed (see Blue-books) £1,520,000; between 1870 and 1896, Catholics had spent on school premises (part of which is still owing) £1,850,000; whilst expenses on schools not under Government, or incurred before 1863, are estimated at over £1,000,000." And the bishops add that "if to the sum £4,370,000 (the sum total of the items just set down) be added the amount of school pence paid by parents of children in Catholic schools (£1,480,000), it will be found that the total contributed by Catholics towards public elementary education has been in reality much larger than the amount received in grants." It was not without a severe strain that the Catholic community supplied these sums; and besides them, there has been the expense of the training colleges, the condition of Government aid as regards which has been that the buildings and 25 per cent. of the cost of maintenance shall be provided by voluntary contributions. In connexion with Catholic elementary schools mention should be made of the Catholic School Committee, formed of priests and laymen representing the different dioceses. This was founded by the bishops in 1847, and has rendered invaluable service ever since. To it belongs the duty of maintaining and managing the training colleges, of making representations to the Education Office on questions that arise from time to time, of carrying out a system of religious inspection, and generally of unifying the action of all engaged in the work of the elementary schools. Besides elementary schools, it has been necessary to provide charitable institutions of various kinds—poor law schools, industrial schools, homes for destitute children, homes for penitents, homes for the sick and aged, nursing institutions, &c. A list of these may be found in the *Catholic Directory*, published annually, and a comparison of the current number with that for 1884 will show that during the interval good progress has been made. None the less, it is keenly felt by all Catholic workers how inadequate the existing supply is to meet the almost overwhelming demand. Further particulars as to these institutions may be learnt from the Catholic Truth Society's *Handbook of Catholic Charities*.

Foreign Missions.

The foreign missionary work of the Catholic Church has never been carried on with such a system of organization and on so large a scale as during the latter part of the 19th century. As regards organization, the whole of the foreign missions are placed under the supreme control of a central "Congregation," a kind of ministry or board, well known as "Propaganda" (Sacra Congregatio de Propaganda Fide), established by Gregory XV. in 1622. This important Congregation has been described as corresponding pretty much in the Catholic Church to the Colonial Office in the British Empire, and its head, the "Prefect of Propaganda," to the Secretary of State for the Colonies. It holds supreme control over all the foreign missions in heathen countries, and also over large and important parts of the Church in Christian countries whose Governments are not Catholic—including the British Empire, the United States, Holland, the Norse kingdoms, Greece, and some parts of Germany and Switzerland. A special section (erected by Pius IX.) has charge of the affairs of all the Oriental Rites in union with the Roman See. Confining our attention at present to the missions strictly understood under "foreign," *i.e.*, to heathen or non-Christian countries, we shall find the whole of these parts of the globe carefully mapped and parcelled out by Propaganda to a variety of missionary agencies or religious orders. The government of the various mission-fields is generally carried on by "Vicars-Apostolic" (*i.e.*, titular bishops acting as vicars or delegates of the Apostolic See) or "Prefects-Apostolic" (*i.e.*, priests with similar powers, but without episcopal rank). In some few cases (notably India and Japan) a regular territorial hierarchy has been established, just as in the United Kingdom and the Netherlands. Of the religious societies engaged in the evangelization of these many fields of labour, some have been established exclusively for foreign missionary work among the heathen—notably the famous Société des Missions Étrangères of Paris, the oldest and greatest of all (dating from 1658, and consisting of 34 bishops, 1099 European missionaries, and 598 native priests); the German "Society of the Divine Word," whose headquarters are at Steyl in Holland; the Belgian Society of Scheat; the celebrated French Society of the "White Fathers," founded by the late Cardinal Lavigerie for African missions; the English Society of St Joseph, founded at Mill Hill by Cardinal Vaughan; and some others. The other missions are entrusted to the care of various religious orders and congregations, which take up foreign missionary work in addition to their labours in Christian countries. Such are the Franciscans, Dominicans, Jesuits, Lazarists, Augustinians, Marists, &c. Besides the above orders of priests, an immense number of religious societies of women are engaged in works of education and charity throughout the whole of the foreign mission field. These have been reckoned at about 42,000 European and 10,000 native sisters. Again, there are some 20 congregations of "Brothers" (not priests) engaged in teaching, and numbering some 4500 members.

Turning now to the individual fields of labour under the care of Propaganda, we may briefly summarize the latest information as follows:—

	Dioceses, Vicariates, or Prefectures.	Stations.	Churches and Chapels.	Clergy.	Schools.	Charitable Institutions.	Catholics.
Africa	51	649	1,000	1,027	1600	231	463,824
Asia—							
India and Ceylon	35	..	4,750	(826 Europ.) (1580 Nat.)	2562	102	2,005,925
Farther India & Indo-China	14	..	2,500	(389 Europ.) (868 Nat.)	1702	148	783,237
Chinese Empire, Japan, and Korea	45	..	3,218	(810 Europ.) (386 Nat.)	2442	85	651,165
Turkey, Persia, Arabia	9	105	215	424?	524	..	138,830
East Indian Islands	2	110	62	60	17	..	50,290
America—							
British North America	32	..	2,716	2,703	5718	132	2,187,480
United States	87	..	10,922	10,049	5022	648	9,479,230
West Indies	4	..	102	119	120	..	250,300
Central and S. America[1]	7	..	120	131	161	11	182,500
Australasia	27	465	1,304	930	700	78	793,218
Oceanic Islands	9	123	165	184	165	12	60,858
Other Pacific Islands[2]	4	..	199	61	66	3	134,800
Europe—							
Sweden and Norway	2	17	25	34	37	10	2,750
Denmark (and Iceland)	1	18	33	40	23	7	7,000
Germany[3]	5	..	128	138	87	..	207,180
Holland and Luxemburg	6	1258	1,896	3,108	1468	..	1,654,340
Balkan Peninsula	18	..	694	390	332	30	896,210
Greece and Crete	9	..	195	115	78	8	55,310
Gibraltar[4]	1	2	8	12	14	4	15,300

[1] Only British, French, and Dutch Guiana, British Honduras, Patagonia, and Lower California.
[2] Carolines, Marquesas, Hawaii, Otaheite.
[3] Embracing Anhalt, some North German Duchies, Hanse Towns, &c., Schleswig-Holstein, Saxony, Lausitz.
[4] Malta is *not* under Propaganda.

FOREIGN MISSIONARY SOCIETIES AND THEIR FIELDS OF WORK.[1]

I. *Société des Missions Étrangères* (Paris, 1658).—*Missions:* Manchuria, Korea, Tibet, Japan, China (Sze-Chuen, Kui-Chow, Kwang-tong, Yunnan), Indo-China (W., S., and Upper Tongking, E., W., and N. Cochin-China; Cambodia; Siam), Malay Peninsula, Burma (S. and N.), S. India (dioceses of Pondicherry, Kombakonam, Mysore, Coimbatore). *Staff:* 34 bishops, 1099 European missionaries, 598 native priests. *Catholic flock:* 1,227,161.

II. *Society of "White Fathers"* (founded by Cardinal Lavigerie, 1868).—*Missions:* Algeria, Sahara, Nyasa, Victoria Nyanza, Tanganyika, Unyanyembe, Upper Congo. *Staff:* 9 bishops, about 150 missionaries.

III. *Lyons Seminary for Foreign Missions* (1856).—*Missions:* Nile Delta, Benin, Ivory Coast, Gold Coast, Dahomey, Upper Niger. *Staff:* 58 missionaries.

IV. *Congregation of the Holy Ghost* (1703 and 1848).—*Missions:* Senegambia, Gambia, Sierra Leone, Lower Niger, Gaboon, French Congo, Lower Congo, Mayotte, Nossibé, and Comoro Islands. *Staff:* 311 missionaries (9 bishops).

V. *Milan Seminary for Foreign Missions* (1850).—*Missions:* China (Hong Kong, N. and S. Ho-nan), East Burma, India (dioceses of Kishnagar and Haidarabad). *Staff:* 59 missionaries (7 bishops).

VI. *Steyl Society of Foreign Missions* (German, 1875).—*Missions:* S. Shan-tung, China; Togo, W. Africa. *Staff:* 1 bishop, 213 missionary priests, 555 lay brothers.

VII. *Scheut Society of Foreign Missions* (Belgian, 1863).—*Missions:* Mongolia, Kang-Su (China), Belgian Congo. *Staff:* 4 bishops, 61 missionaries.

VIII. *Picputian Society*[2] (Paris, 1817).—*Missions:* Hawaii, Tahiti, Marquesas Islands. *Staff:* 3 bishops, 50 missionaries.

IX. *Mill Hill Society* (English, 1866).—*Missions:* N. Borneo and Labuan; N. Punjab, Kashmir; and Ladak; Telugu missions of Madras; Maori missions of N. New Zealand; N. Uganda. *Staff:* 1 bishop, about 100 missionaries.

X. *Congregation of the Sacred Heart* (Issoudun, France, 1855).—*Missions:* New Guinea, New Pomerania, Gilbert Islands. *Staff:* 3 bishops, 34 missionary priests, 38 lay brothers.

XI. *Society of the Divine Saviour* (Rome, 1881).—*Mission:* Assam. *Staff:* 10 missionary priests, 3 lay brothers.

XII. *Verona Society for African Missions.*—*Mission:* The Sudan, Upper Egypt. *Staff:* 12 missionaries (1 bishop).

The following societies are engaged in home as well as foreign missions:—

XIII. *Marists* (French, 1816).—*Missions:* Fiji, Navigator's Island, New Caledonia, Central Oceania, Solomon Islands, parts of New Zealand (dioceses of Wellington and Christchurch). *Staff:* 6 bishops, 130 missionaries.

XIV. *Lazarists* (founded by St Vincent de Paul, 17th century).—*Missions:* Abyssinia, Persia, China (Peking or N. Chih-li, S.-W. Chih-li, Kiang-si, Che-Kiang), S. Madagascar. *Staff:* 226 missionaries (9 bishops).

XV. *Oblates of Mary Immaculate* (1840).—*Missions:* Ceylon (nearly all), S. Africa (Basutoland, Natal, Transvaal, Orange River Colony), the "Great North-West" of Canada (Athabasca-Mackenzie, Saskatchewan, St Boniface, New Westminster). *Staff:* 270 missionaries (9 bishops).

XVI. *Salesians* (founded by Don Bosco).—*Missions:* Patagonia and Tierra del Fuego, Falkland Islands, Indians of S. America (Ecuador, Brazil, Argentine); some missions in Palestine.

XVII. *Pallottines.*—*Missions:* Cameroon, W. Africa; Australia (Beagle Bay, native settlement).

XVIII. *Jesuits.*—*Missions:* India (dioceses of Bombay, Poona, Calcutta, Madura, Mangalore, Trichinopoly), Ceylon (dioceses of Galle and Trincomalee), China (Kiang-nan, S.-E. Chih-li), Madagascar, Koango (W. Africa), Zambezia, Jamaica, British Guiana, British Honduras, Alaska. *Staff:* 800 missionaries, of whom 460 are priests.

XIX. *Dominicans.*—*Missions:* Asiatic Turkey (Mosul), Tongking (N., E., and Central), China (Amoy, Fokien), Curaçao, Trinidad.

XX. *Franciscans.*—*Missions:* Egypt, Tripoli, Morocco, China (N. and S. Shan-si, N. and E. Shan-tung, N. Shen-si, E., N.-W., and S.-W. Hu-pe). *Capuchins:* Aden and Arabia, India (dioceses of Agra, Allahabad, Lahore), Seychelles, Eritrea (Red Sea), Gallas, Cephalonia, Trebizond, Mardin, Crete, Caroline Islands, Araucania, Brazil, Bulgaria. *Conventuals:* Jassy (Rumania).

XXI. *Benedictines.*—*Missions:* Ceylon (diocese of Kandy), New Zealand (diocese of Auckland), N. American Indians (Indian Territory and Oklahoma), Australian natives (New Nursia).

XXII. *Trappists.*—*Missions:* Settlements in Natal (Marianhill), West Africa (Congo), China, Japan.

XXIII. *Augustinians.*—*Missions:* Philippines,[3] China (N. Hu-nan), Balkan Peninsula, Asia Minor ("Assumptionists").

XXIV. *Carmelites.*—*Missions:* Bagdad, India (dioceses of Verapoly and Quilon).

XXV. *Redemptorists.*—*Missions:* Dutch Guiana.

XXVI. *Passionists.*—*Missions:* Bulgaria (diocese of Nicopolis).

SOCIETIES FOR THE SUPPORT OF FOREIGN MISSIONS.

Society of the Propagation of the Faith (est. in Lyons, 1822).

Receipts,	1822–31	£72,000
	1852–61	1,100,000
	1882–91	2,604,000

Total in 70 years, 1822–1892, £10,714,000 (of which sum France contributed £3,000,000).

Society of the Holy Childhood (est. 1843 as auxiliary to the former; "children for children").

Receipts, 1843–91, £3,336,000 (of which France contributed £1,500,000).

Work.—Supports 624 orphanages, 3022 schools, 332 workshops, 167 farms, 837 dispensaries; educates 146,000 children. Number of children subscribers (½d. a month), about five millions.

Society of the Schools of the East (est. 1855).

Smaller and special societies attached to each of the missionary congregations and societies.

AUTHORITIES.—I. **For General Reference.**—The latest and most comprehensive dictionary is the second edition of *Wetzer und Wette's Kirchenlexikon* (edit. Hergenröther and Kaulen, 1882, &c., Freiburg in B., Herder). Taken together with the *Staatslexikon* (same publishers), this work, when completed, will supersede the first edition (1847–1860), of which there is a French translation (edit., I. Goschler, 1870).—MIGNE's ample *Encyclopédie Théologique*, though partly antiquated, contains much useful matter. The same may be said of GAETANO MORERI, *Dizionario di Erudizione.* Venice, 1840–1861; Index, 1875, 107 vols.—ADDIS and ARNOLD (and SCANNELL). *A Catholic Dictionary.* London, Kegan Paul, 1884, 1893, 1897.

II. **On the Machinery of Modern Government at Rome, with allied Questions.**—G. GOYAN (and others). *Le Vatican.* Paris, Firmin Didot, 1895.—CH. DE T'SERCLAES. *Le Pape Léon XIII., sa vie, son action religieuse, politique, et sociale.* Paris, Desclée, 1894.—BERNARD O'REILLY. *Life of Leo XIII.* London, Low, 1887.

III. **Collections of Modern Papal Decrees.**—The best is the *Analecta Juris Pontificii*, 1855 to 1891, since 1893 called *Analecta Ecclesiastica.* Rome, Palazzo Cenci. The Constitutions, etc., of Pope Leo XIII., *S. D. N. Leonis, PP. xiii., Allocationes, etc.* Bruges, 1887–1894, 4 vols.—Shorter English handbooks on this subject: W. HUMPHREY. *Urbs et Orbis.* London, Baker, 1899.—W. H. EYRE. *The Pope and the People.* Leamington, Art and Book Co., 1895.—Many valuable documents concerning the questions discussed at the Vatican Council: *Acta et Decreta S. Conciliorum recentiorum, Collectio Lacensis*, vol. vii. Freiburg im B., Herder, 1890, in progress.

IV. **English Catholic Periodicals**, which report the decrees of Roman congregations, and discuss literary, educational, and legal questions: *The Dublin Review* (quarterly, Burns), *The Month*, (monthly, Longmans), *The Tablet* (London, weekly).

V. **Catholicism in England since the Reformation.**—JOSEPH GILLOW. *Bibliographical Dictionary of the English Catholics.* London, Burns, 1885–1895. In progress, goes to MET, 4 vols. On the general history of Catholicism in Great Britain, the amplest modern work is that of ALPHONS BELLESHEIM, *Cardinal Allen und die Englishen Seminare* (Mayence, Kirchheim, 1885), *Katholische Kirche in Schottland* (*ibid.* 1886), *Katholische Kirche in Irland* (*ibid.* 1890). His *Catholic Church in Scotland* has been translated and enlarged by D. O. Hunter Blair, O.S.B. Edinburgh, Blackwood, 1887.—CHARLES DODD (*vere* HUGH TOOTELL). *Church History of England* (1737, 3 vols., goes down to 1688). New edition 1839–1843, "with notes, additions, and continuation, by Rev. M. A. Tierney" (unfinished).—BUTLER, CHARLES. *Historical Memoirs respecting the English, Irish, and Scottish Catholics.* London, 1819, &c.—W. MAZIERE BRADY. *Episcopal Succession in England, Scotland, and Ireland.* Rome, Typ. della Pace, 1876, 3 vols. The last volume treats of the post-Reformation period exclusively.—T. F. KNOX. *The Douay Diaries.* London, Nutt, 1878. *Letters of Cardinal Allen. Ibid.* 1882.—J. MORRIS. *Catholic England in Modern Times.* London, Burns, 1892.—T.

[1] Many statistics only up to 1890.

[2] Father Damien belonged to this society, which takes its popular name from the Rue de Picpus, Paris.

[3] Not under Propaganda.

MURPHY. *Catholic Church in England during the Last Two Centuries. Ibid.* 1892.

VI. **Nineteenth Century.**—W. J. AMHERST. *The History of Catholic Emancipation,* 1771–1820. London, Kegan Paul, 1886, 2 vols.—F. C. HUSENBETH. *Life of John [Bishop] Milner.* Dublin, 1862.—W. WARD. *Life and Times of Cardinal Wiseman.* London, Longmans, 1897, 2 vols. *W. G. Ward and the Oxford Movement. Ibid.* 1892. *W. G. Ward and the Catholic Revival. Ibid.* 1895.—E. S. PURCELL. *Life of Cardinal Manning.* London, Macmillan, 1895, 2 vols.

VII. **Catholic Education.**—J. GERARD. *Stonyhurst College.* Belfast, Ward, 1894.—R. C. LAING. *Ushaw College.* Newcastle, Mawson, 1895.—B. WARD. *St Edmund's College, Old Hall.* London, K. Paul, 1893. A chronicle of the strenuous efforts of Catholics to provide elementary schools is a desideratum, but much valuable information may be found in the annual *Reports* of the *Catholic School Committee* (London, 42 Gerrard Street), founded in 1847.

VIII. **Catholic Sufferings under the Penal Laws.**—For general reference: R. STANTON. *A Menology of England and Wales.* With supplement, London, Burns, 1892. No part of Catholic history has been better explored than this. The principal modern writers are: T. E. BRIDGETT, A. GASQUET, A. JESSOPP, J. MORRIS, R. SIMPSON; but Bishop CHALLONER'S *Missionary Priests* (1741, &c.) still remains the classical work on this subject.

IX. **Present State of English Catholics.**—*The Catholic Directory.* Annual, London, Burns. *Handbook of Catholic Charities.* London, Catholic Truth Soc., 1894.—W. S. LILLY and J. E. P. WALLIS. *Manual of the Law especially affecting Catholics.* London, Clowes, 1893. The addresses and papers read in the annual *Conference of the Catholic Truth Society.* Reported in the Catholic newspapers. The C.T.S., 21 Westminster Bridge Road, publications also deal briefly with most modern subjects.

X. **Foreign Missions.**—*Missiones Catholicæ cura S. Congregationis de Propaganda Fide descriptæ.* Romæ, ex Typographia polyglotta S. C. de Prop. Fid. [official biennial publication].—LOUVET. *Les Missions Catholiques au xixe. Siècle.* Nouvelle Édition, 416 pp. Lyon, Bureau des Missions Catholiques, 14 Rue de la Charité, 1900.—PIOLET. *Les Missions Catholiques Françaises au xixe. Siècle,* 6 vols. Paris, A. Colin, 5 Rue des Mézières.—O. WERNER. *Atlas des Missions Catholiques.* Tribony en Brisgau, Herder, 1886. *Album des Missions Catholiques,* 4 vols. Paris, Société St Augustin, 1888.

Periodicals.—*Les Missions Catholiques* (weekly), publ. in Lyons, and corresponding monthly or weekly papers in Italian, German, Dutch, Spanish, Polish, Hungarian, and English. (The last-named is monthly, price 3d., published in London, 19 Henrietta Street, Strand, W.C.) *Annales de la Propagation de la Foi* (monthly), published in Lyons, with translations in nearly all countries.

(✠ H. E. V.)

UNITED STATES.

The history of Roman Catholicism in the New World begins with the Norse discoveries of Greenland and Vinland the Good. In the former the bishopric of Gardar was established in 1112, and extinguished only in 1492. To the latter (the coast of New England) the Northmen during the same period made "temporary visits for timber and peltries, or missionary voyages to evangelize for a season the natives." Beyond these facts, the Norse sagas and chronicles contribute little that is certain (cf. "The Norse Hierarchy in the United States," *American Cath. Quart. Review,* April 1890). Although a bishop was appointed by the Pope for the vaguely defined territory of Florida so early as 1528, the oldest Catholic community in what is now the United States dates from 1565, when the Spanish colony of St Augustine was founded. Hence the aboriginal tribes of the South were evangelized. In 1582 the missions of New Mexico were undertaken, and from 1601 Catholic missionaries were at work along the Pacific coast, especially in California. Early in the 17th century trading posts and mission centres were established on the coast of Maine, and during the same century French priests laboured zealously in northern New York, along the entire course of the Mississippi from Wisconsin to Louisiana, and around the Great Lakes. Their principal concern was for the savages, over whom they acquired an extraordinary influence. Political jealousies, human avarice, and treachery arrested the progress of most of their missions. The foundation of the English colony of Maryland (1634) by the Catholic George Calvert (Lord Baltimore), and of Pennsylvania (1681) by the tolerant Quaker William Penn, first permitted the legal existence of Catholicism in English-speaking communities of the New World. It is from these centres that it spread during the 18th century. In 1784 the Rev. John Carroll was appointed Prefect-Apostolic for the Catholics of the English colonies, hitherto dependent on the Vicar-Apostolic of London. In 1790 Father Carroll was made bishop of the see of Baltimore, and given charge of all Catholic interests in the United States. There were then about 30,000 Catholics in the land, of which number 16,000 were in Maryland and 7000 in Pennsylvania. In 1807 they had grown to 150,000, with 80 churches. In the following year Baltimore found itself the first metropolitan see of the United States, with New York, Philadelphia, Boston, and Bardstown as suffragans.

The growth of the Catholic population by decades since 1820 was calculated by a competent historian, the late John Gilmary Shea, as follows:—

1820	244,500	1860	3,000,000
1830	361,000	1870	4,685,000
1840	1,000,000	1880	7,067,000
1850	1,726,470	1890	10,627,000

According to this ratio of increase, the Catholic population of the United States ought to have been in 1900 something over 14,000,000. Hoffmanns' *Directory,* however, for that year puts it at 10,129,677. The reason of this discrepancy is found in the fact that absolutely trustworthy official figures of the Catholic population are not accessible. The main source of this growth has been immigration. Originally the Irish and the Germans furnished the greater quota. Later, the French Canadians, Italians, Poles, and Bohemians added notably to the Catholic population; an appreciable percentage of Oriental Catholics is also found—Greeks, Syrians, Armenians, &c. Natural increase, especially among the descendants of the first Catholic immigrants, and a certain percentage of conversions from Protestantism, are contributory sources. Being under the protection of the constitution, and enjoying the advantages of the common law, Catholicism could not meet with any official opposition; such few outbursts of fanaticism as there have been were but temporary or local, and did not represent the true feelings of the great Protestant majority of the country.

As to the future of the Church in the United States, all Catholics feel, with their latest historian, that "the Catholic Church is in accord with Christ's revelation, with American liberty, and is the strongest power for the preservation of the Republic from the new social dangers that threaten the United States as well as the whole civilized world. She has not grown, she cannot grow, so weak and old that she may not maintain what she has produced—Christian civilization."

Doctrine and discipline.

Internally, Catholicism in the United States has been free from any noteworthy schisms or heresies that might impede its development—its doctrinal history offers nothing of importance. The discipline differs little from that of the other Churches of Catholicism. The unity of doctrine, liturgy, and moral ideals is preserved by an intimate union with the see of Rome. The general canonical legislation of the Church, the legislation by papal rescript and the Congregation of the Propaganda, the decisions of the Apostolic Delegation at Washington, and a certain amount of immemorial custom and practice, form the code that governs its domestic relations. Decennially each bishop of the United States is expected to pay a visit to Rome (*Ad Limina Apostolorum*), and to make a report of the

spiritual condition of religion within his diocese. In addition, a system of synods provides for local unity among bishops, priests, and laity. Thus each diocese holds occasional synods, each province or body of bishops under a metropolitan holds provincial councils, while at greater intervals a plenary or national council is held. Of these last, three have taken place—their decrees, when approved at Rome, are binding on all Catholics in the United States.

In education the Catholic Church endeavours to keep abreast with the best. There were, according to Hoffmanns' (Milwaukee, 1900) *Directory*, 3811 parochial schools, in which 854,523 children of both sexes receive instruction. If to these be added the children in Catholic charitable institutions, the number reached is nearly one million. There were 170 colleges for boys and 662 academies for girls. This system of education is crowned by the Catholic University of America at Washington, established by Leo XIII. and the American hierarchy, and endowed with all the privileges of the old pontifical universities of Europe. In addition, there are several other schools that rank as universities. The education of the clergy is provided for by seminaries. In 30 of these that are under episcopal direction there are 2630 students; in 79 that belong to religious orders, 1998 students are reckoned. The charitable institutions of the Church in the United States are very numerous. There are 251 orphan asylums, with 35,243 inmates. The other charitable institutions are 827 in number, and include every form of public and private charity; no diocese is without one or more such establishments. The actual government of the Catholic Church in the United States is represented by 1 cardinal, 14 archbishops, 77 bishops, 8660 diocesan clergymen under the sole and immediate direction of their bishops, 2976 members of religious orders subject to episcopal supervision—in all, 11,636 clergymen. There are 6409 churches with resident priests, and 3930 mission churches—in all, 10,339, to which must be added 1723 chapels. Several hundred weekly publications are printed in English and in foreign tongues, to minister to the religious needs of the Catholic population. There exist also several literary and academical magazines and reviews of a high order of merit.

The principal religious events since 1880 were the holding of the Third Plenary Council of Baltimore (1884), the Catholic Congress (1889), the opening of the Catholic University (1889), the Columbian Educational Exhibit at Chicago (1893), the establishment of the Apostolic Delegation at Washington (1893).

The Catholic Church in the United States conducts no foreign missions, but takes care of its own percentage of Indians and negroes. Of the Indian population of the United States about 90,000 are Catholics. They are attended by 113 priests, who look after 183 churches or chapels. There are 73 schools conducted by the members of 24 sisterhoods, in which over 5000 Indian children are educated. The Catholic negroes are about 140,000 in number. They have 40 churches, conducted by 45 white clergymen; 81 schools, in which 6401 coloured children are educated by 24 sisterhoods, who also conduct 11 charitable institutions. The expenses of these missions are borne by private charity, and by a general annual collection, which in 1899 amounted to $59,247.

There exists no satisfactory history of American Catholicism. Among the more useful helps may be indicated the following:—**General History**: JOHN GILMARY SHEA. *Life and Times of Archbishop Carroll*, N.Y., 1888; *The Catholic Church in Colonial Days*, N.Y., 1886; *The Hierarchy of the Catholic Church in the United States*. N.Y., 1886.—BISHOP O'GORMAN. *A History of the Catholic Church in the United States*. 1895. This work contains a useful bibliography.—CLARKE. *Lives of the Deceased Bishops*, 1872. **Statistics**: *The Annual Directory of the Catholic Clergy*. Of these, two are published; one by D. and J. Sadlier, New York, the other (Hoffmanns') by M. Wiltzius and Co. of Milwaukee. The Catholic general statistics of the eleventh (1890) census may be found in *The Religious Forces of the United States*, by H. K. Carroll, N.Y., 1893. Those of the twelfth (1900) are printed in the official reports of that census. **Legislation**: *Acta et Decreta Concilii Plenarii Baltimorensis*, iii., Baltimore, 1886. This is illustrated and brought into relation with the general laws of the Church in Smith's *Elements of Ecclesiastical Law*, New York. In connexion with this may be read Humphrey's *Urbs et Orbis*, London, 1899, an account of the general government of Roman Catholicism.

(✠ J. G.)

Roman Walls (*Recent Excavations*).—The mainland of Great Britain twice contracts to a narrow width—once north and once south of the English and Scottish border. From Clyde to Forth is barely 35 miles; from Tyne to Solway, barely double the distance. The Romans at one time or other took each isthmus as their frontier; and since the distances were short, fortified each with a continuous wall. The southern line, Hadrian's Wall, was occupied far longer, and was far more important, than the northern "Wall of Pius."

For modern purposes, the dominant feature of the southern isthmus is the easy natural passage which the valleys of the Tyne and Irthing provide for road and railway between Newcastle and Carlisle. But the utilization of this passage is modern. It was not used by the Romans, and even in 1745 it was found to be roadless. The Roman frontier works followed the high ground to the north of the valleys. In the east they commenced at Wallsend-on-Tyne and traversed the moors of south-east Northumberland; inland they climbed along precipitous basalt cliffs; in the west they descended through the lowlands of Carlisle, south of Scaleby and Solway mosses, to the coast at Bowness. Military reasons—the shortness of distance and the advantages of cliff and moss—seem to have suggested this line. Politics and commerce had no share in determining it: the land south of the wall is for miles as desolate as the land north of it, and no native racial boundary can be traced in this neighbourhood.

The actual frontier works are threefold. First, there is a wall of stone, with a ditch in front, forts behind, and a connecting road. The wall was 8 feet thick and originally perhaps 16 feet high; the forts, walled in stone, varied in size, but the larger covered from 3 to 5 acres. Secondly, there is the so-called vallum—in reality no vallum at all, but a broad flat-bottomed ditch, out of which the earth has been cast upon either side, and heaped into regularly made mounds resembling ramparts. Thirdly, there is the turf wall, constructed of sods laid in regular courses, with a ditch in front. The stone wall and "vallum" have long been known, and are among the stateliest monuments of Roman military power that time has spared. The turf wall was first found in 1895, is nowhere clear on the surface, and is only traceable at all at special points.

Excavations along the Wall have had two objects—either to examine the forts, to plan their buildings, and collect inscriptions, &c.; or to ascertain the relations of stone wall, "vallum," and turf wall—that is, to recover the history of the Roman frontier. Earlier excavators, like Clayton and Bruce, essayed principally the first task; since 1893 both have been tried.

(*a*) *Forts*.—Before 1893 much of Chesters (*Cilurnum*) had been uncovered, and casual search made elsewhere. In 1894–97 bits of Greatchesters were dug; in 1898 Housesteads (*Borcovicium*) was entirely excavated by Mr R. C. Bosanquet and others. If we combine the results won on these sites with those won at High Rochester (partly excavated about 1850), at Hardknott (1892), at Gellygaer, near Cardiff (1900–01), and in Scotland, we

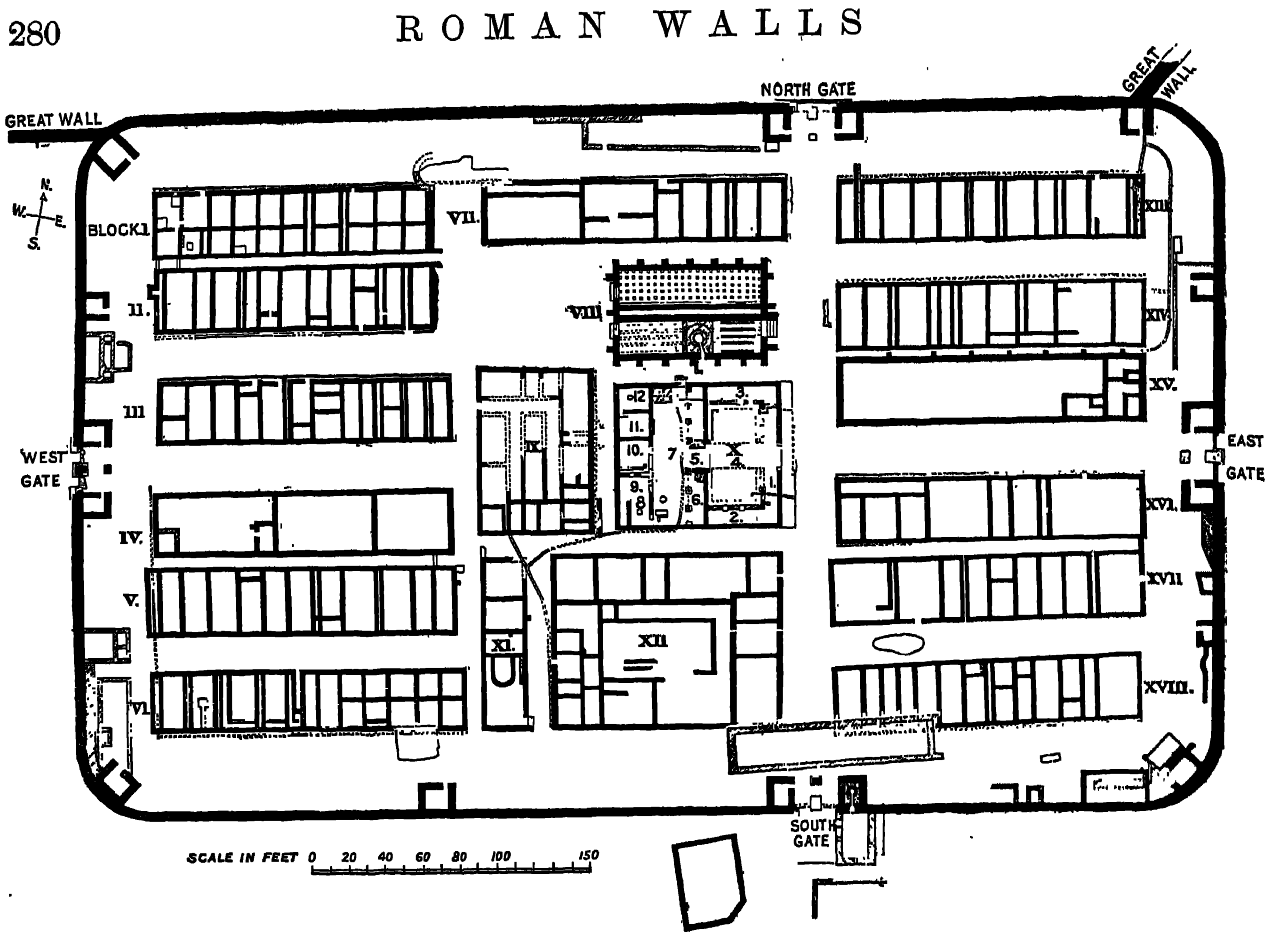


FIG. 1.—Plan of Housesteads (Borcovicium).

may seem to have acquired much evidence respecting Roman forts in Britain. We have, however, achieved less than the Germans on the Limes and the French in Algeria. What we do know may be illustrated from Housesteads. This fort measures about 120 by 200 yards, and covers 5 acres (see Plan, Fig. 1). Its walls are stone, its north wall the same as the great wall which runs from sea to sea. Within, it is full of buildings of stone. Chief among these is the "Prætorium," in the centre of the fort—a rectangular structure enclosing two small open courts and a row of small rooms (shrine for official worship, treasury, &c.), which faced on to the inner (western) court (Plan, x.). This was the official centre of the fort. Close by were officers' quarters (Plan, xi., xii.) and storehouses with buttresses and dry basements (Plan, viii.). The long blocks which filled the ends of the fort were doubtless principally barracks (Plan, i.–vi., xii.–xviii.). Outside the fort stood various buildings not all yet explored —a bath-house, a little way east; a shrine of Mithras, and perhaps other shrines, a little way south; and huts of camp-followers, women, &c. To the north-east, outside the great wall, is a tiny hollow, formerly explained as an amphitheatre, now thought to be only a quarry. Such is Housesteads, and such probably were nearly all the Roman forts in Britain. They differ somewhat from Roman forts in Germany, notably in the details of their "Prætoria" and in the number of their stone-built structures. Even in military matters, it seems, the Roman provinces varied from each other.

(*b*) *Wall, "Vallum," &c.*—Ancient writers assert that Hadrian (about A.D. 120) built in North Britain a wall for 80 Roman miles from sea to sea. The mileage and various inscriptions prove that this refers to some part of

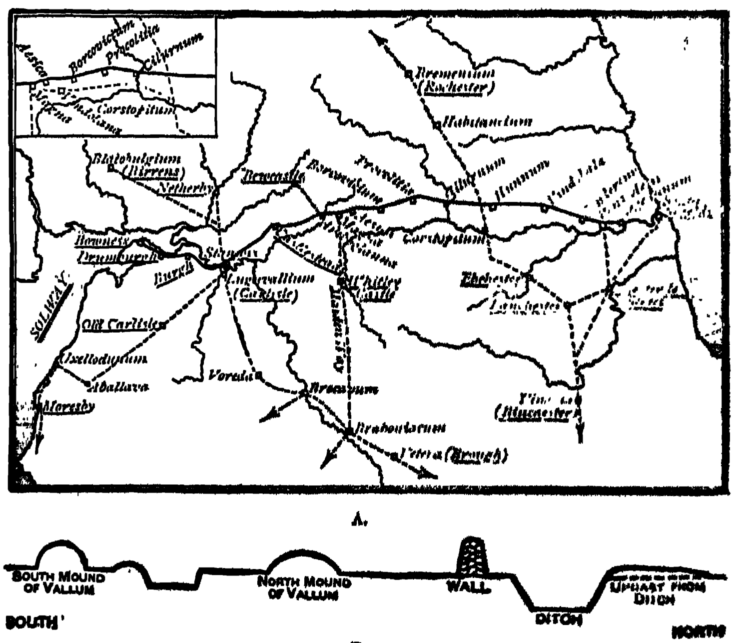


FIG. 2.—A, Hadrian's Wall; B, Section of the same. (From *Social England*, by permission of Cassell and Co. Ltd.)

the frontier works of the southern isthmus. Ancient writers also say that Severus (about A.D. 208) built a wall in North Britain from sea to sea. But they differ as to its length; inscriptions do not wholly support them, and their

statement has been variously explained. Hodgson and Bruce, the chief local authorities of the last century, maintained that Hadrian erected the stone wall, with its forts, against northern enemies, and the "vallum" against southern insurgents, while the work of Severus was confined to a few repairs in the stone wall. This was the accepted view till lately, but recent excavations show that in several points it is not tenable.

In the first place, the stone wall and its forts, which the visitor now admires, were not the earliest frontier works. An earlier line (as it seems, a wall of turf) has left clear traces of itself at Chesters and Birdoswald (*Amboglanna*), and we have not one wall but two walls to deal with. The dates of these are still doubtful. But our ancient writers mention two wall-builders, Hadrian and Severus; and the most natural conclusion is that Hadrian built the first wall in turf, and Severus reconstructed it and its forts in stone. It has been acutely suggested that probably Severus adhered as closely as possible to his predecessor's line, in order to use the existing ditch; in one or two cases, however, as at Birdoswald, he deviated. Evidence can be adduced from other parts of the Roman Empire to show that the Roman military engineers continued to use earthworks for permanent fortifications till after the reign of Hadrian, and that Severus "converted" some of these earthworks into stone.

The "vallum" can no longer be explained as of old, but it is still a puzzle. Many of its features have been elucidated by recent excavations. It has been definitely proved to be Roman, which certain despairing minds had doubted. Its course, not quite accurately known to Bruce and Hodgson, has been better traced. The method of its construction is now plain. Its date has proved to be not earlier than the turf wall; probably it is contemporaneous either with that or with the stone wall. Its object was not military: it must have marked some limit of the civil province. But more precise we cannot be. The "vallum" is one of the largest of extant Roman earthworks; speculation has busied itself about it for two centuries, and excavation for some years. It remains unexplained, a proof of the imperfection of our knowledge of antiquity.

The Wall of Pius consists of a continuous rampart, a ditch in front of it, forts behind it, and a connecting road; it was constructed about A.D. 142, and abandoned within 45 years. An ancient writer states that the rampart was built of regularly laid sods, like the turf wall of the southern frontier: this was verified by excavations in 1891–93. Except for this, the wall is entirely unexplored: a commencement of excavation was, however, being made in 1902 at the fort of Castlecary, 15 miles east of Glasgow. The site has been cut into by road and railway, and the stones of the fort have been taken away wholesale by later builders. But a bath-house, a buttressed storehouse, and a latrine have been found, and also massive stone substructures for the northern rampart. The surviving masonry is finer than that usually visible along Hadrian's Wall, and the work of Pius was plainly far more substantial than has been thought. Tacitus states that Agricola erected a line of forts across the northern isthmus. No trace of these has yet been found, unless possibly at Camelon near Falkirk, recently excavated by the Society of Antiquaries of Scotland.

No report of the Housesteads work has yet been published (July 1902); the writer is indebted to Dr Hodgkin and Mr R. C. Bosanquet for the plan, reduced from surveys by Messrs Bosanquet and Dickie. For other excavations, see *Archæologia Æliana*, vols. xvi., xvii., xxiii., xxiv.; *Transactions of the Cumberland Archæological Society*, 1894–1902; *Report of the Glasgow Archæological Society on the Antonine Vallum.*

(F. J. H.)

Romanes, George John (1848–1894), British biologist, was born at Kingston, Canada, 20th May 1848, being the third son of the Rev. George Romanes, D.D., professor of Greek at the university. He was educated in England, going in 1867 to Gonville and Caius College, Cambridge. He early formed an intimate friendship with Charles Darwin, whose theories he did much during his life to popularize and support. His first appearance as a man of science was at the Royal Society, where he delivered the Croonian lecture for 1875 on the *Locomotor System of Medusæ*, in which he described the nervous system of these little beings, thereby rendering valuable service to the study of elementary physiology. These studies he continued to prosecute, publishing a few years later a work on *Jelly-Fish, Star-Fish, and Sea-Urchins*. In 1881 came *Animal Intelligence*, in 1883 *Mental Evolution in Animals*, in which he traced the parallel development of intelligence in the animal world and in man. He followed up this line of argument in 1888 with *Mental Evolution in Man*, in which he maintained the essential similarity of the reasoning processes in the higher animals and in man, the highest of all. In 1892 he brought out an *Examination of Weissmanism*, in which he sturdily upheld the theory of the hereditability of acquired character. In 1890 he settled at Oxford. Here he founded a lectureship similar to the "Rede" of Cambridge. *Darwin, and after Darwin*, which came out in 1892, he was obliged, owing to failing health, to publish without fully completing. His religious opinions are somewhat interesting: he began life as an Evangelical, and then came under agnostic influences, to which he gave expression in an anonymous book, *A Candid Examination of Theism*, the tone of which is reluctant disbelief in the Deity. Subsequently he was much impressed by the teaching of liberal High Churchmen, and recovered his faith in Christianity. *Thoughts on Religion*, published after his death, shows how very far the pendulum of his mind had swung from the Evangelical and agnostic standpoints. He died 23rd May 1894.

Rome, the capital of the kingdom of Italy. Very great changes in the municipal and social conditions of Rome followed the occupation of the city by the Italians (20th September 1870), and the rapid increase of population due to immigration from other parts of Italy; and even in 1902 it could not be said that the new Rome had assumed its final shape. It is a mistake, however, to attribute all the works undertaken and executed since 1870 to the initiative of the new Government. A plan for the improvement of the city was made, under the direction of Mgr de Merode, during the reign of Pius IX.; and although but a small portion of the projected changes were carried out under the Pope, the general scheme was in most respects satisfactory, and proved a good foundation for further extensive developments. It did not include, however, the destruction of villas such as the Villa Ludovisi, nor the wholesale removal of trees, which is so greatly to be deplored. These acts of barbarism were the consequences of the reckless speculations in land and buildings that accompanied and followed the active and excellent work done by the municipality, and might have been checked by vigorous and timely action of the Government. As it was, a number of the most important Roman families were ruined. At the outset, and as soon as political circumstances admitted the consideration of such matters, the municipality set to work; and though a comprehensible love of the picturesque has caused many persons to regret the result, altogether or in part, it is not to be denied that the improvements carried out have been of the highest advantage to the city, and that the work is in many instances of creditable solidity. Two principal

problems presented themselves at once. By far the more important was the confinement of the Tiber in such a manner as to render impossible the serious floods which had from time to time inundated the city, often causing great damage to property and rendering the lower streets more or less impassable. There were floods which almost reached the level of the first storey near San Carlo in the Corso, and it was common to see the great Piazza Navona and the neighbourhood of the Pantheon full of water for days together during the winter. The interruption of traffic can be imagined, and the damage to property was serious. The other urgent matter was one of which the Government of Pius IX. had been partially aware, namely, the necessity for opening better thoroughfares between different parts of the city. In the Middle Ages the population of Rome had dwindled to twenty or thirty thousand inhabitants, who lived huddled together about the strongholds of the barons, and the modern city had slowly grown again upon the exiguous foundation of a mediæval town. The need for changing this condition of things, which had been felt under Pius IX., became overwhelmingly apparent as the population rapidly increased. That which under a continuance of the old Government might have been done by degrees during a long period, had to be accomplished in the shortest possible time, with means which, though considerable, were far from adequate, and in the face of stormy opposition exerted by many holders of real estate, the most important of whom were conservatively attached to the Papal Government, and resisted change for no other reason. In what was now done it is necessary to distinguish clearly between the work undertaken and carried out by the municipality, under considerable pressure of circumstances, and that which was done in the way of private speculation. The first was on the whole good, and has proved enduring; the second was in many cases bad, and resulted in great loss. As soon as the opening of such streets as the Via Nazionale and the Via Cavour, the widening and straightening of the Via dell' Angelo Custode, now the Via del Tritone Nuovo, and similar improvements, such as the construction of new bridges over the Tiber, had demonstrated that the value of property could be doubled and quadrupled in a short time, and as soon as the increase of population had caused a general rise in rents, owners of property awoke to the situation of affairs, and became as anxious as they had at first been disinclined to improve their estates by wholesale building.

By far the most important and expensive work done by the municipality was the construction of the embankments along the Tiber. Though damaged by the great flood of December 1900, their truly Roman solidity saved the city from the disastrous consequences of a wide inundation. It is impossible not to admire them, and not to feel respect for a people able to carry out such a plan in such a manner and in so short a time, in the face of such great difficulties. But so far as the life of the city was concerned, the cutting of new streets and the widening of old ones produced a more apparent immediate result. The opening of such a thoroughfare as the Via Nazionale could not but prove to be of the greatest value. It begins at the Piazza delle Terme, in which the principal railway station is situated, and connects the upper part of the city by a broad straight road, and then, by easy gradients, with the Forum of Trajan, the Piazza dei Santi Apostoli, and the Piazza di Venezia, whence, under another name, it runs through the heart of the old city to the Bridge of Sant' Angelo. It is true that in order to accomplish this, a part of Villa Aldobrandini had to be destroyed; but this is almost the only point which lovers of beauty can regret, and in compensation it opened to full view the famous palace of the Massimo family, the imposing church of Sant' Andrea della Valle, and the noble pile of the Cancelleria, one of the best pieces of architecture in Rome. Another great artery is the Via Cavour, which was intended to connect the railway station with the south-western part of Rome, descending to the Forum, crossing it by a light iron bridge, and continuing to the river behind the Palatine. These are only examples of what was done, for it would be impossible, within any ordinary limits, to give a just idea of the transformation of the city. Rome is now divided very clearly into two parts, the old and the new, of which the old is incomparably the more artistic and the more beautiful, as it will always remain the more interesting.

Municipal Administration.—After the taking of Rome, those persons who remained loyal to Pius IX. took no part whatever in public affairs, and the municipal administration was entirely in the hands of the Monarchists. The expression "nè eletti nè elettori," meaning that Catholics are to be neither voters nor candidates, which came to be regarded as a sort of rule of the party, was invented at that time by an epigrammatic journalist, and it seems at first to have been applied also to municipal matters, whereas it was later understood to refer only to parliamentary elections. Leo XIII. encouraged the formation of a Catholic party in the municipal administration, and the municipal government drifted largely into the hands of Catholics, though circumstances make it necessary that the Syndic (Mayor) should always be a Royalist. Between 1870 and the end of the century, the Socialist party had no great influence in Rome, which can never be a city of manufacturing interests. For purposes of municipal government the division of the city into districts has been changed. It was formerly divided into fourteen "Rioni." It is now further divided for various purposes of administration into more than one series of divisions. The municipality consists of a Mayor and 78 "Communal Councillors," of whom a considerable proportion are usually members of the aristocracy—a fact which shows the extremely conservative and aristocratic tendency of the city in municipal matters.

Population.—The population on 31st December 1870 was 226,022, as against 512,423 on 31st December 1899. It therefore more than doubled in thirty years. The increase, however, did not take place at a very regular rate, owing to the changes in the rates of immigration and emigration. The largest increase was in 1870, reaching 22,186; the next most important in 1884, 1885, 1886, 1887, in which years it constantly remained near 20,000. The least increase in later years was 4417 in 1891. In 1899 it was 11,813. The garrison of Rome may be taken at about 10,000 men. Careful inquiry has placed it beyond doubt that there are in Rome about the same number of ecclesiastics of all orders, including about 1500 students in the theological seminaries. The average birth-rate of Rome is about 22 per 1000, as against 13½ in Budapest, the lowest in Europe, about 30 in London, and 40 in Cologne, the highest in Europe. It is lower in Rome than in the majority of cities, but is higher than in a considerable number of others, as shown in the *Bulletin de statistique démographique et médical de la Ville de Bruxelles.* The number of births increased after 1870 very nearly in proportion with the increase of population.

Hygiene.—The hygienic conditions of Rome have greatly improved, largely through the ceaseless efforts of Commendatore Baccelli, who is a distinguished man of science, and has repeatedly held office in the Italian Ministry. The publication of exceedingly accurate graphic tables in February 1900 shows the following facts. Ninety per 1000 deaths occurred in 1871 from typhoid (the so-called "Roman fever"), and the average has now fallen

to a low constant. Deaths from small-pox, formerly of alarming frequency, can be said not to occur at all, and their numbers diminished suddenly after the introduction of compulsory vaccination. A great decrease in the number of deaths from malarial fevers is referred to the increased use of quinine among the poor in the outlying districts. Tuberculosis alone produces precisely the same mortality as formerly. On the whole, the tables show a notable decrease in the death-rate, which has now fallen below an average of 18 per 1000, a fact which places Rome among the healthiest cities in Europe. The death-rate of Moscow is nearly 30, for instance, and that of Dublin about 26. With regard to the consumption of meat in Rome, it increased until 1887, after which it suddenly decreased in a remarkable manner, coincidently with the failure of the numerous building speculations; and though the population had increased by nearly 120,000 since 1887, there were slaughtered in 1899 only 116,661 head of cattle, whereas the number in the former year was 140,549, showing a decrease of 23,888 head. In this connexion it should be noted that the slaughter-house of Rome is one of the best organized establishments of the sort in Europe.

Charities and Education.—A great number of small charitable institutions for children and old people have been founded, which are organized on the most modern principles, and in many of these charitable persons of the upper classes give their individual assistance to the poor. There are also private hospitals for diseases of the eye, in which poor patients are lodged and treated without payment. There are two hospitals entirely maintained by private resources, where infants are treated whose mothers fear to send them to a public hospital, or in cases refused by the latter as not being serious enough for admission. Of course the numbers of the poor greatly increased with the growth of population, especially after the failure of building speculations between 1888 and 1890, though great efforts were made by the municipality to send all persons then thrown out of employment back to their homes. One of the difficulties under which Rome labours is that while it attracts the population of the country, as other capitals do, it possesses no great mechanical industries in which the newcomers can be employed. Efforts to create small industries in the populous quarters of the poor met with little success. Previous to 1870 a society was formed, and it has since greatly developed as an intelligent private enterprise, of which the object is to provide the poor with sanitary tenements; but its success is much hampered by the absence of employment, which, again, is partly due to the heavy taxation of small industries. A number of trade schools are also maintained by private funds, such as the Istituto degli Artigianelli, managed by the Fratelli della Dottrina Cristiana, and the Ricovero pei Fanciulli Abbandonati (home for friendless children), which is under lay management and has flourishing workshops. The character of official charities has certainly improved in principle, so far as their educational and moral scope are concerned; for whereas in former times the limited number of the poor made individual and almost paternal relief possible, that form of charity had a pauperizing influence. If anything, the present tendency is to go too far in the opposite direction, and to require too many formalities before any relief is granted; and while the union of the principal charities under a central management on advanced theories improved the methods of administration, it destroyed numerous small sources of immediate relief on which the poor had a traditional right to count, and was in that way productive of hardship. At the same time, however, mutual benefit societies (*società di mutuo soccorso*) have been organized in great numbers by the different crafts and professions, and are chiefly distinguishable by the political parties to which they belong. It is characteristic of the modern Roman people that the most widely different elements subsist without showing any signs of amalgamating, yet without attacking each other. Some of these societies have an exclusively Clerical character, others are merely Conservative, some consist of Monarchists, and some of avowed Republicans.

Popular education is fully half in the hands of private persons, for, over and above the schools officially mentioned in the municipal reports, a very large number of religious institutions impart elementary instruction to children of the lower classes, following, of course, the Government curriculum, and being under the supervision of municipal inspectors both as regards their teaching and their hygiene. The Pope also expends large sums in the maintenance of the people's schools, managed entirely by laymen and also under Government inspection. For education of the higher grade there are many private so-called lyceums and gymnasiums, from which pupils can present themselves for the regular Government examinations, the privilege of conferring certificates and degrees having been allowed only to very few private institutions.

Society.—After 1870 both the aristocracy and the middle classes were divided into hostile factions, each of which maintained a press of its own and rallied round representative individuals. So far as the middle classes were concerned, the common interest of commercial operations soon concentrated political differences. The aristocracy, however, kept rigidly aloof from all speculations for a time, and maintained its traditional attitude of contemptuous superiority, to which the middle class answered with its profound hatred. This state of things lasted about ten years, until the time of the great building speculations, into which a number of noble families were tempted, and in which they soon found themselves hopelessly involved, and brought into close contact with the middle class. The two classes thus became necessary to each other, and the result was a notable and salutary diminution of prejudice, soon leading to alliances by marriage which would formerly have seemed impossible, but which the redistribution of wealth rendered mutually advantageous. The appearance at social gatherings of an official element, almost exclusively taken from the middle class, also tended to reduce inequalities of caste. Yet it must be admitted that the parties composing Roman society were drawn together mechanically, rather than fused into anything really homogeneous. It is worth mentioning that the Jewish element, which is very strong in business, in journalism, and in the administrations, has made no attempt to enter Roman society. Rome and Genoa are practically the only Italian cities in which Israelites are rigidly excluded from social intimacy, and are only met on official occasions.

(M. CR.)

Archæology of Rome and Neighbourhood.

Modern archæological research in Rome and its neighbourhood has proceeded on lines previously traced, and has considerably increased knowledge of the early inhabitants and conditions of life in and about the city. Single buildings and groups of buildings within the walls have been searchingly studied in the effort to elucidate their original form and use, a branch of research particularly valuable in Rome, where continuous habitation and events of war have caused many ancient buildings to be diverted from their original forms and purposes. Excavations connected with the rapid growth of the modern city have, moreover, brought to light an enormous number of the

most varied objects, for the preservation of which, as for the preservation of the results of carefully directed research, several museums, some of purely scientific character and others with artistic intent, have been formed. In most cases the archæologists entrusted with excavations and with the formation of museums have been moved by desire to work in ways fully consistent with modern knowledge and methods. Unfortunately, in some noticeable instances (to be mentioned later) the work was unworthily done, either carelessly or hurriedly, under the influence of momentary excitement.

It was inevitable that the great development of the city should involve much destruction of ancient ruins and monuments. In consequence of the building of the Tiber embankment and scientific regulation of the course of the stream, the channel to the left of the island of San Bartolomeo became filled with silt and joined to the bank by a noisome mud-flat.[1] The Ponte Sant' Angelo has been added to at each end, and its ancient appearance altered. During the work on this bridge in 1892 a piece of the original paved roadway leading from it to the Campus Martius was laid bare. Most of the other bridges have been more or less destroyed, two of the arches of the Pons Æmilius being demolished in 1887, and the Pons Cestius completely altered between the years 1886 and 1889. Fragments of the Servian Wall and tombs on the Flaminian Way were further destroyed in connexion with the building of the monument to Victor Emmanuel. More than once portions of the Golden House of Nero were found and destroyed during the laying out of streets. Outside the walls, the arches of the Claudian Aqueduct near Roma Vecchia were much shaken by the passing trains. In addition to this perhaps inevitable destruction, harm was done by certain methods of preservation. Quantities of unrelated objects from all parts of the city and neighbourhood were heaped together in storehouses, in such a way as to deprive them of value as expressions of ancient life and character, and to make them mere curiosities, mere refuse of "past, incompatible ages." The formation of modern museums is carried out in a spirit very different from that which prevailed when the great private collections or the Papal Galleries were being gathered. Then scientific study of archæology was almost unknown, but much greater interest was taken in beauty *per se*. Humanists cared little for products of barbaric ages, or tribes, and sought objects noteworthy especially for beauty, both in order to develop their own faculties and to multiply opportunities of enjoying adequate expressions of the intellectual life of the highly civilized men of earlier days. Judged by this standard, a modern museum such as the Museo delle Terme seems less satisfying than the Vatican Gallery. In the Museo delle Terme objects are grouped together without system, or scattered through the dark cells and narrow passages of a mediæval convent, where not only is it impossible to see them in the way their makers intended, but even to see them in any way completely. In the Vatican, though the marbles suffered from ignorant restoration, an attempt was made to present them in a proper setting as things of beauty rather than as examples of odd fashions of the past. It would often be well to leave objects where they are found, and to form local museums, or at least to gather on one spot things found together. For instance, it would have been well to make a museum on the Palatine and another in the Forum, for the preservation of antiquities found on those sites, instead of transporting some of them to the Museo delle Terme and leaving others where they were excavated. An attempt in the right direction was made by Signor Boni in connexion with the excavations in the Forum, where two small museums were formed. The general system of scattering antiquities among various museums prevailed, however, in the case of objects found elsewhere in the city. Some were stored at the Botanic Gardens, some in the Museo delle Terme, and some in the Museo dei Conservatori. The authorities had, it is true, to contend with the serious difficulty that, according to the circumstances of their discovery, antiquities may belong to the municipality or to the State; yet this circumstance ought not to form an insuperable obstacle to intelligent arrangement.

A more serious ground for complaint came to light in 1899 in connexion with the Papa Giulio Museum of Etruscan Antiquities. Doubt as to the scientific value of the museum was expressed by Professor Helbig in the preface to the second edition of his guide to Roman museums. Inquiry conducted by three Government commissioners (two of whom held offices under Professor Bernabei, organizer of the museum) proved: (1) That, contrary to the public statements of two Ministers of Public Instruction, the Etruscan tombs, to hold the contents of which the museum was formed, had been excavated without proper supervision, and in large measure by a "boy scarcely fifteen years old." (2) That the published plans and maps could not be certified because, with one exception, all the original topographical notes had been destroyed. (3) That the directors of the museum "did not always act in a praiseworthy manner." (4) That no proper inventories of objects bought for the museum were kept for ten years, and that lists actually forthcoming were inaccurate. (5) That in the case of some twenty tombs the objects exhibited did not tally with the official descriptions of them (*Supplemento al No. 23 del Bollettino Ufficiale del Ministero dell' Istruzione Pubblica*, June 1899). It therefore became evident that the value of the Papa Giulio Museum, as a co-ordinated illustration of the development of Etruscan civilization, is open to serious question.

While so many famous private collections were sold and scattered, two collectors at least gathered objects of interest and beauty with the declared intention (at any rate in the case of one of them) of giving them to their country. One of these is King Victor Emmanuel III., whose collection of Italian coins is unrivalled; the other is Baron Barracco, who has collected choice marbles, selecting them for their artistic excellence rather than for archæological peculiarity (see *La Collection Barracco*, by Helbig, text and plates).

Intimately bound up with the questions of the management of museums, and their arrangement in such manner as to offer facilities for study to properly accredited students, are the problems of scientific excavation and of disposal of important private collections which may come into the market. The various foreign archæological institutions having headquarters in Rome are refused permission to excavate in Italy, although there is vastly more work to do than the Government can possibly undertake, and though permission to excavate is freely given to similar institutions by Greece, and even by Turkey. The attitude of the Italian Government delays the progress of knowledge, prevents the formation of local museums, allows much harm to be done by untrained Italian antiquity dealers, to whom excavation rights are often granted, and who dig merely to find [illegible] to sell, induces much secret digging, and keeps money out of the country. In cases like those arising from the purchase *en bloc* of the Borghese and Boncompagni collections, which contain some masterpieces and much second-rate work, the problem is complicated by the fact that the collections were formed, at least in part, as a public trust. The Government thus possesses the right of pre-emption, but, considering the innumerable treasures already in the various Government museums, would it not be well to let a permanent board of properly trained experts select the objects of

[1] In consequence of the fall of a part of the embankment opposite S. Bartolomeo in November 1900, a special commission was appointed to consider the best means of removing this mud-flat, and of causing the stream again to surround the island, as in former times.

most moment, and sell the remainder at a Government office, as in Egypt? One other question calls for brief notice, namely, the rights of foreign students to study and publish results of research. No one can wish to place foreign students in a more favourable position than native scholars, but the Italian authorities are often slow in publishing proper accounts of discoveries, and unwilling to let foreigners make photographs, or even take notes, of objects exhibited in the museums. It is an exaggeration to say, "We are most liberal in allowing strangers to study the archæological riches excavated and arranged by us, and we favour their researches in every possible way" (*Supplemento al No. 23 del Bollettino Ufficiale del Ministero dell' Istruzione Pubblica*, June 1899).

Excavations in the Forum.

The most important modern excavations took place in the Roman Forum under the direction of Commendatore Giacomo Boni. They began tentatively in September 1898 with the re-erection of a little 3rd-century shrine at the north-west angle of the Atrium Vestæ. The plan adopted by Boni in regard to reconstruction was simple and wise. When large portions of a monument have been preserved and their original positions known with certainty, it is better to replace them in their true relation with each other, supplying missing portions with materials that cannot mislead, than to leave them lying on the ground in unintelligible disorder and liable to injury. From this beginning the work was extended by degrees to the whole Forum. The discoveries were so varied, and in some cases so significant, as to necessitate the re-writing of all existing literature on this part of Roman archæology. The principal modifications and discoveries were as follows:—

Honorary Columns, which formerly stood opposite the Basilica Julia, but of which the chief portions were lying where they had fallen, were in two cases reconstructed and raised on their bases.

Heroon of Cæsar (October 1898). It was manifest that the remains of this temple had not been completely cleared of earth by earlier excavators. This was now done, and in the semicircular recess of the front wall was found the base of the altar erected on the pavement of the republican Forum on the spot where Cæsar's body was burned. The foundation walls were traced, and the temple shown to be larger than previously supposed.

Arch of Augustus.—Lower blocks of the piers, found but not recognized some years ago, were replaced in their original position.

Temple of Vesta.—The shapeless mound previously called by this name proved to be in large part simple earth. This was removed, and in the centre, below the level of the temple floor, was found a trapezoidal chamber of early date, rebuilt (like the temple above) in later times. In the chamber, which was probably the *favissa*, was found a quantity of fragments of vases, bones (ox, dog, sheep, and pig), charred oak, and ashes.

House of the Vestals (September 1899).—Much earth was cleared away, mosaic floors laid bare, and the lower steps of the stairs leading to the second floor discovered. A hoard of 397 *solidi aurei* was found. The coins were mostly of the 4th and 5th century A.D.; ten were of Euphemia, wife of Anthemius. One republican and three mediæval wells were emptied, and an early altar with traces of sacrifices brought to light. The sewers were found to be full of oyster-shells and of various objects used by the Vestals.

Regia (May–August 1899).—The foundation walls were more accurately traced than before, and various fragments of the last (imperial) reconstruction collected. The basis of what may have been the *sacrarium* for the sacred spears of Mars was unearthed, and a subterranean beehive chamber of large dimensions discovered. This chamber, or *tholus*, which had a thick external coating of fine clay and an internal coating of cement, contained, among other objects, seventy-eight bone styluses, a bone writing-tablet, and a piece of well-kerb with the word "Regia" inscribed in republican characters.

Domus Publica (September 1899).—Cleared and examined more accurately than before, mosaic floors (previously known) cleaned and examined, and the *impluvium* found.

Temple of Castor and Pollux (August 1899–January 1902).—The standing columns, which were in great danger of falling, were strengthened; many architectural fragments, previously scattered heedlessly about the Forum, were gathered together; the western side of the stylobate and the foundations were excavated. The excavation was carried round the temple.

Vicus Tuscus was cleared of mediæval paving-stones, and a short stretch of curious pavement, composed of small brick *tesseræ*, like a mosaic, brought to light.

Arch of Fabius (1899).—The exact site of this arch was not found, but three large *voussoirs* of travertine belonging to it were discovered opposite the Heroon of Romulus underneath the previously existing modern pavement, on the line of the Sacra Via. The arch is thus shown to have been larger than hitherto supposed, and to have had a span at its spring 4·58 metres wide. One republican and three mediæval wells were found near by, one of the latter containing, among other things, three large weights of serpentine with bronze handles. Their excellent state of preservation makes them valuable material for the study of Roman metrology.

Forum Pacis (1899).—Cleared of earth and made accessible from the Forum Romanum, in such way as to render visible the well-known door in the eastern side of the Templum Sacræ Urbis and the side of the Basilica of Maxentius (Basilica of Constantine). Some four hundred fragments of the marble plan of Rome which was affixed to the northern wall of the Templum by Septimius Severus were found in April 1899 behind the Farnese Palace.

Temple of Antoninus and Faustina (June 1900).—The modern stairs in front were removed, and the core of the original steps exposed. The lower half and the head of a statue of a seated female figure and another early well were found. Under the ancient steps a grave, dating probably from the 8th century B.C., was found. Its contents were not remarkable, but it shows that at that epoch the Forum was outside the city boundaries. The town was probably limited at that time to the Palatine.

Via Sacra (June 1899).—The finding and clearing of a large early sewer built of *opus quadratum* and *opus reticulatum*, running under the so-called Via Sacra, prompted further exploration, which proved the pavement, hitherto considered ancient, to be of mediæval or of even later date. Several pieces of mediæval carving and coins, some of the 16th century, were found below this pavement; also pieces of the porphyry columns which once stood at the southern entrance of the Basilica of Maxentius. Several republican wells were discovered, containing many small objects of bronze, bone, terra-cotta, or stone. In two mediæval wells several carved marble fragments were found. About two metres below the above-mentioned pavement an early imperial pavement of large, well-laid, polygonal blocks came to light. A continuation of this pavement was also found immediately under the Church of Sta Francesca Romana, thus showing that the Sacra Via originally ran due east from the Forum, a circumstance which suggests that the Arch of Titus is not now standing in its original position.

Horrea Margaritaria (spring 1900).—Deeper excavations than those previously made on this site revealed the existence of buildings earlier than the imperial constructions hitherto known. Many small objects of various materials were found among them, fragments of Aretine pottery, and some three hundred terra-cotta lamps of diverse patterns.

Basilica Æmilia (begun spring of 1899).—This was one of the first large undertakings, and its success led to the continuation of Signor Boni's work. It was necessary to expropriate a block of houses which partly covered the site, and this expense was borne by an Englishman, Mr Lionel Phillips. The southern half of the Basilica was cleared, and work gradually proceeded with. Although the Basilica was rebuilt at various times, it is now a complete ruin. Nevertheless, much has been learned concerning its character. The plan consisted of a nave, with aisles on each side running east and west, surrounded by a colonnade. Several important inscriptions and architectural fragments were found, including portions of the large pillars of African marble (about 3 feet in diameter and 30 feet high) which separated the nave from the aisles. These columns show that the *pavonazzetto* pillars in St Paul's outside the Walls were not, as was previously believed, taken from the Basilica Æmilia. Traces of many partial reconstructions have been found, the last having apparently been executed in the time of Theodoric. The final destruction of the edifice was due to fire.

Niger Lapis (spring of 1899).—On 10th January 1899 a square pavement some 12 feet by 12 in extent, composed of thick slabs of black marble veined with white, was discovered at a short distance from the front of the Arch of Septimius Severus. The objects found below this pavement are convincing proof that it is the "black stone" mentioned by Festus as marking the spot where, according to tradition, Romulus was buried (cf. also *Schol. Crug. ad Hor. Epod.* xvi. 13; *Dion. Hal.* i. 87). Beneath the "black stone" are two bases on which, in all probability, stood the two lions known to have been near the Tomb of Romulus. Close by, also under the "black stone," were discovered a (hitherto unexplained) cone shaped shaft of tufa and a *cippus*, of which the upper half had been destroyed. On the four sides of this *cippus* was a Latin inscription, perhaps of the 6th century B.C., which, so far as it can be deciphered, relates to sacrificial ritual. Around these monuments lay a thick stratum of sacrificial remains, in which were found, among other objects, half a dozen finely worked bronze figurines, similar to the Apollo of Tenea.

Comitium (January–November 1900).—The various strata, more than twenty in number, were carefully examined down to the

original geological stratum. Each of the principal epochs was characterized by a different flooring—the mediæval of travertine, the imperial of marble, the republican of tufa, and others perhaps of beaten earth. Many inscriptions and statue bases were found, among the latter being one dedicated to Mars and to the founders of the Eternal City by Maxentius on 21st April 308 A.D., the anniversary of the foundation of Rome. Four rows of ritual pits (22 in all) of the republican epoch, and set according to the early orientation of the Forum, were found in front of the Comitium, but, unfortunately, contained little of special interest.

Cloaca Maxima (August 1899–September 1900).—When, after exploring the Comitium and the Basilica Æmilia, the outside of this sewer was uncovered, it become evident that it was built of blocks taken from republican buildings, and that its date could not be anterior to the time of Agrippa. A large drain, perhaps two centuries older, was found under the Basilica Æmilia, together with another massive sewer, which may be the original Cloaca Maxima. This latter is made of rough-hewn blocks of tufa, and has rather the appearance of a walled-in stream than that of a regular sewer.

Rostra (December 1898–November 1900).—Some discoveries of great interest were made, although not entirely explained. Signor Boni shows reason for the belief that he has found traces of the original Rostra near the "black stone." He also advances convincing architectural proof that the construction considered by Middleton and others to be the Rostra built by Cæsar in 45 B.C. was really built in the time of Domitian, with, as was already known, an addition at the northern end dating from the 5th century A.D. Behind this construction is a curved platform, sometimes called the Græcostasis, to the rear of the southern half of which Signor Boni found another construction of *opus incertum*, consisting of barrel-vaulted niches some 5 feet high, with carefully laid floors of brick *tesseræ* and piers and archivolt of neatly cut well-set blocks of tufa. The whole structure, except the floors, was covered with stucco. The materials and the excellent method of construction show the monument to date from the republican epoch. The arches suggest that it may be the Rostra shown on the famous Palikanus coin of the *gens Lollia;* but one serious difficulty lies in the way of this explanation, namely, the absence of all trace of an attachment of the *rostra* either within or without the arches. It is to be noted that the traces of the Miliarium Aureum, placed by some students on the spot where this arched structure was found, can never have existed. There was no evidence to justify, and many architectural reasons against, the belief that the curved mouldings in this locality had anything to do with the monument. Nor is there the slightest evidence that the fragment of granite column was, as it has been asserted to be, part of the shaft of the *miliarium*.

Fountain of Juturna.—This fountain and the *sacrarium* connected with it were found on the precise spot indicated in the marble plan of Rome, slightly to the south-east of the Temple of Castor and Pollux. The square basin in which the water from the spring was collected was in early times made of tufa, and was larger than the marble-lined basin of the imperial epoch. Ample traces of both basins were found. On a high level, somewhat to the south of the fountain, stood the *sacrarium*, in front of which was found a well, the marble kerb of which bears a dedicatory inscription of the Curule Ædile, Marcus Barbatius Pollio. The water ran to the well through a leaden pipe from the basin of the fountain. The *sacrarium*, though of late construction, has the orientation of the earliest buildings in the Forum. Several fragments of sculpture were found on this site, by far the most important being pieces of the group of Castor and Pollux, with their horses. This group formerly stood in the middle of the basin of the fountain, upon a base of which traces exist. The spirit of the sculptures is that of 5th-century Greek work, but certain details of treatment make it probable that they were executed by some Italianized Greek from one of the numerous Greek colonies, or by some native trained by Greek masters, as were the terra-cotta decorations of the temple of the Capitoline Jupiter.

Palatine Basilica (begun in June 1899).—Discoveries made since the demolition of the modern Church of Sta Maria Liberatrice (recently expropriated by the Italian Government) settled the controversy as to the site of Sta Maria Antiqua. A fine imperial basilica, built probably by Domitian and afterwards converted into a church, was unearthed. Inscriptions prove this to have been the Church of Sta Maria Antiqua, which, according to the *Liber Pontificalis*, was decorated by John VII. (795–707). By him also the *ambon* was made, and an episcopal residence erected close by. Within the basilica Signor Boni has found an inscription in Latin and Greek, in which Pope John VII. calls himself "Servant of the most holy Mary"—the same title as is inscribed on his tomb in the Sacre Grotte of St Peter's. The outer of the two halls of which the church consists contains many mural sepulchres, and was probably considered as an *atrium*. Between this *atrium* and the shrine of Juturna, at right angles to the left side of the church, is a chapel which frescoes show to have been dedicated to the Forty Martyrs, and which may possibly have been the *secretarium*. The interior of the main building is covered with frescoes of the 8th century in remarkable preservation. Among them are rows of saints of the Greek and Latin Churches, conventional religious groups, scenes from the lives of saints and of Biblical characters. The most interesting are portraits of Popes Paul I. (757–767), Zacharias (774–752), and Theodotus, uncle of Hadrian I. The best preserved of the frescoes is a Crucifixion, practically uninjured, and as fresh as the day it was painted. This church, which was decorated and endowed with precious objects by many Popes (cf. *Liber Pontificalis*, Leo III., Benedict III., and Nicholas), was after the time of Nicholas called Sta Maria Nova. In 1702 the site was dug over by men hunting for marbles, and parts of the paintings were seen, but the erection of the modern Church of Sta Maria Liberatrice on the spot prevented thorough investigation, and gave rise to many theories. The facts are at last known.

Results.

The importance of the work in the Forum is obviously very great. During the searches marble and bronze objects, some of beauty and many more of great historical interest, were found, together with a number of valuable inscriptions. Much was learned concerning the history of the Forum, and after many centuries the position and ground-plan of the most ancient buildings is known with reasonably complete certainty. In other parts of Rome two monuments were subjected to critical study. One is the Pantheon (see Luca Beltrami, *Il Pantheon*, 1898), which, by the presence of certain brick-stamps throughout the edifice, was proved to be of the time of Hadrian. The other is the Church of Sta Maria in Cosmedin, which is built above an ancient temple of Ceres. It was freed from all Renaissance and later additions, and restored to its 12th-century form. In places the early temple walls can be seen; in others, 4th and 6th century structures can be detected; but as a whole its form and its interesting frescoes are of the 12th century. It is no light task to sift the mass of explorations and discoveries in Rome and neighbourhood, or to gain a clear view of archæological progress in this part of the world. Certain broad features are to be noted. Just as the modern city has lost much of the charm of the years before 1870, so the character of archæological study has largely changed. The old school of students, who, with fewer objects to consider, had more time to think, and who sought rather to grasp general points of view than to burden their minds with particular facts, has given way to a class whose work partakes of the nature of catalogues, and who lengthily debate the value of scattered fragments. It is no longer common to find private individuals collecting the objects of beauty and interest which continually come to light; nor are public collections governed by any understanding of the meaning and proper treatment of works of fine art. Not unfrequently they appear to aim at exhibiting to a restless public mere masses of dull, unrelated material. Doubtless much work of detail was necessary, and must be regarded as an inevitable consequence of the valuable modern contributions to knowledge; but the question arises whether such work may not engender a tendency to seek entertainment in a maze of detail, and to forget the value of fruitful and inspiring generalization. It is often said with truth that the ancients knew less than we about the development of themselves and of their arts; but of what value is such knowledge as compared with their power to carve the splendid portraits of Egypt or the thrilling masterpieces of Greece?

Accidental finds.

Among the antiquities discovered in a semi-accidental manner are the various objects and remains found during the construction of the forts encircling the city. In 1877 (see *Notizie degli scavi*, p. 311) tombs were found on the Via Appia, and a reservoir on the Via Gianicolenzi, outside Porta San Pancrazio. In 1878 (*ibid.* pp. 38, 134–369) more tombs were found on

the Via Appia. In 1883 (*ibid.* pp. 130, 422) a mausoleum with statues and inscriptions was found on the Via Ostiensis; these objects were of little beauty but of considerable interest. In the same year a somewhat elaborate system of water-works was found on the Via Latina. In 1884 (*ibid.* pp. 43–81) a large villa was discovered on the Via Tiburtina. It was in fairly good condition, and many of the patterns of the mosaic floors and the designs of the stuccoed walls could be made out; statues of Apollo and Æsculapius were also found here. The most interesting discoveries were made in 1881 (*ibid.* p. 60; and Lanciani, *Ancient Rome*, p. 28) and in 1887 (*Notizie degli scavi*, p. 64). In the former year the military engineers working on the summit of Monte Mario came upon the burial-chamber of the family of Minicia Marcella, the friend of Pliny the Younger, by whom she was charmingly immortalized. The burial-chamber, some 26 feet square, was of simple construction, with brick floor and stuccoed walls. In it were six sarcophagi, beside which stood an urn with an inscription declaring it to contain the ashes of the mother of Pliny's girl friend, and in the centre of the room a marble slab with the inscription D. M. (MINICIÆ) MARCELLÆ FUNDANI F. VIX. A. XII. M. XI. D. VII. In 1887 a fort was planted on the site of Antemnæ—the *turrigeræ Antemnæ* of Virgil (*Æn.* vii. p. 631). The site mentioned by various ancient authors (Strabo v. 3; Dionysius i. 17. 11. 35; Plutarch in *Sulla* 30 and *Varro* v. 5, who explains the name, *quia ante amnem qui influit in Tiberim*) was already known, although no visible traces existed, and it had not been explored. Some rudely made stone objects found during the construction of the fort probably date from the earlier periods of the history of Antemnæ, when it was a member of the league formed against Rome after the rape of the Sabines. Portions of an early wall made of tufa without cement, some wells and reservoirs, bronze pins and rude terra-cotta vases similar to those found in the archaic tombs on the Esquiline Hill in Rome, were discovered on the site; though not of special importance, they afforded clear indications as to the original character of Antemnæ. In imperial times a villa was built there (as on other similar sites). During the construction of the forts many remains of terra-cotta antefixes and life-sized human figures, with which the villa was decorated, were brought to light.

In September 1880 several bronze busts of the 1st century, and other bronze objects, were found during the excavation of the foundations of the English Church in Via Babuino. These objects were dispersed by antiquity dealers. The same fate befell several fine bronzes and marbles found about the same time at the corner of Via Nazionale and Via Santa Eufemia. In 1884 a burial-chamber with nine sarcophagi, decorated with exceptionally beautiful carvings, was found on the Via Salaria (see *Bulletin de l'Institut de Correspondance Archéologique*, 1884–85). The sarcophagi were those of Cn. Pompey, Licinius Crassus, Calpurnius Pisonis Frugus, Scribonius Libo, and others of the same families. Concerning these persons, it is known that M. Licinius Crassus and his wife Scribonia were condemned to death by the Emperor Claudius; Cn. Pompey, son-in-law of Claudius, was put to death at the instigation of Messalina; L. Calpurnius Piso Frugi Licinius was adopted by Claudius in the presence of the Prætorian Guard, and by the same guard put to death a few days later. Among the scenes carved on the sarcophagi were: The Triumph of Bacchus, Bacchus and Ariadne, Rape of the Daughters of Lucipus, Childhood of Bacchus. Of this most interesting set of sarcophagi, one is in the Museo delle Terme, and the others in the collection of Don Marcello Massarenti.

Numerous and interesting sculptures were found on the sites once occupied by the gardens of Mæcenas and of Sallust. Portrait busts, fountains, original Greek works of various dates, in relief or in the round, and copies of Greek originals, suggest that these gardens were, in fact, museums. The throne of Aphrodite, which has been bought by the Government, with the rest of the Boncompagni collection, was found in 1887 in the gardens of Sallust. This is perhaps the most beautiful piece of Greek bas-relief of the early 5th century in existence. A similar and even better preserved throne, discovered at the same time and place, was sold by the antiquity dealers. Several of the works found in these gardens were sold to foreign purchasers. In 1884 two colossal bronze statues, probably of the 2nd century B.C., were found in digging the foundations of the Teatro Nazionale. One is a seated figure of a pugilist, and the other a standing figure of a man. Both are in perfect preservation, and are fine examples of a coarse but powerful school of art. In 1887 a fine though imperfect replica of the Apollo Barberini was found in the Prati di Castello. It is now in the Museo dei Conservatori. In 1899 a good copy of a very fine statue of Apollo of the early part of the 5th century B.C. was brought out of the Tiber. The river continues from time to time to give up works of the greatest interest. Several other works were discovered in making the foundations of the monument to Victor Emmanuel II., and in 1897 a broken copy of the Athena of Velletri was unearthed in Piazza Sciarra. This summary description of objects accidentally found from time to time in Rome will serve to convey an idea of the vast amount of sculpture buried within the city. Those which have not been bought by foreigners are placed in the Museo delle Terme, the Museo dei Conservatori, or the Magazzino Archeologico.

Under the following headings we give a summary of the progress made in elucidating the archæological interest connected with various sites near Rome:—

Excavations at sites near Rome.

Alba Longa (see Ashby, *Journal of Philology*, vol. xxvii.).—In the light of modern knowledge, and with the advantage of discussion with Professor Lanciani, the chief authority on the Campagna and neighbourhood of Rome, Mr Ashby reviewed the various theories propounded with regard to the site of Alba Longa. He decided in favour of Castel Gandolfo (see Tomasetti, *Campagna di Roma nel medio evo*, 1–587).

Conca (see *Notizie degli scavi*, 1896, and *Mélanges d'Archéologie et d'Histoire*, 1896).—Nibby (*Analisi della Carta dei dintorni di Roma*, p. 748 f.) believed this place to be the site of the ancient town of Satricum, and excavations carried on in 1896 have shown this belief to be well founded. Satricum is not often mentioned by ancient authors (see Livy, vi. 22, vii. 27, xxviii. 11; Diodorus xiv. 102; Pliny, *Hist. Nat.* iii. 5. 9). But it is clear that the town was famous for the Temple of Mater Matuta. Though Satricum was twice destroyed, the temple seems not to have suffered, probably because it stood outside the actual city limits. This inference is borne out by the results of excavations, which were undertaken privately by the late Count Tyskiewicz, with the help of students from the French School of Rome. The site explored was at Conca, one of the largest properties in the so-called Agro Romano, and situated in a marshy region south of the Alban Mountains. After five weeks' work, notwithstanding the great interest of the results obtained, operations were suspended, by order of the Government, because "it was necessary to confirm the rule that in Italy no archæological explorations are to be made by foreigners, not even by scientific schools or societies" (see *Supplemento al No. 23 del Bollettino Ufficiale del Ministero dell' Istruzione Pubblica*, Rome, 10th June 1899). The excavations, as far as they went, made it clear that the temple was more than once reconstructed. The earliest form of which traces were found dated from the 7th century B.C. The temple was then built of red tufa, with an orientation from east to west, the columns, used only in the portico, being of heavy proportions and of the Tuscan order. In the following century the temple was enlarged and rebuilt on a more elaborate plan, with a whiter kind of tufa and a somewhat different orientation. This second temple was probably made peripteral, and was elaborately decorated with terra-cotta figures

and ornaments. Large quantities of these ornaments were found, mostly painted with white, red, and black. The figures were in bold relief, and apparently formed a frieze, of which the subject cannot be made out. Possibly it consisted not of one subject only, but of a series of groups, one of which represented the not uncommon scene of a satyr embracing a nymph. Besides the figures, many antefixes, with relief heads, and many geometrical designs were found, some painted and some consisting of open-work patterns, like those discovered at Civita Castellana. The subjects represented, the heavy proportions of the figures, and their bold but loose modelling, show the work to be akin to the branch of Greek art called Ionian. The artists were evidently trained on Greek models by Greek masters; in no sense did they produce true Etruscan or Italian work.

Gabii (see *Notizie degli scavi*, 1885).—The usually good results obtained when this site was partially explored by Gavin Hamilton in 1792 justified hope that more statues and inscriptions might be found here. No attempt at further excavations has, however, been made. In 1885 the site was surveyed, but no new knowledge obtained, beyond the picking up of two fragments bearing a few letters of the Fasti Gabini, or lists of Roman public officials. Many ruined tombs and other Roman structures exist in the neighbourhood, and it is noteworthy that the tombs differ from those nearer Rome in having a square plan. As Gabii was used as a quarry during the Roman Empire, most traces of it have been destroyed. Much harm has been done in modern times, the mosaic floor of the Temple of Juno (Virgil vii. 176), which was in reasonably good condition forty years since, having been entirely destroyed.

Hadrian's Villa at Tivoli.—The writings of earlier students, such as Ligorio, Piranesi, or Canina, are still valuable, though superseded by the more accurate work of modern scholars. Reconstructions, based by Daumet in 1860 upon careful exploration and measurements, were continued by Girault in 1885 and by Esquié in 1887. Their attention was directed to the so-called Piazza d'Oro and the neighbouring buildings. In 1892 similar investigations were made by Winnefeld, and his results published in 1895 as *Ergänzungsheft III. zum Jahrbuch des kaiserlich-deutschen Archeologischen Instituts.* This is the most useful book on the subject as a whole. From 1873 the excavations were conducted by the Government. First the "Poikile," the "Room of the Seven Wise Men," and the "Natatorium" were explored, and in the summer of 1880 these excavations were joined to those of the "Library," "Piazza d'Oro," &c., to the left of the "Vale of Tempe" (see *Notizie degli scavi*, 1880, p. 479). In 1884 the "Poikile" was further explored, but after that no work was done, except in preserving the ruins. Many rooms, corridors, porticos, courts, and nymphaia were cleared; their floors, as a rule, were of mosaic laid in simple patterns, and in fairly good preservation. Most of the marble or stucco mural decoration was found to have been destroyed, though in several cases the original designs were still perceptible. Unfortunately, most of the architectural fragments were removed from the rooms in which they were found, and stored in odd corners in such way as to impede study. Considering the extent of ground excavated, comparatively few works of art were found, the most important being a nearly finished marble copy of a life-size Greek bronze, representing the youthful Dionysos (see *Notizie degli scavi*, 1881, p. 195), which was placed in the Museo delle Terme. The original bronze was probably the work of some disciple of Polykleitos.

Nemi (see *Notizie degli scavi*, 1885, 1887, 1888, 1895, 1896).—Two main objects governed the work at the Lake of Nemi, called by the ancients *Speculum Dianæ*: (1) to clear the ground formerly occupied by the temple and *temenos* sacred to Diana; (2) to determine the exact character of the ancient boats visible at the bottom of the lake near the temple. The work, which in view of its importance should have been done by trained archæologists under Government supervision, was carried out partly by the British ambassador to the Quirinal (Sir John Savile Lumley, now Lord Savile), partly by an antiquity dealer, and only in small measure by the Government. The result was unsatisfactory: most of the objects excavated were sold, and much needless damage was done to the boats. During 1885 parts of the ancient paved road leading to the temple from the surrounding hillside were laid bare, the *favissæ* of the temple found, and a portico to the rear of the temple partially cleared. Architectural fragments, some of gilded bronze; some sculpture; thousands of statuettes, mostly in terra-cotta, but many in bronze; and several hundred coins, from *aes rude* to imperial currency, were unearthed in 1885, and an astonishing quantity of similar objects were found in 1886, 1887, and 1888. In 1895 an antiquity dealer obtained from the Government permission to work on the sunken boats, the existence of which had been known for some centuries. Leon Battista Alberti had tried to raise them; in 1827 some fragments had been raised to the surface; but in 1895 the smallest of them, which measured 60 by 18 metres, was wrenched to pieces by divers, whose methods were both reckless and ignorant. After the damage had been done, a survey by Government engineers showed the possibility of raising the boats; but no attempt was made to raise the larger vessel, still intact. The boat demolished by the divers seems to have been a sort of floating palace moored by ropes to the shore. The floors were of glass mosaic, the windows were closed by bronze gratings, and the beams fastened together by splendid bronze nails often more than a foot long. The hawsers by which the boat was moored ran through bronze rings held in the mouths of colossal wolves' and lions' heads. These heads projected from massive bronze bands or frames, which were originally attached to stakes or pillars. A Medusa head of similar character, but without the ring for the hawser, and a forearm and hand (doubtless used, as in other cases, as a charm on the bow of the ship) were also found. Considered artistically, these works show great vigour, and the over-dramatic treatment of the hair and facial expression characteristic of periods when sculpture is used chiefly for decorative ends. From inscriptions found in 1895 it appears certain that these boats were built by Caligula, who also built the fantastic ships in which he coasted along the shores of Campania (see Suetonius, *Caligola*, 37).

Lake Regillus (see Ashby in the *Rendiconti della Reale Accademia dei Lincei*, February 1898).—Nibby's suggestion (*Analisi della Carta dei dintorni di Roma*, iii. 9), that Pantano Secco is the site of Lake Regillus, is probably correct.

Terracina.—A *nymphæum*, subsequently used as a tomb, was discovered in 1891 during the excavation of the foundations of the railway station of Terracina, which stands on the site of the ancient city of the same name. Fragments of statues of Venus, a nymph, and an unknown male figure were also found, together with some architectural remains. In another part of the town were discovered a sarcophagus and a copy of the marble Faun of Praxiteles. During 1894 more important discoveries were made in connexion with the Temple of Jupiter Anxur, where Jupiter was worshipped as a child (see Livy xxviii. 11, xl. 45; Virgil, *Æn.* vii. 799; and Servius, *ad Æn.* vii. 799). The ruins are situated on a hill called Monte Sant' Angelo. The dimensions of the foundation walls, of which the orientation is north and south, are 33·50 by 19·70 metres. The cella measured 14·10 by 13·60 metres. The walls were decorated with engaged half-columns, six on each side and four at each end. All the walls and the upper parts of the columns were of *opus incertum*, but the lower parts of the columns were of travertine. The *pronaos*, 12·80 metres long, was decorated with Corinthian columns of early imperial style made of a local stone. The temple was destroyed by fire, but also bears traces of having been razed by the hand of man. In front of the temple cisterns were found, and on the east side a curious cleft in the rock, intended perhaps for the taking of the oracle. Some metres below the temple ran a great arcade of *opus incertum*, for the distance of 62 metres towards the south and 24 metres towards the west—a structure traditionally known as the Castle of Theodoric, but shown by the excavations to be the retaining wall of the terrace on which the temple stood. Many curious leaden objects (now in the Museo delle Terme) were found in the *favissæ* situated on the east side of the temple. They represent plates, dishes for cooking fish, tables, chairs, dolls, pitchers, and candelabrum—toys dedicated to the baby Jupiter. A few small fragments of the sculpture which once adorned the temple were also found.

Veii.—Little more is known of this site than in the days of Nibby and Gell. In 1889 (see *Notizie degli scavi*, 1889) Italian officials did some unimportant work at the expense of the Empress of Brazil. Some traces of buildings were found, and large numbers of tombs were opened. They contained objects of an early date (*circa* 6th century B.C.), some of Eastern character suggesting Phœnician trade, but of little importance. Objects of precious metal were few and small. Much bucchero ware came to light, with some aretine cups and several thousand votive offerings in terra-cotta. These latter represented various human organs, but were of coarse make and similar to those discovered on many other sites.

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Rome, a city of Georgia, U.S.A., the capital of Floyd county. It is situated in 34° 16′ N., 85° 10′ W., on a plain in the angle of junction of the Etowah and Oostanaula rivers, which here form the Coosa, navigable to this point, in the north-western part of the state, at an altitude of 652 feet. The town is divided into five wards, and has a good water-supply and sewerage system. It has three railways, the Chattanooga, Rome, and Southern, the Southern, and the Western and Atlantic. It is in a fertile cotton region, has cotton compresses and a large trade in that staple, and is the seat of Shorter College, a Baptist institution for women, opened in 1877, which had in 1899 a faculty of 14 and was attended by 129 students. Population (1890), 6957; (1900), 7291, of whom 108 were foreign-born and 2830 negroes.

Rome, a city of Oneida county, New York, U.S.A. It is situated in 43° 13′ N., 75° 27′ W., on the Mohawk river, on the Erie Canal, and on the New York Central and Hudson River and the New York, Ontario, and Western railways, in the central part of the State, at an altitude of 445 feet. The city derives its water-supply from the Mohawk, and is well drained and lighted, but few of its streets are paved. Rome is in the dairying region of central New York, and contains butter and cheese factories. It has varied manufactures of iron, brass, and copper goods, breweries, and locomotive works. Population (1890), 14,991; (1900), 15,343, of whom 2527 were foreign-born and 89 negroes.

Romesh Chandra Mitra, SIR (1840–1899), Indian judge, was born in 1840. When the East India Company's charter was renewed in 1853, the old Supreme Courts and Sadr Courts in the presidency towns were changed into High Courts, and Roma Prasad Roy, son of the great reformer Raja Ram Mohan Roy, was the first Indian who was appointed a judge of the new High Court of Calcutta. He did not live, however, to take his seat on the Bench, and was succeeded by Sambhu Nath Pandit, and then by Dwarka Nath Mitra, perhaps the most talented judge that India produced in the 19th century. Dwarka Nath's great ability and thorough insight into cases were universally recognized in India; his decisions were valued and often quoted; and his name was often mentioned as an illustration of the judicial capacity of the natives of India. Anukul Chandra Mukerji also sat on the Bench for a time; and on his death in 1871, Romesh Chandra Mitra was appointed judge in his place. He maintained the high reputation of his predecessors, and for a period of nearly twenty years, down to 1890, he performed his judicial duties with credit and distinction. When the post of Chief-Justice was temporarily vacant in 1882, the Marquis of Ripon, then Viceroy of India, appointed Romesh Chandra to officiate in that post—the highest judicial position in the Indian Empire. Lord Dufferin, who succeeded Lord Ripon as Viceroy of India, appointed Romesh Chandra a member of the Public Service Commission, and in this capacity he did valuable work. Failing health compelled him to retire from the High Court in 1890, and he was then knighted and appointed a member of the Viceroy's Legislative Council. Till he died in 1899, he continued to take interest in all social, educational, and political reforms in India. (R. C. D.)

Romford, a parish, urban district (1894), and market town, Essex, England, in the Romford parliamentary division of the county, about 12 miles east-north-east of London by rail. In 1895 the ancient civil parish was divided into three civil parishes. A new Wesleyan chapel and a public hall have been erected. Population of urban district (1891) (extended area), 10,473; (1901), 13,656.

Romilly-sur-Seine, town and railway station, arrondissement of Nogent-sur-Seine, department of Aube, France, 22 miles in direct line north-west of Troyes, on the Seine. It is an important industrial town, with extensive manufactures of cotton and woollen hosiery, and of the special machinery and appliances required for the industry. The Eastern Railway Company has large workshops here. Population (1896), 7733; (1901), 8991.

Romney, New, municipal borough, Cinque Port, railway station, and parish, Kent, England, in the Southern or Ashford parliamentary division of the county, 22 miles south-south-west of Canterbury, in the alluvial district called Romney Marsh, a rich grazing area of 24,950 acres secured against the sea by an immense embankment under the management of an ancient corporation. It was formerly a busy port, but its harbour was destroyed by the silting up of shingle, and the town is now 1 mile inland. Littlestone-on-Sea is on the sea-front of the borough, with a fine sandy beach, and is growing in popularity as a summer resort. Population of the borough (1881), 1007; (1901), 1327.

Romsey, a municipal borough and market town, in the New Forest parliamentary division of Hampshire, England, 7 miles north-west of Southampton by rail. The town is very ancient, and was called by the Romans "Romana Insula," because it (and its abbey) stood upon an island partly washed by the river Test. The abbey church of SS. Mary and Elfleda, dating from the first half of the 12th century, is cruciform and mainly fine Norman in style, but with an Early English west front. It was partially restored in 1892. The town has tanyards and ironworks, and the Berthon Boat Company has extensive works here. Population of the municipal borough (1881), 4204; (1901), 4365.

Ronconi, Giorgio (1810–1890), Italian baritone vocalist, was born in 1810. He learnt singing from his father Domenico, who had been a celebrated tenor in his time, and made his début in 1831 at Pavia. After singing in Italy for some years with ever-growing success, he appeared for the first time in England, in 1842, as Henry Ashton in *Lucia di Lammermoor*. His success was immediate, and he continued to be one of the most popular artists on the lyric stage until his retirement in 1866. His voice was neither extensive in compass nor fine in quality, but the genius of his acting and the strength of his personality fully atoned for his vocal defects. He was equally at home in comedy and tragedy, and the two parts by which he is best remembered, Rigoletto and Figaro, show conclusively the range of his talent. In his later years Ronconi founded a school of singing at Granada, and he also accepted the post of professor of singing at the Madrid Conservatoire. He died in 1890.

Ronda, a town of Spain, province of Malaga, on the river Guadalaviar. It has a station on the railway line from Algeciras to the junction of Bobadilla, on the Cordova–Granada–Malaga lines. The local industries are chiefly soap, flour, chocolate, tanneries, alcohol, and hat-making. Ronda has four parish churches. The most important public buildings are the town-hall, bull-ring, casino, Casa del Rey Moro, the hospital of Santa Barbara, refuge for aged paupers, eight municipal schools for both sexes, and normal schools. Population (1897), 19,307.

Ronsdorf, a town of Prussia, Rhine province, 4 miles south of Barmen by rail, the seat of iron, steel, and copper industries, ribbon factories, brewing, and distilling. Has monuments to the Emperors William I. and Frederick III. Population (1885), 10,542; (1900), 13,299.

Röntgen, Wilhelm Konrad (1845-——), German physicist, was born at Lennep on 27th March 1845. He received his early education in Holland, and then went to study at Zürich, where he took his doctor's degree in 1869. He then became assistant to Kundt at Würzburg and afterwards at Strasburg, becoming *privat-docent* at the latter university in 1874. Next year he was appointed professor of mathematics and physics at the Agricultural Academy of Hohenheim, and in 1876 he returned to Strasburg as extraordinary professor. In 1879 he was chosen ordinary professor of physics and director of the Physical Institute at Giessen, whence in 1885 he removed in the same capacity to Würzburg. It was at the latter place that he made the discovery for which his name is chiefly known, the Röntgen rays. In 1895, while experimenting with a highly-exhausted vacuum tube on the conduction of electricity through gases, he noticed that a paper screen covered with barium platinocyanide, which happened to be lying near, became fluorescent under the action of some radiation emitted from the tube, which at the time was enclosed in a box of black cardboard. Further investigation showed that this radiation had the power of passing through various substances which are opaque to ordinary light, and also of affecting a photographic plate. Its behaviour being curious in several respects, particularly in regard to reflection and refraction, doubt arose in his mind whether it was to be looked upon as light or not, and he was led to put forward the hypothesis that it was due to longitudinal vibrations in the ether, not to transverse ones like ordinary light; but in view of the uncertainty existing as to its nature, he called it X-rays. For this discovery he received the Rumford medal of the Royal Society in 1896, jointly with Professor Philip Lenard, who had already shown, as also had Hertz, that a portion of the cathode rays could pass through a thin film of a metal such as aluminium. Professor Röntgen has also carried out researches in various other branches of physics, including elasticity, capillarity, the conduction of heat in crystals, the absorption of heat-rays by different gases, piezo-electricity, the electromagnetic rotation of polarized light, &c.

Röntgen Rays. See Electricity.

Roon, Albrecht Theodor Emil, Count von (1803–1879), Prussian field-marshal, author, and reorganizer of the Prussian army, was born at Pleushagen, near Colberg, in Pomerania, on the 30th April 1803. His family was of Flemish origin, and was settled in Pomerania. His father, an officer of the Prussian army during the French occupation, died in poverty, and young von Roon was brought up by his maternal grandmother. He entered the corps of cadets at Kulm in 1816, whence in 1818 he proceeded to the military school at Berlin, and on the 19th January 1821 received a commission in the 3rd (now 14th) Pomeranian regiment quartered at Stargard in Pomerania. In 1824 he went through the three years' higher course of study at the war school in Berlin. In 1826 he was transferred to the 15th Foot at Minden, but the same year was appointed an instructor in the military cadet school at Berlin, where he devoted himself especially to the subject of military geography. He published in 1832 the well-known *Principles of Physical, National, and Political Geography*, in three volumes (*Grundzüge der Erd-Völker-und-Staaten-Kunde*), thereby founding a practically new system and making a name for himself. This work was followed in 1834 by *Elements of Geography* (*Anfangsgründe der Erdkunde*), in 1837 by *Military Geography of Europe* (*Militärische Länderbeschreibung von Europa*), and in 1839 by *The Iberian Peninsula* (*Die Iberische Halbinsel*).

Meantime, in 1832, he rejoined his regiment, and was afterwards attached to the headquarters of General von Müffling's corps of observation at Crefeld, when he first became alive to the very inefficient state of the Prussian army. In 1833 he was appointed to the Topographical Bureau at Berlin, in 1835 he entered the General Staff, and in the following year was promoted captain and became instructor and examiner in the military academy at Berlin. In 1842 he was promoted to be major, and was present at the manœuvres on the Rhine under General von Pfhül, when he was again impressed with the inefficiency of the organization of the army, and occupied himself with schemes for its reform. Two years later, as tutor to Prince Frederick Charles, he attended him at the Bonn University and in his European travels. In 1848 he was appointed chief of the staff of the 8th Army Corps at Coblenz, under the command successively of Generals von Dunker, von Schreckenstein, and von Hirschfeld. During the disturbances of that year he served under the Crown Prince William (afterwards German Emperor) in the suppression of the insurrection at Baden, and distinguished himself by his energy and bravery, receiving the 3rd class of the order of the Red Eagle in recognition of his services. While attached to the Crown Prince's staff at that time he broached to him the subject of his schemes of army reform. In 1849 he was promoted to be lieutenant-colonel and entrusted with the details of the mobilization to take place the following year; but the defective condition of the organization of the army was so serious that the differences with Austria had to be arranged by the humiliating treaty of Olmütz in November 1850.

Promoted to be major-general in 1856 and lieutenant-general in 1859, von Roon had held since 1850 several commands and had been employed on important missions. Prince William became regent in 1857, and in 1859 he appointed von Roon a member of a commission to report on the reorganization of the army. Supported by Manteuffel and von Moltke, von Roon was able to get his plans seriously considered and generally adopted. His aim was to create an armed nation, to extend Scharnhorst's system, and to adapt it to Prussia's altered circumstances. To attain this he proposed a universal three years' service, and a reserve (*Landwehr*) for the defence of the country when the army was actively engaged. During the Italian war he was charged with the mobilization of a division. At the end of 1859 he succeeded von Bonin as War Minister, and two years later the Ministry of Marine was also entrusted to him. His proposals of army reorganization met with the bitterest opposition, and it was not until after long fighting against a hostile majority in the Chambers that, with Bismarck's aid, he

carried the day. Even the Danish campaign of 1864 did not wholly convince the country of the necessity of his measures, and it required the war with Austria of 1866 to convert obstinate opposition into enthusiastic support. Then von Roon, from being the best hated man in Prussia, became the most popular, and his reforms were ultimately copied throughout continental Europe. The system adopted by the North German Confederation produced its inevitable result in the victorious war with France in 1870–71, throughout which von Roon was in attendance on the German Emperor. The fiftieth anniversary of his entrance into the army was celebrated at Versailles on the 19th January 1871, when the Emperor expressed his gratitude for the great services he had rendered. He was created a count, and in December 1871, having resigned the Ministries of War and Marine, he succeeded Bismarck as President of the Prussian Ministry. Ill-health compelled him to resign in the following year. He was promoted to be field-marshal on the 1st January 1873. He died at Berlin on the 23rd February 1879.

After his death his son published the valuable *Denkwürdigkeiten aus dem Leben des Generalfeldmarschalls Kriegsministers Grafen Roon, Sammlung von Briefen, Schriftstücken und Erinnerungen* (2 vols., Breslau, 1892), and *Kriegsminister von Roon als Redner politisch und militärisch erläutert* (Breslau, 1895). (R. H. V.)

Roorkee, or RURKI, a town of British India, in the Saharanpur district of the North-West Provinces; situated in 29° 52′ N. and 77° 55′ E.; on the Oudh and Rohilkhand Railway, 22 miles east of Saharanpur. Population (1891), 14,291; municipal income (1897–98), Rs.13,730. Headquarters of the workshops of the Ganges canal, and also of the Bengal sappers and miners. Thomason Civil Engineering College, founded 1847, was transferred from the Public Works to the Education Department in 1895, and then reorganized. It consists of an engineer class of 22 English and 11 native students, an upper subordinate class of 31 English civil and military and 16 native students, a lower subordinate class of 66 native students, a military survey class of 8 English and 10 native students, together with mechanical apprentice and industrial classes. The college, which is not affiliated to the Allahabad University, works in co-operation with the workshops and foundry of the canal, and also trains in surveying and in photography.

Roosevelt, Theodore (1858– ——), President of the United States, was born in New York City on the 27th October 1858. His ancestry connected him with old and substantial families in both the Northern and the Southern section of the Union. The Roosevelts, his father's forebears, had been, from the middle of the 17th century, conspicuous in the Dutch element of the citizens of New York, and his mother, *née* Bullock, was a member of an old family which furnished the first revolutionary governor to the state of Georgia. The education of Theodore Roosevelt was that common to the well-to-do boys of his time, and culminated in the course at Harvard College, from which he graduated in 1880. After a period of travel in Europe, he returned to New York in 1881, and studied for a year in the law school of Columbia College and in the office of his uncle. The law proved, however, to have little attraction for him, and the year during which he was nominally engaged in its study saw the beginning of his active career in the two lines which were most to his taste—literature and politics. It was at this same time, moreover, that he began his familiar acquaintance with Western frontier life, and added another and most significant element to those hereditary interests which attached him in sympathy to widely diverse sections of the country.

Mr Roosevelt entered political life as a Republican, but in opposition to the "machine." As the nominee of a body of independents in the party, he was elected member of the state legislature from New York City in the autumn of 1881, and served continuously for three years, 1882–84. During this period his energy, honesty, and fearlessness won for him a very prominent position in his party and in general public esteem. He devoted himself especially to the cause of administrative reform in New York City, and pursued to extinction a number of grave abuses in the government of the municipality. In 1884, as a delegate to the National Convention of the Republican party, he joined with the faction which opposed the nomination of Mr Blaine for President; and while he did not, like many of his associates in that cause, refuse to accept Mr Blaine when nominated, his support of the candidate lacked something of his familiar vehemence, though he strenuously proclaimed himself a loyal party man. Two years later he justified his professions of party loyalty by accepting the Republican nomination for mayor of New York City, at a time when most of the reform element in the party wished to unite in a non-partisan movement against Tammany Hall. His conduct at this time brought upon him censure from many who had hitherto warmly supported him, and he was badly defeated in the election. For three years after this Mr Roosevelt devoted himself chiefly to literature and to the enjoyment of life on his ranche in the mountains of Dakota. In April of 1889, at the beginning of Mr Harrison's administration, the President appointed Mr Roosevelt a member of the National Civil Service Commission, on which he served for six years. In this position he found congenial occupation in promoting with all his energy the substitution of competitive examination for congressional patronage in filling the minor administrative offices. He retired from this position only when the scheme had been worked out through which, by President Cleveland's order, practically the whole civil service was brought under the operation of the new system. From this work of reform Mr Roosevelt was called back to municipal affairs in 1895, through his appointment as one of the police commissioners of New York City. A legislative investigation had revealed widespread and inveterate corruption in the police force, and Mr Roosevelt found a field for all his energy in restoring in some measure the *moral* of the organization. The two years of service in this work confirmed his reputation for great administrative efficiency, and general approbation was given to his appointment by President McKinley as Assistant Secretary of the Navy in 1897. In this position it fell to Mr Roosevelt to contribute very greatly to the preparation of the navy for the war with Spain. Himself anticipating and convinced of the justice of the war, he saw to it that the vessels and supplies were so distributed, both at home and in the Orient, that when hostilities broke out the victories in the waters of Cuba and the Philippines followed as matters of course. Dissatisfied with a function that kept him from participation in the actual fighting, Mr Roosevelt resigned from the Navy Department 6th May 1898, and devoted himself to the organization of a volunteer regiment of cavalry—popularly known as the "Rough Riders"—of which he was commissioned lieutenant-colonel. His reputation and extensive acquaintance throughout the country brought together in this regiment a remarkable assortment of typical characters, from the fashionable clubs and the police force of New York, football players and all-round athletes from the prominent colleges, and cowboys and other venturesome spirits from the West. With this command, which was quickly drilled into a well-disciplined and formidable body of troops, he took part in the campaign

which resulted in the fall of Santiago. For conspicuous gallantry in action Mr Roosevelt was promoted to be colonel. After the surrender of the Spaniards he quickly became weary of the idle waiting, in the hot and fever-stricken region, for the return to America, and his vigorous and reasonable, if somewhat insubordinate, representations to the commander-in-chief greatly hastened the withdrawal of the troops to the United States, where the regiment was mustered out of service at the end of the summer.

With the addition of conspicuous military achievement to his record for strength and efficiency in civil office, Mr Roosevelt's political career was now assured. Nominated on his return from Cuba as the Republican candidate for governor of New York State, he was elected by a substantial majority in November 1898. His administration was characterized by the same devotion to honest and straightforward party politics and to pure and efficient administrative methods that had been manifest in his earlier career. When the presidential elections of 1900 drew near, there was evidently a strong feeling in the rank and file of the Republican party that Governor Roosevelt should receive national office. Since many circumstances conspired to make the renomination of Mr McKinley as President inevitable, the demand arose that Governor Roosevelt should be named for Vice-President. The relatively insignificant duties of this office, however great its dignity, offered no attraction to so active a spirit as that of Mr Roosevelt, and he was, moreover, anxious to serve another term as governor. Hence he resisted openly and with all his power the movement to name him for Vice-President. But the popular enthusiasm was sedulously stimulated by the New York politicians of the baser sort, who were very willing to get rid of a governor who had little sympathy with their general aims and methods, and the National Republican Convention, disregarding the persistent refusals of Mr Roosevelt, put him by main force in nomination as Vice-President. The elections of 1900 gave an easy victory for McKinley and Roosevelt. Inaugurated in March 1901, the Vice-President's only service was a nominal presidency of the Senate in the special session in March. The assassination of Mr McKinley brought the succession to Mr Roosevelt, who took the oath and assumed the functions of President on the day of Mr McKinley's death, 14th September 1901.

PRESIDENT ROOSEVELT.

Mr Roosevelt's contributions to literature have had a pretty close relation to the events of his active life. His first work, *The Naval History of the War of 1812*, was published in 1882, at the outset of his career. Between 1885 and 1889, when not in the public service, he entered upon that systematic study of frontier life which produced not only his chief historical work, *The Winning of the West*, but also a series of volumes descriptive of his experiences in hunting and ranching in the Far West. His experiences in political life resulted in a number of volumes and very many magazine articles in all of which the leading feature was the gospel of activity and effort—the "strenuous life," as opposed to either the aloofness of the mere philosopher and critic, or the indolence and idleness of the Sybarite or the cynic. Some of these articles were published in 1902 under the title of *The Strenuous Life*.

Rops, Félicien (1833–1898), Belgian painter, designer, and engraver, excelled in these three methods of artistic expression; but his engraved work is the most important, both as to mastery of technique and originality of ideas, though in all his talent was exceedingly versatile. Hardly any artist of the 19th century equalled him in the use of the dry-point and soft varnish. By his assured handling and admirable draughtsmanship, as well as the variety of his sometimes wildly fantastic conceptions, he made his place among the great artists of his time. "Giving his figures a character of grace which never lapses into limpness," says his biographer, E. Ramiro, "he has analysed and perpetuated the human form in all the elegance and development impressed on it by modern civilization." Félicien Rops (born at Namur, in Belgium, 10th July 1833) spent his childhood in that town, and afterwards in Brussels, where he composed in 1856, for his friends at the university, the *Almanach Crocodilien*,

his first piece of work. He also brought out two *Salons Illustrés*, and collaborated on the *Crocodile*, a magazine produced by the students. The humour shown in his contributions attracted the attention of publishers, who offered him work. From 1864 to 1866 he designed, among other things, almost all the frontispieces for Poulet-Malassis, and afterwards for Gay and Doucé. In 1865 he started a satirical journal: *Uylenspilgel*, a sort of *Charivari*. The issue, limited unfortunately to two years, included his finest lithographs. In the same year he brought out his famous "Buveuse d'Absinthe," which placed him in the foremost rank of Belgian engravers; and in 1871 the "Dame au Pantin." After 1874 Rops resided in Paris. His talent, which commanded attention by its novel methods of expression, and had been stimulated by travels in Hungary, Holland, and Norway, whence he brought back characteristic sketches, now took a soaring flight. To say nothing of the six hundred original engravings enumerated in Ramiro's *Catalogue of Rops' Engraved Work* (Paris, Conquet, 1887), and one hundred and eighty from lithographs (Ramiro's *Catalogue of Rops' Lithographs*, Paris, Conquet, 1891), besides a large number of oil-paintings in the manner of Courbet, and of pencil or pen-and-ink drawings, he executed several very remarkable water-colour pictures, among which are "Le Scandale," 1876; "Une Attrapade," 1877 (now in the Brussels Museum); a "Tentation de St Antoine," 1878; and "Pornocrates," 1878. Most of these have been engraved and printed in colours by Bertrand. From 1880 to 1890 he devoted himself principally to illustrating books: *Les Rimes de Joie*, by Théo Hannon; *Le Vice Suprême* and *Curieuse*, by J. Péladan; and *Les Diaboliques*, by Barbey d'Aurévilly; *L'Amante du Christ*, by R. Darzens; and *Zadig*, by Voltaire; and the poems of Stéphane Mallarmé have frontispieces due to his fertile and powerful imagination. Before this he had illustrated the *Légendes Flamandes*, by Ch. Decoster; *Jeune France*, by Th. Gautier; and brought out a volume of *Cent Croquis pour rejouir les Honnêtes Gens*. His last piece of work, an advertisement of an exhibition, was done in November 1896. Rops died, 23rd August 1898, at Essonnes, Seine-et-Oise, on the estate he had purchased, where he lived in complete retirement with his family. Scorning display, Rops almost always opposed any exhibition of his works. However, he consented to join the Art Society of the "XX.," formed at Brussels in 1884, as their revolutionary views were in harmony with the independence of his spirit. After his death, in 1899, the Libre Esthétique, which in 1894 had succeeded the "XX.," arranged a retrospective exhibition, which included about fifty paintings and drawings by Rops. Rops was a Chevalier of the Legion of Honour.

In 1896 *La Plume* (Paris) devoted a special number to this artist, fully illustrated, by which the public were made aware how many of his works are unsuitable for display in the drawing-room or boudoir. E. Deman, the publisher at Brussels, brought out a volume in 1897 with the title, *Félicien Rops et son œuvre*—papers by various writers. We may also mention a study of *Félicien Rops*, by Eugène Demolder (Paris, Princebourde, 1894), and another by the same writer in *Trois Contemporains* (E. Deman, 1901); *Les Ropsiaques*, by Pierre Gaume, brought out in London, 1898; and the admirable notice by T. K. Huysmans in his volume called *Certains*. (O. M*.)

Rosario, a city and important river port of the Argentine Republic, in the province of Santa Fé, on the river Paraná, in 32° 56′ S. and 60° 33′ 39″ W. Population in 1900, 112,461, an increase of 23 per cent. as compared with the census of 1895. Railways following seven distinct routes afford communication with the other cities of the republic, and within Rosario itself various tramways are laid down. There are a municipal zoological garden, several parks and recreation grounds, and monuments in honour of Garibaldi and the "25th of May," (Revolution Day, 1810). A public hospital has been erected; there are also Italian and Anglo-German hospitals. Public buildings also include a handsome Palais de Justice, a normal school for teachers, a school for secondary education, and a theatre. The exports consist chiefly of cereals and other agricultural produce from the busy settlements that have been established in the district. In 1900 the grain exported from Rosario was 809,000 tons of wheat, 202,000 tons of maize, and 64,000 tons of linseed. The railways carry much of the trade, but besides the river and coast traffic, steamers maintain direct communication with Europe. In 1880 the imports were valued at £1,130,000, and the exports at £1,230,000; in 1890 at £3,120,000 and £3,280,000; in 1898 at £1,840,000 and £5,160,000; in 1899 at £2,027,442 and £7,350,121; and in 1900 at £1,913,803 and £5,851,239. In 1890, 1039 vessels of 742,967 tons entered, and 913 of 654,623 tons cleared; in 1898, 664 vessels of 696,550 tons entered, and 831 of 922,000 tons cleared. In 1900, 682 ocean-going vessels of 1,027,353 tons entered the port, and approximately the same number cleared.

Roscher, Wilhelm Georg Friedrich (1817–1894), German political economist, was born at Hanover, 21st October 1817. He studied at Göttingen and Berlin, and obtained a professorship at Göttingen in 1844 and subsequently at Leipzig in 1848. He is one of the most important in what is known as the "historical" school of political economy. He published a number of works on this and kindred subjects, the two chief being his great *System der Volkswirthschaft*, published in 5 vols. between 1854 and 1894, and his *Geschichte der Nationalökonomie in Deutschland* (1874). He also published in 1842 an excellent commentary on the life and works of Thucydides. He died at Leipzig, 4th June 1894.

Roscommon, an inland county of Ireland, province of Connaught. The area of the administrative county in 1900 was 607,002 acres, of which 120,406 were tillage, 358,090 pasture, 69 fallow, 7444 plantation, 75,431 turf bog, 9875 marsh, 6213 barren mountain, 29,474 water, roads, fences, &c. The administrative county under the Local Government (Ireland) Act, 1898, includes one electoral division formerly situated in Galway, and two electoral divisions formerly situated in Mayo, but does not include the portions of the towns of Ballinasloe and Athlone formerly in Roscommon.

Population.—The population in 1881 was 132,490; in 1891, 114,397; and in 1901, 101,639, of whom 51,143 were males and 50,496 females, divided as follows among the different religions: Roman Catholics, 98,985; Protestant Episcopalians, 2229; Presbyterians, 247; Methodists, 96; and other denominations, 82. The decrease of population between 1881 and 1891 was 13·65 per cent., and between 1891 and 1901, 12·8 per cent. The average number of persons to an acre in 1891 was ·19, and of the total population, 107,201 inhabited the rural districts, being an average of 147 to each square mile under crops and pasture. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr. Ep.	Presb.	Meth.
Read and write	37,546	34,702	72,248	69·2	92·3	95·9	95·8
Read only	5,579	6,450	12,029	12·0	4·0	2·7	1·7
Illiterate	9,186	9,621	18,807	18·8	3·7	1·4	2·5

The percentage of illiterates among Roman Catholics in 1881 was 28·2. In 1891 there were 5 superior schools, with 237 pupils (Roman Catholics 49, and Protestants 188), and 236 primary schools, with 17,714 pupils (Roman Catholics 17,211, and

Protestants 503). The number of pupils on the rolls of the National schools on 31st December 1900 was 20,707, of whom 20,241 were Roman Catholics and 466 Protestants. The following table gives the number of births, deaths, and marriages in various years:—

	Births.	Deaths.	Marriages.
1881 . .	3615	2001	593
1891 . .	2383	1717	388
1900 . .	1921	1536	404

In 1900 the birth-rate per 1000 was 18·9, and the death-rate 15·1; the rate of illegitimacy was ·7 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 102,273, of whom 50,328 were males and 51,945 females. The chief towns in the county are Boyle, Castlerea, and Roscommon.

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 8871 and 9610. The rateable value in 1900 was £300,187. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises seven rural sanitary districts.

Agriculture.—The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county:—

	Wheat.	Oats.	Barley, Rye.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	452	28,329	803	28,901	4543	2369	68,367	133,564
1891	455	21,815	2168	23,547	4820	3220	68,227	124,252
1895	172	19,528	1075	20,609	4186	3577	72,487	121,335
1900	409	17,603	1425	20,764	3939	3833	72,425	120,406

For 1900 the total value of the cereal and other crops was estimated at £771,870. The number of acres under pasture in 1881 was 335,118; in 1891, 344,186; and in 1900, 358,090.

	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881 .	10,552	8,514	103,759	138,067	28,181	10,646	466,075
1891 .	12,733	10,639	124,502	196,305	37,059	15,787	500,083
1395 .	13,421	10,916	121,644	171,165	37,939	14,279	535,498
1900 .	12,247	11,844	134,528	192,459	42,774	14,358	595,507

The number of milch cows in 1891 was 31,128, and in 1900, 34,635. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £2,146,410. In 1900 the number of holdings not exceeding 1 acre was 925; between 1 and 5, 2256; between 5 and 15, 8718; between 15 and 30, 5796; between 30 and 50, 1750; between 50 and 100, 924; between 100 and 200, 539; between 200 and 500, 282; and above 500, 21; total, 21,211. The number of loans issued (the total of loans being the same as that of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1811, amounting to £347,437. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 575, and the amount issued was £38,029. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £232,683.

(W. H. Po.)

Rosebery, Archibald Philip Primrose, 5th Earl of (1847–——), British statesman, born in London on 7th May 1847, was the grandson and successor to the title of Archibald John Primrose, 4th earl of Rosebery (*d.* 1868), a representative peer of Scotland, who was in 1828 created a peer of the United Kingdom as Baron Rosebery, and was an active supporter of the Reform Bill. The Scottish earldom was first conferred in 1700 upon the 4th earl's great-grandfather, Archibald Primrose of Dalmeny (1661–1723), a staunch Whig and commissioner for the Union. The 5th earl's mother was Catherine Lucy Wilhelmina, only daugher of Philip Henry, 4th Earl Stanhope; she was thus a sister of Earl Stanhope the historian, and a niece of Lady Hester Stanhope, who was the niece of William Pitt. A celebrated beauty, a maid of honour and bridesmaid of Queen Victoria, she married, on 20th December 1843, Archibald Lord Dalmeny (1809–1851), member for the Stirling Burghs, who became a lord of the Admiralty under Melbourne. After his death she became the wife of Harry George Vane, 4th duke of Cleveland, and died in 1901.

The young Lord Dalmeny was educated at Brighton and at Eton, where he had as slightly junior contemporaries Mr A. J. Balfour and Lord Randolph Churchill. He was described by the most brilliant Eton tutor of his day, William Johnson Cory (author of *Ionica*), as a "portentously wise youth, not, however, deficient in fun." He added that Dalmeny "desired the palm without the dust." In 1866 he matriculated at Christ Church, Oxford, but went down in 1868, by the request of the dean, rather than abandon the possession of a small racing stud. In the same year he succeeded to the earldom and to the family estates. In February 1871 he seconded the Address in the House of Lords; a more original effort followed in November 1871, when he delivered a remarkable essay on the Union of Scotland and England at the Edinburgh Philosophical Institution. Three years later he was elected president of the Social Science Congress at Glasgow, where, on 30th September, he gave a striking address upon the discovery of means for raising the condition of the working class as the "true leverage of empire." In the meantime he travelled in the south of Europe and in North America. On his return he acquired an English country house called The Durdans, Epsom, which he largely rebuilt and adorned with some of the finest turf portraits of George Stubbs. Following the example, as he declared, of Oliver Cromwell (for whom he showed an admiration in other respects—culminating in 1900 in the erection of a statue outside Westminster Hall, which was not appreciated either by the Irish Nationalist party or by others among his political associates), he took a pride in owning racehorses, and afterwards twice won the Derby, in 1894 and 1895. No former premier had attained to the distinction of being Derby-winner during office; but though the distinction was popular among many classes, it did not endear Lord Rosebery to the Nonconformists, who considered a racehorse a mere gambling-machine. On 20th March 1878 he married Hannah, only child of Baron Meyer Amschel de Rothschild, of Mentmore, Bucks. The newly married couple took a lease of Lansdowne House, which for several years was a salon for the Liberal party and a centre of hospitality for a much wider circle.

Though impeded in his political career by his exclusion from the House of Commons, Lord Rosebery's reputation as a social reformer and orator was steadily growing during these years. In 1878 he was elected Lord Rector of Aberdeen and in 1880 of Edinburgh University, where he gave an eloquent address upon Patriotism. In 1880 he entertained Mr Gladstone at Dalmeny, and during the "Midlothian campaign" he had much to do with the stage-management of the demonstrations. It is possible that their success may have led him to form a somewhat unduly histrionic conception of the part of a political leader, and this tendency was not weakened by an enthusiastic study of Lord Beaconsfield's political novels, more particularly of *Sybil*, after the heroine in which he named one of his daughters. In August 1881 he became under-secretary at the Home Office, his immediate chief being Sir William Harcourt. His

work was practically confined to the direction of the Scottish department of the Office. A clamour was nevertheless raised in regard to the incompatibility of the under-secretaryship with a position in the House of Lords, and Lord Rosebery resigned the post in June 1883. He and his wife utilized the interval to make a trip round the world, being most warmly received in Australia, and returning by way of India. At the close of 1884 he resumed office as first commissioner of works with a seat in the cabinet, and his adherence carried with it a distinct accession of strength to the Liberal ministry, which was much discredited by the tragedy attached to the fate of Gordon. The attitude of the Government on the Afghan question and generally in regard to Russia was held by many to have been perceptibly stiffened owing to Lord Rosebery's influence.

In June 1885 the Liberal administration broke up, but Lord Salisbury's ministry, which succeeded, was beaten early in February 1886, and when Mr Gladstone adopted Home Rule, Lord Rosebery threw in his lot with the old leader, and was made secretary of state for foreign affairs during the brief Liberal ministry which followed. He rather distinguished himself in the Lucia Bay negotiations then being carried on with Germany. If Busch is to be believed, Prince Bismarck's view was that Lord Rosebery had "quite mesmerized" Count Herbert Bismarck, and the latter, from his father's standpoint, conceded too much to Lord Rosebery, who proved himself to be, in Bismarck's language, "very sharp." His views on foreign policy differed materially from those of Granville and Gladstone. His mind was dwelling constantly upon the political legacy of the two Pitts; he was a reader of Sir John Seeley; he had himself visited the colonies; had predicted that a war would not, as was commonly said, disintegrate the Empire, but rather the reverse; had magnified the importance of taking colonial opinion; and had always been a convinced advocate of some form of Imperial Federation. He was already taunted with being an Imperialist, but his independent attitude won public approval. Cambridge gave him the degree of LL.D. in 1888; in January 1889 he was elected a member of the first County Council of London, and on 12th February he was elected chairman of that body by 104 votes to 17. The tact, assiduity, and dignity with which he guided the deliberations of the council made him exceedingly popular with its members. In the spring of 1890 he presided over the Co-operative Congress, but with a view to the impending political campaign he found it necessary to resign the chairmanship of the County Council in June. In November of this year, however, Lady Rosebery died, and he withdrew for a period from public business. In 1891 he made some brief Continental visits, one to Madrid, and in October he saw through the press his little monograph upon *William Pitt*, in the "Twelve English Statesmen" series, of which it may be said that it competes in interest with Mr John Morley's *Walpole*. In January 1892, upon a new election, he again for a few months became chairman of the County Council. It was already recognized that in him the country possessed not only a public man of exceptionally attractive personality, but one whose literary tastes were combined with a gift for expression which was at once original and fluent. In October the Garter was conferred upon him by Queen Victoria.

THE EARL OF ROSEBERY.
(*From a photograph by Elliott and Fry, London.*)

Meanwhile, in August, upon the return of Gladstone to power, he was induced with some difficulty (for he was suffering at the time from insomnia) to resume his position as Foreign Minister. His acceptance was construed as a security against the suspicion of weakness abroad which the Liberal party had incurred by their foreign policy during the 'eighties. He strongly opposed the evacuation of Egypt; he insisted upon the exclusive control by Great Britain of the Upper Nile valley, and also upon the retention of Uganda. In 1893 the question of Siam came near to causing serious trouble with France, but by the exercise of a combination of firmness and forbearance on Lord Rosebery's part the crisis was averted, and the lines were laid down for preserving Siam, if possible, as a buffer state between the English and French frontiers in Indo-China. In the spring of 1895 he was clear-sighted enough to refuse to join the anti-Japanese League of Russia, France, and Germany at the end of the China-Japan war.

Lord Rosebery's personal popularity had been increased at home by his successful intervention in the coal strike of December 1893, and when in March 1894 the resignation of Gladstone was announced, his selection by Queen Victoria for the premiership was welcomed by the public at large and by the majority of his own party. On all hands he was then considered *dignus imperio*—it was only as the new administration went to pieces that people began to add *nisi imperasset*. The conditions he had to face were by no means hopeful. The Liberal majority of 44 was already dwindling away, and the malcontents, who considered that Sir William Harcourt should have been the prime minister, or who were perpetually intriguing against a leader who did not satisfy their idea of Radicalism, made Lord Rosebery's personal position no easy one. A systematic policy of detraction was pursued by the small section of the Radical party who objected to a peer premier as such, and a great deal of adverse criticism was also aroused by a speech in which the prime minister, taunted for not again bringing forward a Home Rule measure, insisted upon the truism that the conversion of England, the "predominant partner," was a necessary condition of success. The support of the Irish Nationalists was by no means secure. Lord Rosebery's foreign policy, moreover, was too Tory for his Radical followers; he insisted upon "continuity of policy in foreign affairs," which

meant carrying on the Conservative policy and not upsetting it. The premier was thought to have shown a restlessness and a rawness at the touch of censure, which did not increase his reputation for reserve power or strength, but this was undoubtedly due in large measure to the recrudescence of the insomnia from which he had suffered in 1891. The Government effected little. In Mr Asquith's phrase, it was "ploughing the sands." The Parish Councils Act was only passed by compromising with the Opposition. Local Veto and Disestablishment of the Welsh Church were put in the forefront of the party programme, but the Government was already to all appearances riding for a fall, when on 24th June 1895 it was beaten upon an adverse vote in the Commons in regard to a question of the supply and reserve of small arms ammunition.

The general election which followed after Lord Salisbury had formed his new ministry was remarkable for the undisciplined state of the Liberal party. At the Eighty Club and the Albert Hall, Lord Rosebery advised them to concentrate upon the reform of the House of Lords, that assembly being, as he said, a foremost obstacle to the passing of legislation on the lines of the Newcastle programme, but he was unable to suggest in what direction it should be reformed. Sir William Harcourt and Mr John Morley, on the other hand, concentrated respectively upon Local Option and Home Rule. The result was an overwhelming defeat. Lord Rosebery handed over the seals of office with undisguised relief. Considerable difficulties in Africa, in Chitral, and in the Levant were transmitted to the new Government. The question of intervention between the Sultan and the Armenians became a burning one in the country in 1896, and Mr Gladstone emerged from his retirement to advocate intervention. Lord Rosebery declined to support this demand at the risk of a European war, and on 8th October 1896 he announced to the Liberal whip, Mr Thomas Ellis, his resignation of the Liberal leadership. On the following day he made a farewell speech at the Empire Theatre, Edinburgh, to over 4000 people, and for some time he held aloof from party politics, "ploughing his furrow alone," as he afterwards phrased it.

In 1898, on the death of Mr Gladstone, he paid a noble and eloquent tribute in the House of Lords to the life and public services of his old leader. He was a pall-bearer at his funeral on 28th May, as he had previously been at the burials of Tennyson and Millais. His influence in the country was still a strong one on personal grounds, and he came forward now and again to give expression independently to popular feeling. In the autumn of 1898 he gave valuable support to the attitude taken up by Lord Salisbury upon the Fashoda question. He was indeed bound by consistency to withstand what his own Government, by the words of Sir Edward Grey, had declared would be an unfriendly act on the part of France. Again, after Mr Kruger's ultimatum in October 1899, Lord Rosebery spoke upon the necessity of the nation closing its ranks and supporting the Government in the prosecution of war in South Africa. After Nicholson's Nek he reiterated the resolution of the country "to see this thing through." Nevertheless, in a letter to Captain Lambton, an unsuccessful Liberal candidate for Newcastle, in September 1900, he condemned the general conduct of affairs by Lord Salisbury's Government, while in several speeches in the House of Lords he strongly urged the necessity of army reform. Since his abandonment of the leadership in 1896, the lack of coherence in the Liberal party had become more and more manifest. The war had brought to the front a pro-Boer section, who seemed gradually to be compromising the whole party, and had apparently succeeded in winning the support of Sir Henry Campbell-Bannerman, the leader in the House of Commons. Lord Rosebery maintained for the most part a Sphinx-like seclusion, but in July 1901 he at last came forward strongly as the champion of the Liberal Imperialist section.

In deference to the wishes of supporters such as Mr Asquith, Sir Henry Fowler, and Sir Edward Grey, he determined to "put his views into the common stock" at a representative meeting of Liberals held at Chesterfield in December 1901. There he advised the Liberal party that "its slate must be cleaned," and, as he subsequently explained, this cleansing must involve the elimination of Home Rule for Ireland. His appeal for "spade work" resulted in the formation of the Liberal League, inside the Liberal Opposition; and what Lord Rosebery himself described as his "definite separation" from Sir Henry Campbell-Bannerman's "tabernacle" took place. This announcement, however, was no sooner made than it was explained away by the supporters of both, and early in 1902 Lord Rosebery spoke at the National Liberal Club in a way which indicated that an understanding might still be arrived at. But, as he candidly admitted in a recent speech delivered at the Liberal League dinner, 31st July 1902, the principles of Liberal Imperialism have not yet prevailed, and until they prevail the reconciliation of the two wings of the party may, in Lord Rosebery's opinion, remain impossible.

In 1900 he published a volume called *Napoleon: the Last Phase*, an ingenious, if paradoxical, attempt to vindicate Napoleon's conduct during his exile at St Helena; and he also showed his interest in literature by an address on Biography at Edinburgh. His family consists of two sons and two daughters, his elder son, Lord Dalmeny, having been born in 1882. His younger daughter was married in 1899 to the earl of Crewe, who as Lord Houghton was Lord Lieutenant of Ireland, 1892–95.

Rosecrans, William Starke (1819–1898), American soldier, was born in Kingston, Ohio, 6th September 1819, and graduated in 1842 from the U.S. Military Academy. After serving (1843–47) as assistant professor at West Point, and in fort construction, he resigned, April 1854, from the army and went into business in Cincinnati. Early in the Civil War he organized Ohio regiments, and in June 1861 was made colonel of the 23rd Ohio volunteers, and afterwards a brigadier-general of regulars. He was second to General McClellan in the operations in West Virginia, fought and won at Rich Mountain, 11th July 1861, and succeeded to the command when McClellan was called to Washington. In March 1862 he was made a major-general of volunteers, and by and by was sent to the west, where he served under Generals Hallock and Grant. After the battles of Iuka (19th September) and Corinth (3rd–4th October), he was transferred to the command of the department of the Cumberland, to relieve General Buell. This command he held for a year from October 1862, with brilliant successes alternating with disappointments. He beat the Confederate General Bragg in the bloody battle at Murfreesboro, 31st December 1862–1st January 1863; and then, after long inaction, resumed operations the next summer, and in the fighting between 24th June and 3rd July 1863 drove his adversary out of Middle Tennessee; next, after some delay, he pursued and compelled Bragg, 9th September, to withdraw from impregnable Chattanooga. But he had lost favour, and misfortune now overtook him: he was defeated, 19th–20th September, at Chickamauga, and forced back to Chattanooga, to which Bragg laid confident siege. When General Grant took full direction, Rosecrans was succeeded, 20th October, by General Thomas. After a brief service

in Missouri, Rosecrans was relieved, December 1864. Resigning from the army 1867, he was minister to Mexico 1868, and between 1869 and 1881 was engaged in railway and industrial enterprises there. He was a member of Congress, from California, 1881–85, and register of the Treasury, 1885–93. Under an Act of Congress he was, 2nd March 1889, restored to the rank of brigadier-general, and retired. He died near Redondo, Cal., 11th March 1898. On 17th May 1902 his body was reinterred with military honours in the National Cemetery at Arlington, in the presence of President Roosevelt, members of the Cabinet, and many of his campaigning comrades.

Rosenheim, a town and watering-place of Bavaria, Germany, district of Upper Bavaria, on the river Inn, 40 miles by rail south-east of Munich, frequented for its saline, sulphur, and other springs. There are important salt-works, the brine being conveyed from Reichenhall in pipes; also machine factories, metal-works, and breweries. Population (1885), 9257; (1900), 14,247.

Rosieres. See SUDAN, ANGLO-EGYPTIAN.

Roskilde, or ROESKILDE, a market-town of Denmark, capital of Roskilde county, 20 miles by rail west of Copenhagen, during the Middle Ages next after Schleswig the most important town of Denmark. Here is the Danish Westminster Abbey, with numerous monuments and tombs of Danish kings and queens. Other public buildings are the town-hall (1883), hospital (1878–80), diocesan library (in part 15th century, in part 1858–59), royal palace (1733), institute for daughters of noblemen (1670), church of Our Lady (originally 11th century, rebuilt 1242, restored 1864–65). Population (1890), 6974; (1900), 8368.

Roslavl, a district town of Russia, in the government and 67 miles south-south-east of the town of Smolensk, on the railway from Orel to Riga and on the highroad between St Petersburg and Warsaw, near the Oster river. It is a very old town, founded by Vladimir Monomach, and often mentioned in the annals after 1150. It frequently changed hands between Russia and Lithuania, before it was finally annexed by Russia in 1686. It has two gymnasia, a railway technical school, and a number of philanthropic institutions, and carries on an active trade in flax, hemp, corn, hides, and tobacco. In 1897 the population numbered 17,848.

Rosmead, Hercules George Robert Robinson, 1ST BARON (1824–1897), British colonial administrator, was born on 19th December 1824. He was of Irish descent on both sides; his father was Admiral Hercules Robinson, his mother a Miss Wood of Rosmead, Co. Westmeath, from which he afterwards took his title. Passing from Sandhurst into the 87th Foot, he attained the rank of captain; but, deciding that the army was not his proper vocation, he obtained in 1846, through the influence of Lord Naas, a post in the Board of Public Works in Ireland, and subsequently became chief commissioner of fairs and markets. The energy he displayed in these positions, notably during the great famine of 1848, and the clearness and vigour of his reports, secured for him at the age of thirty the office of president of the island of Montserrat. Subsequently he was governor of St Christopher, from 1855 to 1859, when he was knighted in recognition of his services in introducing coolie labour into the island; of Hong-Kong; of Ceylon (K.C.M.G. in 1869); and in 1872 of New South Wales. It fell to his lot to annex the Fiji Islands to the British Empire, and his services were rewarded in 1875 by promotion to G.C.M.G. In 1879 he was transferred to New Zealand, and in 1880 he succeeded Sir Bartle Frere as high commissioner of South Africa. He arrived in South Africa shortly before the disaster of Majuba, and was one of the commissioners for negotiating a peace which was personally distasteful to him. It left him with the task of conciliating on the one hand a Dutch party elated with victory, and on the other hand a British party almost ready to despair of the English connexion. He was called home in 1883 to advise the Government on the terms of the London Convention of 1884. Charged on his return with a protectorate over the natives of Bechuanaland, he soon found that the excesses of the Boer settlers in Goshen and Stellaland must be put down by the Imperial authority. His declaration, that the advice of his ministers to patch up a settlement was equivalent to a condonation of crime, led to the expedition of Sir Charles Warren and the annexation of Bechuanaland. A dispute arose between Robinson and Sir C. Warren, who declared that the high commissioner's duties to the home Government were at times in conflict with the action which, as governor of Cape Colony, he was bound to take on the advice of his ministers in the interests of the colony. Sir Hercules Robinson succeeded in winning the confidence of President Kruger by his conspicuous fair-mindedness, while he heartily seconded Mr Rhodes's efforts to unite the British and Dutch parties in Cape Colony, and to open up its territory to the north. His cast of mind, however, was essentially that of the administrator as distinguished from the statesman, and he was content to settle difficulties as they arose. In 1886 he investigated the charges brought against Sir John Pope-Hennessy, governor of Mauritius, and decreed his suspension pending the decision of the home authorities, who eventually reinstated Pope-Hennessy. Robinson retired in 1889. In his farewell speech he declared that there was no permanent place in South Africa for direct Imperial rule. This was absurdly interpreted to mean that South Africa must ultimately become independent—an idea wholly repugnant to his mind. He himself explained in a letter to *The Times* in 1895 that he had referred to the "direct rule of Downing Street over the Crown colonies, as contrasted with responsible colonial government." He was made a baronet in 1891. Early in 1895, when he had entered his 71st year and was by no means in robust health, he yielded to the entreaties of Lord Rosebery's cabinet, and went out again to South Africa, in succession to Sir H. Loch. His second term of office, however, was not fortunate. The Jameson Raid produced a permanent estrangement between him and Mr Rhodes, and he was out of sympathy with the new colonial secretary, Mr Chamberlain, who had been prominent in criticizing his appointment, and now desired Robinson to take this opportunity of settling the whole question of the Uitlanders in the Transvaal. Robinson curtly answered that the moment was inopportune, and that he must be left to choose his own time. Alarmed at the imminent danger of war, he confined his efforts to inducing the Johannesburgers to lay down their arms on condition that the raiders' lives were spared, not knowing that these terms had already been granted to Jameson. He came home to confer with the Government, and was raised to the peerage as Baron Rosmead. He returned to South Africa later in the year, but was compelled by ill-health, in April 1897, to quit his post, and died in London on 28th October 1897. (H. SY.)

Ross and Cromarty, a highland county of northern Scotland, bounded on the N. by the Dornoch Firth and Sutherlandshire, on the E. by the Moray Firth, on the S. by Inverness-shire, and on the W. by the Atlantic.

Area and Population.—In 1891 the counties of Ross and Cromarty were amalgamated, the latter having previously been made up of detached portions scattered through the former. At the same time some alterations were made in the boundaries

between the united county and the shires of Inverness and Nairn, the parish of Urray being restricted to Ross-shire and part of the Inverness parish of Kilmorack being added to it, and the parish of Urquhart and Logie-Wester, which had been divided between Ross and Nairn, being placed wholly in the former county. The county includes Lewis and a number of smaller islands. The official estimate of the area is 2,049,423 acres, or about 3202 square miles. The population was, in 1881, 78,547; in 1891, 77,810; in 1901, 76,421; in 1891 on the above area, 78,727, of whom 37,279 were males and 41,448 females; in 1901 it was 76,421. On the old area, taking land only (1,970,004 acres, or 3078·1 square miles), the number of persons to the square mile was 24·8, and the number of acres to the person, 25·7. In the registration county the decrease of the population between 1881 and 1891 was 1·06 per cent. Between 1881 and 1891 the excess of births over deaths was 8605, and the decrease of the resident population 824. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimate.
1880	1197	363	2087	4·6
1890	1299	303	1893	4·6
1899	1277	345	1809	4·3

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate .	26·20	25·36	24·05	24·27	23·26
Death-rate .	15·03	15·74	16·50	16·76	16·42
Marriage-rate .	4·56	4·18	3·85	4·08	4·43

At the census of 1891, 38,018 persons were returned as Gaelic-speaking, and of these 18,620 spoke Gaelic only; there were 43 foreigners. Valuation in 1889–90, £277,948; 1899–1900, £275,996.

Administration.—The county returns a member to Parliament, and contains Fortrose (1179), one of the Inverness group of parliamentary burghs, and Cromarty (1233), Dingwall (2519), and Tain (2074), which belong to the Wick or northern group. All of these are royal burghs except Cromarty, and Dingwall is the county town. Police burghs are Invergordon (1014) and Stornoway (3711). There are 33 civil parishes, and there are poorhouses at Tain and Fortrose; the number of paupers and dependents in September 1899 was 3339. Ross and Cromarty forms a sheriffdom with Sutherland, and there are resident sheriffs-substitute at Dingwall and Stornoway, the former sitting also at Tain and Cromarty.

Education.—Thirty-five school boards manage 135 schools, which had an average attendance of 11,747 in 1898–99, while 5 voluntary schools (1 Episcopal) had 236. There are academies at Tain and Fortrose, and 33 schools in all earned grants in 1898 for giving higher education. The county council hands over the "residue" grant to the county committee on secondary education, which subsidizes science and art classes in various schools and higher grade (science) schools in process of being built at Dingwall, Tain, and Stornoway.

Agriculture.—Oats are the predominant corn crop, and the barley acreage is rather less than half the oats acreage. Wheat shows a tendency to recover after a prolonged and continuous decline from 7527 acres in 1854 to 694 in 1897; it was 1090 in 1898. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	134,899	47,639	26,496	40,819	19,075	370
1890	136,974	46,082	26,326	41,662	22,621	469
1895	137,703	44,878	25,809	40,405	26,957	135
1899	141,324	44,206	24,330	43,219	29,342	196

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1885	7365	42,976	17,811	309,590	6770
1890	7256	41,685	17,678	311,933	6359
1895	8060	41,922	17,622	320,969	5201
1899	8093	43,965	18,126	326,144	4790

At the date of the last return, 1895, the average size of the 7221 holdings was 19 acres; the percentage under 5 acres was 59·80, between 5 and 50, 32·61, and over 50 acres 7·59. Only Sutherland has a larger proportion of holdings under 5 acres. The total number under 20 acres was 6269; between 50 and 100 acres 229; between 100 and 300 acres, 231; between 300 and 500, 77; between 500 and 1000, 10, and there was one over 1000 acres. The excessive proportion of small holdings is partly due to the overcrowding of the island of Lewis (*q.v.*). There were 61,482 acres under wood in 1895, and the cultivated area was 6·8 per cent. of the whole. From the commencement of the operations of the Crofters' Commission in 1886 down to the end of 1898, 1097 applications to fix a fair rent were dealt with, and rents of a total amount of £16,182 were reduced to £11,509, while arrears amounting to £41,988 out of £59,801 were cancelled; 438 applications for enlargement of holdings were dealt with, and 400 acres were added to existing holdings. Deer forests covered 795,545 acres in 1899, an increase of 147,662 since 1883, and the annual value of the whole was £34,776.

Industries and Trade.—According to the census of 1891, 14,407 men and 3221 women were engaged in agriculture and fishing, and 9947 men and 3032 women in agriculture alone. The county contains two fishery districts, Stornoway and Cromarty, and part of two others, Lochbroom (which includes part of Sutherland) and Lochcarron and Skye (which includes part of Inverness). The following table gives particulars of the industry for the first three districts:—

Year.	Boats.			Value of Gear.	Resident Fishermen and Boys.	Total Value of All Fish.
	No.	Tons.	Value.			
1890	2443	15,291	£62,725	£79,031	8646	£198,118
1898	1383	9,476	£14,509	£47,318	6718	£179,804
1899	1312	8,672	£41,271	£46,567	6236	£118,671

£73,294 of the total value of fish in 1899 represented the value of the herring catch. The number of persons employed in 1899 in connexion with the various branches of the sea fisheries was 10,044. In Ross and Cromarty alone there are about 100 ports, which had, in 1898, 1372 boats of 8818 tons, and 6291 resident fishermen and boys. The Black Isle (1894) and Kyle (1897) branches of the Highland Railway added 24 miles to the mileage of the country.

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(W. WA.)

Rossetti, Christina Georgina (1830–1894), English poet, was the youngest of the four children of Gabriele and Frances Mary Rossetti. She was born at 38 Charlotte Street, Portland Place, London, on the 5th of December 1830. She enjoyed the advantages and disadvantages of the strange society of Italian exiles and English eccentrics which her father gathered about him, and she shared the studies of her gifted elder brother and sister. As early as 1847 her grandfather, Gaetano Polidori, printed privately a volume of her *Verses*, in which the richness of her vision was already faintly prefigured. In 1850 she contributed to *The Germ* seven pieces, several of which are still among the very finest of her lyrics. In her girlhood she had a grave, religious beauty of feature, and sat as a model not only to her brother Gabriel, but to Mr Holman Hunt, to Madox Brown, and to Millais. In 1853–54 Christina Rossetti for nearly a year helped her mother to keep a day-school at Frome in Somerset. Early in 1854 the Rossettis returned to London, and the father died. In poverty, in ill-health, in extreme quietness, she was now performing her life-work. She was twice sought in marriage, but each time, from religious scruples, she refused her suitor; on the former of these occasions she sorrowed greatly, and her suffering is reflected in much of her early song. In 1861 she saw foreign countries for the first

time, paying a six weeks' visit to Normandy and Paris. In 1862 she published what was practically her earliest book, *Goblin Market*, and took her place at once among the poets of her age. In this volume, indeed, is still to be found a majority of her finest writings. *The Prince's Progress* followed in 1866. In 1867 she, with her family, moved to 56 Euston Square, which became their home for many years. Christina's prose work *Commonplace* appeared in 1870. In April 1871 her whole life was changed by a terrible affliction of the head, known as "Graves's disease"; for two years she was not merely very ill, but her life was in constant danger. She had already composed her book of children's poems, entitled *Sing-Song*, which appeared in 1872. After a long convalescence, she published in 1874 two works of minor importance, *Annus Domini* and *Speaking Likenesses*. The former is the earliest of a series of theological works in prose, of which the second was *Seek and Find* in 1879. In 1881 she published a third collection of poems, *A Pageant*, in which there was evidence of slackening lyrical power. She now gave herself almost entirely to religious disquisition. The most interesting and personal of her prose publications (but it contained verse also) was *Time Flies* (1885), a sort of symbolic diary or collection of brief homilies. She collected her poetical writings in 1891. In 1892 she was led to publish a very bulky commentary on the Apocalypse, entitled *The Face of the Deep*. After this she wrote little. Her last years were spent in great retirement at 30 Torrington Square, Bloomsbury, which was her home from 1876 to her death. In 1892 her health, always extremely delicate and fluctuating, broke down finally, and she had to endure very terrible suffering. From this she was at length released on the 29th of December 1894. The Bishop of Durham, Dr Westcott, with whom she had been greatly in sympathy, preached her funeral sermon, and a memorial to her, designed by Sir E. Burne-Jones, was erected at Christ Church, Woburn Square, where she habitually worshipped. In spite of her manifest limitations of sympathy and experience, Christina Rossetti takes rank among the foremost poets of her time. In the purity and solidity of her finest lyrics, the glow and music in which she robes her moods of melancholy reverie, her extraordinary mixture of austerity with sweetness and of sanctity of tone with sensuousness of colour, Christina Rossetti, in her best pieces, may challenge comparison with the most admirable of our poets. The union of fixed religious faith with a hold upon physical beauty and the richer parts of nature has been pointed to as the most original feature of her poetry. Hers was a cloistered spirit, timid, nun-like, bowed down by suffering and humility; her character was so retiring as to be almost invisible. All that we really need to know about her, save that she was a great saint, was that she was a great poet. (E. G.)

Rossetti, Dante Gabriel Charles (1828–1882), English painter and poet. A biography of Dante Gabriel Rossetti is given in the ninth edition of this Encyclopædia (vol. xx. p. 857), in which his career, more especially as a poet, is treated. It is felt, however, that the view there taken of Rossetti as a painter, and the account given of his artistic work other than literary, require, in the light of the history of the subsequent developments of Rossetti's influence on British art, to be supplemented; and in this article, accordingly, Rossetti's record solely as an artist is briefly estimated, without any reference to other considerations. It is certain that throughout his own career he looked upon himself as a painter who wrote rather than as a verse-maker who painted. Nevertheless, there can be no doubt that with regard to the constructive portion of his genius Rossetti was better equipped in verse than in design. He made himself an artist by means of enormous pains and amazing struggles against the difficulties imposed by a naturally desultory habit.

It was rather late in 1843 that Gabriel Rossetti entered Sass's art school (then conducted by Mr Cary), which was in great repute, and numbered John Everett Millais among its pupils. Here, working in a characteristically irregular manner, but making more progress than met the eye, he remained till July 1846, when, having passed the probationary stage required at the Royal Academy, he was admitted a student in full: he did not aspire to grades higher than that of the Antique School, but continued to divide himself between drawing proper, poetic reading, and writing poetry. Time passed, and Rossetti, being much impressed by some of the early works of Ford Madox Brown exhibited at the Academy (1841), Westminster Hall (1844–45), and the British Institution (1845), sought from that master of technique technical instruction of a more direct and stringent kind than he had previously submitted to. Brown, ever generous in that way, undertook without a fee the training of Rossetti as a painter, and set him to work upon such rudimentary studies as pickle-pots and other "still-life." The pupil's course of such work was, as might be expected, short; the master's example and that of Millais, together with the uncompromising energy of Mr Holman Hunt, with both of whom Rossetti became intimate about this time, helping and encouraging him. Most of all, perhaps, so far as his temporary impressions were concerned, a picture of Brown's which was shown at the "Free Exhibition," Hyde Park Corner, in the spring of 1848 profoundly affected Rossetti. This was, of course, months before the formation of the Pre-Raphaelite Brotherhood in the autumn of the last-named year, when five painter-students, a sculptor (Thomas Woolner), and a layman (W. M. Rossetti) agreed upon certain principles they desired should obtain in art. None of the five owed the initiative of his views to any of the others or to Brown, whose impulse was purely technical and connected with Rossetti only; neither Millais, Holman Hunt, J. Collinson, nor F. G. Stephens needed the help of Madox Brown. The point of Pre-Raphaelite crystallization which had so great though brief an influence upon Rossetti's life and art was found at a chance meeting of Rossetti, Millais, and Holman Hunt in Millais' house in Gower Street, where certain prints from early Italian frescoes were studied. The enthusiasm of Rossetti led him to propose the formation of a "Brotherhood" with more or less definite views and much loftier aims than artists generally venture to announce. This took effect; the views of the remaining three men were already known, and in a few days they joined the new society and took their shares in the obloquy which attended the doings of Millais, Hunt, and Collinson. Brown, though invited, declined to become a P.R.B. Rossetti's first effort was by means of "The Girlhood of Mary, Virgin," which in March 1849 was exhibited at Hyde Park Corner. It was a picture which attested the prodigious value of his studies since the previous October, and the native genius of the painter and the sincere passion with which he had accepted the obligations of Pre-Raphaelitism, as they were then, but not for long, understood. Nothing of his producing was more independent than the inception of "The Girlhood of Mary, Virgin"; indeed (as the present writer believes) the design for it was made some half a year before the meeting in Gower Street, though the execution of this work owed not a little to the influence, if not the actual help, of Millais and Hunt. Its mysticism was Rossetti's own, its technique owed something to Brown. On the whole, there can be no doubt that in this work was the first pronouncement of a

new view of art, a fresh technique and power rapidly developing itself. Of course, the style of this noteworthy and epoch-marking picture was jejune, its handling was timid, while its coloration and tonality were dry, not to say thin. Such was Rossetti's advent in art under the Pre-Raphaelite banner. The picture's reception was not encouraging, nor did the next work from his hands induce him to emerge from that proud exclusiveness in which all such minds as his are content to abide. The diverse moods of the other Brothers chose otherwise, but of Rossetti's immediate circle it has been truly said: "It appears that of seven young men and Brethren five have attained eminent positions, four of them being pre-eminent, although for years after the society was formed no single member, whatever his position might be, escaped insult, obloquy, and wicked and malicious misrepresentation. The more conspicuous the Brother [*e.g.*, Millais], the more outrageously was he attacked." No estimate of Rossetti's genius, his triumph, and his life as a whole can be justly based without ample allowance being made for the circumstances which attended his advent as a painter. "Ecce Ancilla Domini!" the smaller picture which is now in the National Gallery of British Art at Millbank, was the natural sequence to that which we have been considering. It is so well known that its name suffices now, but it should be recognized as the one perfect outcome of the original motive of the Pre-Raphaelite Brotherhood by its representative and typical member. It is replete with the mystical mood which then ruled the painter's mind; that mood chose what may be called virginal white and its harmonies as its aptest coloration, and the intense light of morning sufficed for its tonality. It was exhibited at the Portland Gallery in 1850. After these pictures were finished, the outside world saw no more of Rossetti as a painter until it had prepared itself to see modern art from a higher plane than before.

In December 1850 there appeared the first number of *The Germ*, a magazine in which Rossetti had a leading place as the poet in verse and prose. The influence of Browning upon Rossetti was more potent in *The Germ* than in that splendid romance in water-colours called "The Laboratory," where a court lady of the *ancien régime* visits an old poison-monger to obtain from him a fatal potion for her rival in love. This wonderful gem of colour, glowing in lurid and wicked passion and voluptuous suggestion, marked the opening of the artist's second period and signalized his departure from that phase of Pre-Raphaelitism of which "Ecce Ancilla Domini!" was the crowning achievement, and, so far as he was concerned, the artistic *ne plus ultra*. Millais and the other Brothers remained faithful during several years yet to come. Later in 1850, Rossetti produced the original, which is in ink, of the famous "Hesterna Rosa," a gambling scene of men and their mistresses in a tent by lamplight, while pallid dawn gathers force between the trees without. Then came from his hands "Borgia," which, like "The Laboratory," is in water-colours, and, like "Hesterna Rosa," is a sardonic tragedy. "How they met Themselves" came next, and, in illustrating a legend similar to that of the Döppelgänger, affirmed the force, the originality, and the tragic passion of Rossetti's genius. Two lovers are walking in a twilight wood, where they are confronted suddenly by their apparitions, portending death. The year 1852 produced "Giotto painting Dante's Portrait," and saw a new development of the painter's mind and mood, dashed with a humour not often to be seen in him. In its somewhat dry coloration it differed from the ardent jewel-like glow and deeper gloom of "Borgia" and its successor and the sumptuous visions of womanhood in later pictures. "Found," Rossetti's sole contribution of the sort which Mr Holman Hunt affected, was begun somewhere about this period; but this piece of pictorial moralizing (the analogue of the poet's own "Jenny"), vigorous and intensely pathetic as it is, was never really finished by its author, being, indeed, far remote from Rossetti's inner self, which was rather over-scornful of didactic art, and thoroughly indisposed towards attempts to ameliorate anybody's condition by means of pictures. Nor did the stringency of naturalistic painting suit his mood or his experience. Nevertheless, what is his in the existing picture remains a masterpiece of poetry with exquisitely finished parts.

Passing a few fine but comparatively unimportant drawings, such as "Lancelot and Guinevere at the Tomb of Arthur," "Lancelot looking at the Dead Lady of Shalott," "Mariana of the South," "Sir Galahad," "The Blue Closet," and various works owing subjects to the Arthurian cycle of romances, we may note that the artist illustrated by five cuts *Poems by Alfred Tennyson*, on which Millais and Mr Holman Hunt were also engaged, and which was published by Moxon in 1857. As in "Ecce Ancilla Domini!" we had virginal white and morning light employed to strengthen the mystical significance of the design, so in "Borgia" Venetian voluptuousness and sensuous splendours obtained, and in "The Blue Closet" is a very potent and suggestive exercise intended to symbolize the association of colour with music. The last is one of the subtlest of the artist's "inventions," and it shows how he had developed upon "Borgia" an artistic sympathy which is but too likely to be "caviare to the general." "The Wedding of St George" is not so fine; nor was "The Damsel of the Sangreal," Rossetti's part in the luckless decorations of the Oxford Union (1857–58); nor are "Guinevere and Sir Lancelot," "Galahad in the Chapel," and other Arthurian examples quite worthy of his art. "Bocca Baciata," the super-sensuous portrait of a woman, a work of wonderful fire, and the pictures on the pulpit at Llandaff Cathedral, marked the expiration of the second epoch in Rossetti's art and the beginning of a new, the third, last and most powerful of all the phases of his career. The picture "Dr Johnson at the Mitre," when the "pretty fools" consulted the lexicographer anent Methodism, is a good example of his humour.

In 1861 Rossetti produced several fine designs for stained glass, and in the revival of stained-glass painting as an art he had a larger share than has frequently been ascribed to him. The practice of designing upon a large scale, and employment of masses of splendid though deep-toned colours, had probably something to do with the prodigious development of his powers and the enlargement of his views as regards painting which took effect at this period (1862–63). At this time a striking and highly imaginative triptych, representing three events in the careers of Paolo and Francesca, was produced; it is a great improvement upon an earlier design. There is unprecedented energy in the group of the lovers embracing in the garden-house just as they have paused in reading the fatal romance. The composition of this group, with the circular window behind their figures, is as fine as it was comparatively novel in Rossetti's practice. Its lurid coloration was so thoroughly in harmony with the pathos of the subject that in this respect the work excelled all the painter had previously produced. The same elements, energy, a sympathetic and poetic scheme of colour, and composition of a fine order, combined with far greater force and originality in "The Bride," or "The Beloved," that magnificent illustration of The Song of Solomon. The last named is a life-size group of powerfully coloured and diversely beautiful damsels accompanying their mistress with music and with song on her way to the bridegroom. This picture, as regards its brilliance, finish, the charms of four lovely faces, and the splendour of its

"ECCE ANCILLA DOMINI!" BY DANTE GABRIEL ROSSETTI.
(From a Photograph by Frederick Hollyer.)

lighting, occupies a great place in the highest grade of modern art of all the world. It is likewise, so far as the qualities named are concerned, the crowning piece of Rossetti's art, and stands for him much as the "Sacred and Profane Love" of Titian represents that master. Very fine, indeed, but hardly so passionate and virile, is the "Beata Beatrix," now in the National Gallery of British Art with "Ecce Ancilla Domini!" which he produced thirteen years earlier. These works belong to a category of fine and quite original examples, all replete with similar technical qualities, poetry, and pathos. The group comprises paintings by which Rossetti is best known, such as "Proserpina in Hades," which is, on the whole, perhaps the most original, if not indeed the most poetical and powerful, of all his output; "Sibylla Palmifera;" "Venus Verticordia;" "Lilith" (the better of the two versions is now referred to); "Washing Hands;" "Monna Vanna;" "Il Ramoscello;" "Aurea Catena;" "La Pia;" "Rosa Triplex;" "Veronica Veronese;" "La Ghirlandata;" "Pandora;" "The Blessed Damosel;" and, last and largest, but not, perhaps, the greatest, of his paintings (a distinction for which the "The Bride" and "Proserpina" must contend), the famous "Dante's Dream," now in the Walker Art Gallery at Liverpool. Besides these, Rossetti produced a large number of fine things. Nearly the whole of them were exhibited by the Royal Academy and at the Burlington Fine Art Club in 1883, after their author's death.

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Rossland, the most important city (incorporated in 1897) of the Kootenay district of British Columbia, the centre of a rich mining district. Some of the best known mines of British Columbia are in the neighbourhood of Rossland, which has been connected with the Canadian Pacific Railway, as well as with systems belonging to United States companies. It is distant a few miles by railway from Trail, on the banks of the Columbia, where an extensive smelting plant is in operation. Population (1901), 6159.

Rosslau, a town of Germany, duchy of Anhalt, on the right bank of the Elbe, by rail 3 miles north of Dessau and 35 south-east of Magdeburg. It has two castles, a good church, and produces machinery, paper, sealing-wax, wire goods, sugar, bricks, and chemicals, and has some boat-building. Population (1885), 6567; (1900), 10,061.

Rostock, a seaport town of Germany, grand-duchy of Mecklenburg-Schwerin, on the Warnow, 8 miles above its entrance into the Baltic, and 46 miles by rail south-west of Stralsund. An assembly hall of the estates of Mecklenburg was built in the Gothic style in 1889–93. Other buildings, &c., include the theatre (1895) and the provincial lunatic asylum (1896), the latter on the right bank of the river. In 1900 the university was attended by 495 students and had 55 professors; its library numbers some 175,000 volumes. Amongst the public institutions are the zoological, geological-mineralogical, commercial, and several medical institutes, the municipal picture gallery, a collection of municipal antiquities, a theological seminary, an astronomical observatory, an agricultural experimental station, a seamen's school, and a botanical garden. Rostock is the chief commercial town of Mecklenburg, and owns a considerable fleet—49 vessels of 30,170 tons in 1900. In 1898 its port was cleared by 1743 vessels of 342,900 tons. Vessels drawing 16 feet are able to get up to the wharves. It is also a place of some industry. For a German town it enjoys a large share of autonomous government. Population (1885), 39,356; (1900), 54,713.

Rostov-on-the-Don, a seaport of Russia, in the province of the Cossacks of the Don, 40 miles from the Sea of Azov. Its population has grown rapidly, and in 1897 numbered 119,889, exclusive of the suburbs; if these, which already form part of the town and comprise Nakhichevan (29,312), be included, the population is well over 150,000, a figure which is still further swollen in the summer by the influx of about 60,000 men, who find work in connexion with the shipment of grain for export. Owing to its very advantageous situation, on the navigable river Don and at the junction of three railways radiating to north-western Russia, the Caucasus, and the Volga, Rostov has become the chief seaport of south-eastern Russia, being second in importance on the Black Sea only to Odessa. It has immense storehouses for all sorts of goods shipped to the Caucasus and to the Don province, and is the chief centre for the supply of agricultural machinery to all the prairie provinces of south-eastern Russia. Its foreign exports, which were valued at 41,000,000 roubles in 1882, were only 37,000,000 roubles in 1895; but on an average 35,000,000 roubles worth of wheat and 10,000,000 roubles worth of rye are exported annually, besides considerable quantities of flax, vegetable oils, raw wool, and caviare. The imports are insignificant. There are now a shipbuilding yard, two large tobacco factories, iron works, machinery works, distilleries, soap works, timber mills, bell foundries, paper mills, and rope works. Rostov is the chief centre of steam flour mills for south-eastern Russia and the Caucasus. The aggregate returns from all industrial establishments exceed £2,000,000 per annum. In 1897 the port was visited by 2840 ships of about 450,000 tons. The town is well built, and has about sixty schools, gymnasia, navigation schools, technical schools, &c., the city contributing freely to education. It has also a good municipal library, two theatres, two newspapers, and extensive systems of telephones and electric tramways.

Rostov Velikiy, a district town of Russia, in the government and 34 miles by rail south-west of the town of Yaroslav, near Lake Rostov or Nero. It has a gymnasium for girls and a school of art, and there are twenty-one factories (cotton and linen mills), employing about 1000 workmen and showing yearly returns of 1,000,000 roubles. Its great fair has lost its importance, but the town remains a centre for a variety of domestic trades: tailoring, the manufacture of leather, and the making of boots and small enamelled ikons; it is also a great centre for kitchen gardening and the export of pickled and dried vegetables. The restoration of the buildings of the large Kreml was begun in 1901. Its population in 1897 was 14,342.

Rothenburg ob der Tauber, a town of Bavaria, district of Middle Franconia, 49 miles by rail west by south of Nuremberg. It presents a characteristically mediæval appearance, with walls pierced by picturesque old gates. Amongst the more interesting buildings are the town-hall (1578 and earlier), hospital (1570–76), Topler Castle, the church of St James (1373–1471, restored in 1851), with three carved altar-pieces of the 15th century, and St Wolfgang's church (1473–83). It also possesses a technical school, interesting archives, and manufacture of toys, agricultural machinery and implements, brewing, dyeing, &c. Rothenburg, which is first mentioned in 942, was a free imperial city from 1172 to 1803. In

the Thirty Years' War it suffered severely. Population (1885), 6826; (1900), 7923.

Rotherham, a municipal borough and market town, Yorkshire, England, in the Rotherham parliamentary division of the West Riding, 5 miles north-east of Sheffield by rail. The manufacture of railway waggons is now an important industry. Population of municipal borough (1891), 42,061; (1901), 54,348.

Rothesay, a royal burgh and the chief town of the county and island of Bute, Scotland, on a fine bay, 40 miles west by north of Glasgow. Fishing has left the port, which is almost exclusively given up to the Clyde passenger and tourist traffic. Modern buildings are a hydropathic (rebuilt after fire), a second institute (1885), and a new post office; there are also a Roman Catholic orphanage and an academy. Population (1891), 9108; (1901), 9323.

Rottenburg, a town and episcopal see of Würtemberg, Germany, on the left bank of the Neckar, which is crossed by two bridges connecting the town with the suburb of Ehingen, 7 miles by rail south-west of Tübingen. It is the see of the Roman Catholic bishop of the kingdom, and possesses the (Gothic) cathedral of St Martin, a former Jesuit monastery with a collection of Roman antiquities from Sumelocenna near by, and an old castle now used as a prison. Tanning, machinery making, brewing, and the growing of hops are carried on. Population (1900), 7027.

Rotterdam, the first commercial and the second largest city of the Netherlands, extended by the incorporation in 1886 of Delfshaven and in 1895 of Charlois and Kralingen, in the province of South Holland, 14½ miles by rail south-east of The Hague. Among the institutions of Rotterdam are a large infirmary (Groot Ziekenhuis), a school of music, a natural science society, with rich collections, and three theatres. A new building was erected in the west of the city to accommodate the archives in 1899–1900. The new waterway between Rotterdam and the North Sea, only 15 feet deep in 1880, has since been deepened to 29½ feet. The new docks opened include Rynhaven, on the left bank of the Maas, Parkhaven, the first and second Katendrechthaven, and the Dokhaven. Nassauhaven, newly constructed, also on the left bank of the river, is connected by railway with the large factories. Another dock, 143 acres in area, to cost £750,000, was in 1902 in process of construction. Between 1850 and 1897 the area of the docks increased from 96 to 309 acres, about two millions sterling having been spent on the building of docks in the final quarter of the 19th century.

The following table shows the increase in the shipping of Rotterdam from 1885 to 1900:—

	Sailing Vessels.	Steam Vessels.	Total Tonnage of Sailing and Steam Vessels.	Percentage of all Outgoing Vessels from Holland leaving Rotterdam.
1885 . .	43	50	99,018	45
1900 . .	84	101	458,968	63·1

	Tonnage of Exports from Rotterdam.	Shipping on the New Waterway.	
		Number of Ships.	Tonnage.
1885 . . .	about 2,000,000	8,177	4,382,100
1900 . . .	22,623,000	15,202	36,349,000

According to the report of the Rotterdam Chamber of Commerce, the shipping of Rotterdam with a draught of from 24 to 26½ feet, to the exclusion of smaller vessels and fishing-smacks, numbered in 1899, 6890 vessels of 9,779,229 tons. Rotterdam's share in the Rhine traffic has increased from 1,706,587 tons in 1883 to 6,494,375 tons in 1898. Of the total imports into Holland, more than 40 per cent. have in recent years entered by way of Rotterdam, and of the total imports into Holland of grain, ores, margarine, petroleum, and oils, 50 to 80 per cent. land at Rotterdam. Of the total imports into the kingdom of coffee, tobacco, rice, sugar, and seeds, Rotterdam receives respectively 49, 39, 26, 24, and 37 per cent. There are separate wharves, with six tanks, for the imports of petroleum from America and Russia. Of the total imports into Holland in 1898, estimated at 8,486,000 cwt., those entering by way of Rotterdam amounted to 5,952,000 cwt. Besides the river commerce with Germany, Rotterdam trades principally with the Dutch colonies of the East and West Indies, New York, La Plata, and the east and west coast of Africa. Shipbuilding yards, extending along the Maas to great distances above and below Rotterdam, build iron steamers and large ships, also for foreign countries. The population, 169,477 in 1884, numbered 332,185 in 1900.

See FRUIN. *De oudste Oorkonden betreffende Rotterdam.*—SCHEFFER and OBREEN. *Rotterdamsche Historiebladen.* 1869–78.—DE BAS. *Rotterdam van 1853–78.*—*Tijdschrift van het Aardrijkskundig Genootschap*, iv. 22.

Rottweil, a town of Würtemberg, Germany, above the river Neckar, 46 miles by rail south-west of Tübingen. It is still in part surrounded by walls. It possesses a fine church of the Holy Cross (1364–1473), a collection of mediæval wood-carvings, Roman antiquities, a salt mine and brine springs. Population (1885), 6052; (1900), 7970.

Roubaix, an industrial town in the north of France, situated 6 miles north-east of Lille, and only 1 mile from the Belgian frontier, on the Roubaix canal which connects the Deule with the Scheldt in Belgium. Its population has risen from 91,000 in 1881 to 124,660 in 1901. With the adjoining communes of Tourcoing, Croix, and Watrelos the combined population is 250,000. The woollen industry is the chief business of Roubaix. In 1898 there were 8 wool-combing works with 750 combing machines; 44 spinning mills (28 for combed or carded wool, 15 for cotton, 1 for floss silk); 129 weaving establishments (26 for cloth, 18 for woollen goods, 9 for velvet, 8 for upholstery, 2 for black goods, 1 for linen thread, 65 for novelties and miscellaneous goods). In 1897 Roubaix contained 39 dyeworks and 17 establishments for finishing and dressing. Mechanical work prevails in the town, as shown by the fact that there are 20,000 steam looms and only 5000 hand looms. Four hundred firms act as commission agents for the sale of raw material and the other requisites for industries. The station of the Northern Railway at Roubaix, where the merchandise arriving by goods train in 1887 amounted to 443,350 tons, in 1898 received 952,016 tons. On the canal the transport tonnage has also risen, and from 491,651 tons (English) in 1887 reached 595,322 tons in 1898. The trade of the port consists principally of building materials, agricultural produce, and coal. A modern industry is that of tomato and grape growing, under glass, for the winter market. To maintain the high standard of artistic taste which has made the industry of Roubaix a success, schools have been multiplied, and by the co-operation of the town and the State the National School of Industrial Arts has been founded. This is a small university of art, commerce, and industry, the twenty-two courses of which include all the branches of knowledge useful in any of those pursuits. There is also a special establishment (*bureau de conditionnement*) for determining the nature and weight of silk, wool, and cotton. The chief streets, lined with elegant buildings, contrast in their luxury with the poverty of the sordid working class quarters. The town, a third of the population of which

is Belgian, is a centre of socialism and collectivism. The number of public-houses is exceedingly high in proportion to the inhabitants—one for every 60 persons or for every 15 adult males.

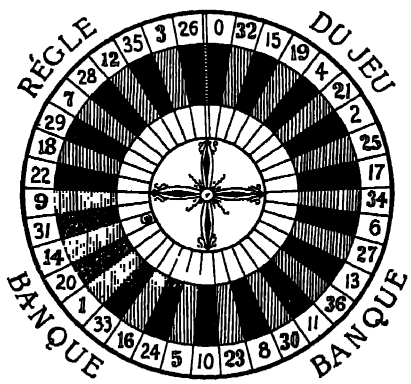
Rouen, chief town of the department of Seine-Inférieure, 84 miles from Paris by rail. It is now only the eleventh town of France in respect of population, after having occupied the fifth rank.

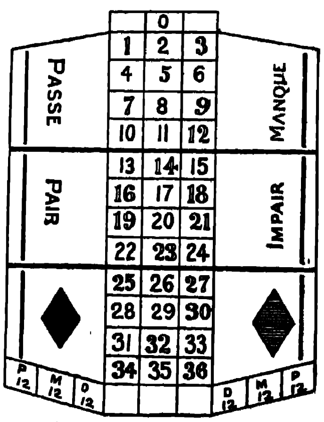
Its port on the Seine has grown in importance, but industry in general has made no progress. The port is accessible to ships of about 5000 tons, which can come up to it on a single tide. The *bassin maritime* is lined with quays and continuous wharves for a length of about 1¼ mile on both the right and left banks of the river. Its platforms cover 42 acres on the north and 33 acres on the south. Those of the *bassin aux bois* (wood dock) cover 30 acres, and there are 11 wharves of a total length of 3176 feet. The petroleum dock has 8 wharves, with a length of 2362 feet. The total available length of these docks in which ships can lie and discharge is 4 miles, and the total platform area round the docks is 111 acres. Railway lines run across the quays and connect them with the stations of Martainville on the north and of Orléans and St Sever on the south. Subterranean canalization conveys the petroleum direct from its special dock to the refineries. The river dock covers 28 acres. The maritime port has a repairing dock for vessels 312 feet long and of 1800 tons. Its quays are lighted by electricity or gas. Formerly the Seine at Rouen was crossed only by the stone bridge of Corneille and by a suspension bridge, the middle portion of which opened to permit the passage of ships. The latter has been replaced by the Boïeldieu bridge, the first steel bridge built in France, costing £140,000, and inaugurated in 1888. A slung moving bridge has a height of not less than 197 feet, and connects the banks of the Seine. Steam ferry boats also place the shores in communication. In 1899, 2604 vessels of 1,145,921 tons entered and 2637 of 1,149,382 tons cleared, showing a progression corresponding to the improvement in the channel of the Seine. The value of the exports amounted to £2,144,000, and that of the imports to £8,364,000. In 1898 the river dock was entered and cleared by 10,437 ships of 2,072,442 tons. The principal imports of Rouen are cereals (165,000 tons in 1899), wine (191,000 tons), petroleum, wood (254,600 tons), and wood pulp (39,900 tons). The exports are sugar, plaster, sand, and pyrites. On 31st December 1899 there were 176 ships of 36,669 tons attached to the port, at which 16 French and 10 foreign shipping companies call regularly. The cotton industry, which made the fortune of Rouen, and reached its highest prosperity in the middle of the 19th century, is in a depressed state. In 1896 only 1,223,442 spindles were working in the whole department of Seine-Inférieure, and the decline continued till the end of 1898. Subsequently, however, the situation somewhat improved. In 1883 there were 48 power-loom weaving mills in the department, 29 of which were in Rouen, employing 14,000 power-looms and 10,000 hand-looms. The latter are decreasing. In 1890 there were only 3700 hand-looms in the whole department. Neither has cotton-printing made progress. Rouen enjoys protective tariffs in Indo-China and Madagascar. In 1895, through an Indo-China syndicate, 1195 tons of white cotton goods, bleached and unbleached, and nearly 600 tons of coloured and printed goods were exported. Flax, hemp, and jute are spun in the neighbourhood, and there is a flourishing manufacture of braces. That of printed calico declines. In 1897, 14 firms each turned out 560,000 pieces of 1083 yards length each; 300,000 pieces were made in the homes of the workers. These products are sent to Algeria, Madagascar, &c. Dyeing progresses, 12,000 tons of cotton being dyed annually, but the bleaching and finishing industries are depressed; the manufacture of carding combs is, on the other hand, rising. Rouen is an important centre of chemical industries, producing various acids, salts of tin, lead, zinc, cobalt, and nickel. One company alone employs 800 workmen, and produces 160,000 tons of products. There are two important soap-works. The clothing industry, the manufacture of machine-made boots, which increases rapidly, and the hat industry deserve notice. The manufacture of machinery declines. There are only two important workshops making steam motors, boilers, and various machinery, and five factories for heavy copper ware and safety fittings for boilers. Much grain is distilled at Rouen, mainly maize and rice. The petroleum industry is considerable, engaging four mills, each able to produce annually from 50,000 to 60,000 tons of raw and 40,000 to 50,000 tons of refined petroleum. In 1899 Rouen imported 115,000 tons of raw petroleum from Russia and the United States. A celluloid factory has also some importance. Rouen is being improved by the gradual restoration of the grand *façade* of its cathedral. Monuments of recent erection include one to Jeanne d'Arc. The population in 1896 was 106,825, and in 1901, 115,914.

Rouher, Eugène (1814–1884), French statesman, was born at Riom, in the Puy de Dôme, 30th November 1814. He was educated at the lycée of his native town, and having taken his law degree at Paris in 1835, began to practise his profession at Riom. At this stage in his career he was a Liberal, but greatly to the astonishment of both friends and enemies, in 1846 he stood in the Conservative interest for Riom, with the support of the Guizot ministry. Though unsuccessful, he again championed the Conservative cause at the general election of 1848, and was returned to the Constituent Assembly for the Puy de Dôme. Re-elected to the Legislative Chamber in 1849, to the great surprise of the political world he became prime minister of the Prince President, with the title of Minister of Justice and Keeper of the Seals. Cautious and subservient, he was entrusted by Napoleon with the drawing up of the new Constitution after the *Coup d'État* of 2nd December 1851 had laid France prostrate at his feet. But as it required a more daring nature than that of the provincial barrister to carry the drastic scheme into effect, the cabinet was reconstructed under Marshal St Arnaud, Rouher remaining out of office. When Louis Napoleon became emperor of the French in 1852, Rouher had his reward. He re-entered the Imperial service as vice-president of the Council of State. The emperor likewise presented him with £40,000 and the estate of Cirey. In 1855 he became minister of commerce and public works. In this capacity he provided the emperor and Baron Haussmann with enormous sums of money for the rebuilding and embellishment of Paris, and for various undertakings in the provinces. To Rouher was also intrusted the important task of preparing the treaty of commerce with England, a work involving great and detailed labour. In 1860 the treaty was carried through, and some time afterwards its French sponsor visited England, where he was much fêted. Though pliant towards the emperor, Rouher was not popular with his ministerial colleagues, towards whom he assumed a haughty attitude. In 1863 he was appointed minister of state, and as such was spokesman of the Government in the Corps Législatif. Though no orator, he was now the most prominent statesman, as well as the most powerful minister, of the Second French Empire. But with men like Thiers, Berryer, and Jules Favre arrayed against him, he could only carry out the Imperial policy by a frequent use of the *clôture*, although the Government had an enormous majority in the Chamber. After a constitutional contest in the Chamber prolonged over several years, the emperor was convinced in 1869 that reforms must be granted. A manifesto was accordingly issued restoring parliamentary institutions, and M. Emile Ollivier was placed at the head of a Liberal cabinet in order to carry them out. Rouher, however, was the moving force behind the cabinet, and in January 1870 he was appointed president of the Senate. After the fall of the empire, Rouher fled to England. The rest of his life was spent as the representative of the fallen empire in France, and the faithful and untiring agent there of the Imperial family. A constituency in Corsica, which had always been faithful to the Bonapartes, returned him as deputy to the National Assembly in February 1872. From that period until the death of the Prince Imperial in 1879 he carried on a ceaseless Bonapartist propaganda, and his house in Paris was used as the headquarters of the party. In 1875 he delivered a violent speech against the Republic at Ajaccio. His prosecution was mooted, but the Government finally contented itself with dismissing the mayor of Ajaccio from office. The untoward death of the Prince Imperial was a calamity from which Rouher never recovered, and

in the summer of 1883 he was stricken with paralysis and lost his reason. His death occurred at Cirey on 3rd February 1894. (G. B. S.)

Roulette.—Roulette is one of the most ingenious games ever devised, for the reason that temptation to continue assails the player from so many directions and in so many ways: rich successes are sometimes attained, and very frequently only just missed, whilst all the time there is a steady, infallible, and undeviating bias against the player in favour of the bank. It is solely a game of chance, a fact strenuously contradicted by half-informed students, for so-called "systems" are innumerable, and some of them for a greater or a longer period often appear to give the player an advantage. There is no possible system, however, which will assure success in the long run, and it is herein that the ingenuity of the game consists. Every systematic method of play must depend upon increased stakes to retrieve past losses; and though a player with an unlimited capital might be practically certain to achieve his end in the course of time, the circumstance of there always being a maximum renders the bank invincible. The roulette table, covered with a green cloth, is made up of precisely corresponding halves, a circular space let into the middle holding the wheel, on either side of which the cloth is marked out as in the accompanying illustration. The wheel is divided into thirty-seven compartments, marked alternately black and red, numbered from one to thirty-six, the thirty-seventh being zero. *Pair* indicates even numbers, *impair* odd numbers; *manque* includes the numbers from 1 to 18; *passe*, from 19 to 36. The methods of staking are innumerable. *Rouge*, *noir*, *pair*, *impair*, *manque*, and *passe* are even chances; *i.e.*, a stake put upon any of them—five francs being the minimum at roulette—is paid in corresponding coin should the player win, the exception being when the little ball which is spun round the wheel falls into zero, in which case the even money chances are put "in prison"; that is to say, laid aside *in the place shown in the design* (the thick vertical line in the spaces marked *passe*, *pair*, *manque*, *impair* and the black and red diamonds) until another spin, when if the bank wins they are lost, if the player wins he is allowed to retrieve his money. The maximum in the case of these chances is 6000 francs. Any one who desires to play *en plein* puts his stake on one of the thirty-seven numbers. If the ball falls into the corresponding number on the cylinder, the stake is paid thirty-five times; and as there are thirty-seven numbers on the board, with the advantage already described of imprisoning the even money chances when zero comes up, it will be seen that there is a steady percentage in favour of the tables and consequently against the player. The maximum stake allowed *en plein* is 180 francs. The next most daring selection is *à cheval*, when the stake is placed on the line separating any two numbers, and if either of them wins the player is paid seventeen times, the highest stake permissible being 360 francs. *Transversale pleine* covers any three numbers in a line, the coin or note being placed on the line dividing either of the numbers from the neighbouring even money chance, as for instance between 4 and *passe*, or 6 and *manque*. A *transversale simple* covers six numbers, as for example where the line between 4 and 7 joins *passe*, or between 6 and 9 joins *manque*; and if either of these numbers wins, five times the value of the stake is paid, the maximum here being 1200 francs. *En carré* includes four numbers, the coin being placed, for instance, on the cross between 1, 2, 4, 5, or 28, 29, 31, 32; eight times the value of the stake is paid, and the maximum is 760 francs. It will be seen from the board that the dozens and the columns are also indicated, the first dozen of course including 1 to 12. In each of the columns are twelve numbers in different order. A stake placed on either a dozen or a column is paid twice its value, the maximum here being 3000 francs. A stake very constantly played is called the *quatre premiers*, which includes zero, 1, 2, and 3, the stake being placed on the line where zero and 1 join *passe*, or where zero and 3 join *manque*. If either of these four numbers, including zero, wins, the stake is paid eight times; and four times eight being thirty-two, there is a greater advantage to the table than when it loses *en plein* or on certain other chances. Zero can also be played in combination with any one or two of its neighbours; if with one of them the stake is paid seventeen times, if with two of them eleven times. A croupier sits on either side of the wheel; there is also one at each end of the table, their business being to assist the players in staking and recovering their winnings. Behind each of the former pair an official on a high chair supervises the table. The croupier whose duty it is to spin the wheel waits for a time till stakes have been made, and then, exclaiming, "Messieurs, faites votre jeu!" sets the cylinder in motion, throwing the ball in the direction contrary to that in which the wheel revolves. When it is seen that the ball will soon fall at rest in one of the compartments of the cylinder the croupier gives the notice, "Rien ne va plus," after which no stakes can be placed. When the ball finally rests in the compartment, the croupier announces the number and the even money chances that win, as for instance *rouge*, *impair*, and *manque*. He and his fellows then proceed to gather in with a rake all the money that has been lost, after which the winnings are paid and the game proceeds. (A. E. T. W.)





Roumania. See RUMANIA.

Rousseau, Pierre Etienne Théodore (1812–1867), French painter, one of the artists of Barbizon, in many ways the strongest of the group, and a landscape painter who devoted himself in his prime almost entirely to pictures of the Forest of Fontainebleau. He was an only son, and was born in Paris on 15th April 1812, of a bourgeois family which included one or two artists. At first he received a business training, but very soon displayed a special aptitude for painting. Although his father regretted the decision at first, he speedily became reconciled to his son leaving business, and throughout the artist's career (for he survived his son) was an ardent sympathiser

"MARSH IN THE LANDES." By THEODORE ROUSSEAU.

with him in all his conflicts with the Salon authorities. Théodore Rousseau shared to the full the difficulties of the romantic painters of 1830 in securing for their pictures a place in the annual Paris exhibition. The whole influence of the classically trained artists was against them, and not until 1848 was Rousseau adequately presented to the public. He had exhibited one or two unimportant works in the Salon of 1831 and 1834, but in 1836 his great work "La Déscente des Vaches" was rejected by the vote of the classic painters; and from then until after the revolution of 1848 he was persistently refused. He was not without champions in the press, and under the title of "le grand refusé" he became known through the writings of Thoré, the trenchant critic who afterwards resided in England and wrote under the name of Bürger. During these years of artistic exile Rousseau produced some of his finest pictures: "The Chestnut Avenue," "The Marsh in the Landes" (now in the Louvre, see Plate), "Hoar-Frost" (now in America); and in 1851, after the re-organization of the Salon in 1848, he exhibited his masterpiece, "The Edge of the Forest" (also in the Louvre), a picture similar in treatment to, but slightly varied in subject from, the composition called "A Glade in the Forest of Fontainebleau," in the Wallace collection at Hertford House.

Up to this period Rousseau had lived only occasionally at Barbizon, but in 1848 he took up his residence in the forest village, and spent most of his remaining days in the vicinity. He was now at the height of his artistic power, and was able to obtain fair sums for his pictures (but only about one-tenth of their value thirty years after his death), and his circle of admirers steadily increased. He was still ignored by the authorities, for while Diaz was made Chevalier of the Legion of Honour in 1851, Rousseau was left undecorated at this time, but was nominated shortly afterwards.

At the Exposition Universelle of 1855, where all Rousseau's rejected pictures of the previous twenty years were gathered together, his works were acknowledged to form one of the finest of the many splendid groups there exhibited. But during his lifetime Rousseau never really conquered French taste, and after an unsuccessful sale of his works by auction in 1861, he seriously contemplated leaving Paris for Amsterdam or London, or even New York. Misfortune then overtook him: his wife, who had been a source of constant anxiety for years, became almost hopelessly insane; his aged father looked constantly to him for pecuniary assistance; his patrons were few in number. Moreover, while he was temporarily absent with his invalid wife, a youth living in his home (a friend of his family) committed suicide in his Barbizon cottage; when he visited the Alps in 1863, making sketches of Mont Blanc, he fell dangerously ill with inflammation of the lungs; and when he returned to Barbizon he suffered from insomnia and became gradually weakened in strength. He was elected president of the fine art jury for the 1867 Exposition. His extreme disappointment at being passed over in the distribution of the higher awards told seriously on his health, and in August he was seized with paralysis. He slightly recovered, but was again attacked several times during the autumn. Finally, in November, he began to sink, and he died, in the presence of his lifelong friend, J. F. Millet, on 22nd December 1867.

Rousseau's other friend and neighbour, Jules Dupré, himself an eminent landscape painter of Barbizon, relates the difficulty Rousseau experienced in knowing when his picture was finished, and how he, Dupré, would sometimes take away from the studio some canvas on which Rousseau was labouring too long. Millet, the peasant painter, for whom Rousseau justly had the highest regard, was much with him during the last years of his life, and at his death Millet took charge of the insane wife, whose malady had so seriously harassed the artist. Rousseau was a very good friend to Diaz, teaching him how to paint trees, for up to a certain point in his career Diaz considered he could only paint figures.

Rousseau's pictures are always grave in character, with an air of exquisite melancholy which is powerfully attractive to the lover of landscapes. They are well finished when they profess to be completed pictures, but Rousseau spent so long a time in working up his subjects that his absolutely completed works are comparatively few in number. He left many canvases with parts of the picture realized in detail and with the remainder somewhat vague; and also a good number of sketches and water-colour drawings. His pen work in monochrome on paper is rare; it is particularly searching in quality.

There are a number of fine pictures by Rousseau in the Louvre, and the Wallace collection contains one of his most important Barbizon pictures. There is also an example in the Ionides collection at the Victoria and Albert Museum.

AUTHORITIES.—ALFRED SENSIER. *Souvenirs sur Th. Rousseau.* Paris, 1872.—E. MICHEL. *Les Artistes Célèbres: Th. Rousseau.* Paris, 1891.—J. W. MOLLETT. *Rousseau and Diaz.* London, 1890.—D. CROAL THOMSON. *The Barbizon School of Painters: Th. Rousseau.* London, 1892.—ALBERT WOLFF. *La Capitale de l'Art: Th. Rousseau.* Paris, 1886.—E. CHESNEAU. *Peintres Romantiques: Th. Rousseau.* Paris, 1880.—PH. BURTY. *Maîtres et Petit-Maîtres: Th. Rousseau.* Paris, 1877.

(D. C. T.)

Rouxville. See ORANGE RIVER COLONY.

Rovereto, or ROVEREDO, one of the chief industrial cities of South Tirol, and, after Trent, the principal seat of the Tirolese silk manufacture. Population (1890), 9030; (1900), 10,180, Italian and Catholic (about 5 per cent. German). Leather and paper are manufactured, in addition to the staple silk industry, and there is a considerable trade in silk, sumac, corn, wine, hams, and sausages.

Rovigno, a town on the Adriatic coast, in the Austrian province of Istria, of which it is the chief trading centre. Population (1890), 9662; (1900), 10,205, Italian and Catholic. It is the principal centre of the Austrian tunny and sardine fishery. The industries, in addition to shipbuilding and the preservation of fish, include the manufacture of tobacco, cement, macaroni and similar preparations, and flour.

Rovigo, a town and episcopal see of Italy, Venetia, capital of the province of Rovigo. It stands on the low ground between the lower Adige and the lower Po, 50 miles by rail south-west of Venice, and on the Adigetto canal. Its institutions include a 17th-century campanile, a technical school, a bronze equestrian monument (1894) to Garibaldi by Ferrari, and a monument (1881) of Victor Emmanuel by Monteverde. Population (1881), 10,800; (1899), about 7500.

Rovno, a district town of Russia, in the government of Volhynia, 150 miles by rail west-north-west of Zhitomir. Population (1897), 24,905. It has several steam flour mills and Crown provision factories, and carries on an active trade in corn, cattle, and timber. Under the name of Rovensk it was one of the oldest towns of Volhynia, having been founded in the 13th century. It became subsequently a dependency of Poland, and was an important centre of trade in the 16th century. Later on

it was utterly ruined by the Cossacks and the Tatars, and was finally annexed to Russia.

Rovnoye, a town of Russia, in the government of Kherson, on the Tashlyk river, 23 miles from Bobrinets. It was founded in 1785 by runaways from all parts of Russia, and has become a wealthy town, carrying on trade in agricultural produce and the manufacture of carriages. Its population in 1897 was 24,905.

Rovuma, a considerable river in East Africa, forming during the greater part of its course the boundary between German and Portuguese territory. The lower Rovuma is formed by the junction in 38° 1′ E. of two branches of nearly equal importance, the longer of which, the Lujenda, comes from the south-west, the other, which still bears the name Rovuma, from the west. Its source lies on an undulating plateau, 3000 feet high, immediately to the east of Lake Nyasa, in 10° 45′ S., 35° 40′ E., the headstream flowing first due west before turning south and east. In its eastward course the Rovuma flows near the base of the escarpment of an arid sandstone plateau to the north, from which direction the streams, which have cut themselves deep channels in the plateau edge, have almost all short courses. On the opposite bank the Rovuma receives, besides the Lujenda, the Msinje and Luchulingo, flowing in broad valleys running from south to north. The Lujenda rises in close proximity to Lake Chilwa or Shirwa, in the small Lake Chiuta (1700 feet), the swamps to the south of this being separated from Chilwa only by a narrow wooded ridge. The stream which issues from Chiuta passes by a swampy valley into the narrow Lake Amaramba, from which the Lujenda finally issues as a stream 80 yards wide. Lower down it varies greatly in width, containing in many parts long wooded islands which rise above the flood level, and are often inhabited. The river is fordable in many places in the dry season. At its mouth it is about a mile wide. The lower Rovuma, which is often half a mile wide but generally shallow, flows through a swampy valley flanked by plateau escarpments containing several small backwaters of the river. The mouth, which lies in 10° 28′ S., is entirely in German territory, the boundary near the coast being formed by the parallel of 10° 40′. The length of the Rovuma is about 500 miles.

See *Proc. R.G.S.*, February 1882, September 1884, December 1886, April 1890 (map).

Rowing.—*United Kingdom.*—The last twenty years of the 19th century witnessed a further decline in the standard of English professional sculling, but the period since 1880 has been one of remarkable prosperity in the amateur world. Efforts have been made not only in England but also in the British colonies, in the United States of America, and in several countries on the continent of Europe, to keep amateur rowing pure and free from the taint of professionalism, and these efforts have on the whole met with considerable success. Nearly all the minor regattas in England are now held under the rules of the Amateur Rowing Association, and even the stewards of Henley Regatta hold their regatta "in accordance with" the rules of that body. The exact effect of the distinction is not obvious, but—such as it is—it is probably due to the fact that should any difference of opinion arise between these bodies, the committee of the Amateur Rowing Association (founded in 1876) are hardly in a position to dictate to the stewards of Henley Regatta (founded in 1839).

The Amateur Rowing Association exists for the following objects:—(1) To maintain the standard of amateur rowing as recognized by the Universities and principal boat clubs of the United Kingdom. (2) To promote the interests of boat-racing generally. It consists of clubs which adopt the following definition of an amateur, namely:—No person shall be considered an amateur oarsman, sculler, or coxswain (1) who has ever rowed or steered in any race for a stake, money, or entrance fee; (2) who has ever knowingly rowed or steered with or against a professional for any prize; (3) who has ever taught, pursued, or assisted in the practice of athletic exercises of any kind for profit; (4) who has ever been employed in or about boats, or in manual labour, for money or wages; (5) who is or has been by trade or employment for wages a mechanic, artisan, or labourer, or engaged in any menial duty; (6) who is disqualified as an amateur in any other branch of sport. Any amateur club willing to bind itself to observe the rules of the association may become affiliated, subject to election by the committee, and all the amateur clubs of any importance in the United Kingdom are members. The government and management of the Amateur Rowing Association (or A.R.A., as it is usually designated) is vested in a committee of twenty-five, who have power to affiliate clubs, appoint officers, make or alter rules, suspend, disqualify, and reinstate amateurs, and generally determine all questions and disputes relating to boat-racing which may be referred to them. The principal amateur regattas and boat-races have been held in accordance with the "Rules for Regattas" and "Laws of Boat-Racing" drawn up by this body. They are of the greatest assistance to the stewards or committees of small regattas, as the local officials might often be unwilling to inquire too closely into the amateur status of visiting crews, or to enforce the laws of boat-racing too strictly, had they not bound themselves, when they accepted the entrance fees and offered prizes, to hold their regattas "under the rules of the A.R.A."

Two important changes have been made in the Henley Regatta course. Before 1886 the races started at the upper end of the Temple Island and finished at Henley Bridge. This course was practically straight for three-quarters of the distance, but at the end there was a curve which, in a close race, gave a distinct advantage to the boat which rowed from the Berkshire side. In 1886 a new course was instituted, starting at the lower end of the island and finishing at the upper end of the wall of Phyllis Court lawn. This course is of the same length as the old one, namely, 1 mile 550 yards, but, although it has two slight angles in favour of the Buckinghamshire station, it is to all intents and purposes straight. The course is marked out on either side by a line of piles driven into the river-bed. Between 1886 and 1899 some minor alterations were made in the course. In 1888 it was narrowed to 120 feet, and in 1897 it was brought farther over to the Berkshire side, in order to diminish the advantage given to the Buckinghamshire boat in a westerly wind by the shelter of the trees upon that bank. Between 1889 and 1899 the number of spectators continued to increase, and there were frequent instances of races being interfered with by craft which were forced out on to the course by the crush of boats; and consequently, in 1899, the regatta stewards resolved to place floating booms between the piles along the greater portion of the Buckinghamshire side of the course, and along the last part of the Berkshire side. This proposal to boom off the course was very severely criticized, but the stewards had the courage of their opinions, and carried it into effect. It proved to be a great advantage not only to the competitors, who thus have a clear course, but also to the spectators, who are able to take their ease and watch the rowing without fear of being pushed out on to the course during the progress of the races. These and many other minor improvements

were instituted on the initiative and under the personal supervision of Mr Herbert T. Steward, for many years chairman of the managing committee of the regatta stewards, and it is not too much to say that the continued success of the meeting was to a great extent due to the enthusiastic and practical interest which he took in its welfare.

Another noticeable modern feature of the Henley Regatta has been the increase of foreign competition. Twice have the British colours been lowered in the Diamond Sculls. In 1892 these sculls were won by Mr J. J. K. Ooms, a Dutch sculler of considerable power and undoubted pace; and in 1897 the winner was Mr E. H. Ten Eyck, the son of an American professional sculler. This oarsman sent in his entry again in 1898, but it was refused by the stewards. In the principal rowing events Englishmen have held their own. In 1895 a Canadian crew were beaten by two feet only for the Stewards' Cup, but on few other occasions, if any, have the home crews been really hard pressed by any of the Canadian, American, French, Dutch, or German crews who have competed. A Dutch crew, the Nereus Boating Club (Amsterdam University), won the Thames Challenge Cup in 1895, but this is not considered a first-class event. In 1901 a very strong crew from the University of Pennsylvania, U.S.A., competed for the Grand Challenge Cup, and were beaten after a good race by Leander Club in the final heat. The former crew had practised together for nearly a year, while business and other engagements prevented the Leander men from getting a crew together till within a fortnight of the regatta. An outcry was raised in the newspapers against the unfairness of subjecting English crews, who with true amateur spirit treated rowing as a pastime, to competition with foreign crews who, although they obeyed the letter of the amateur definition, really made a business of their rowing. A motion was proposed at the October meeting of the Henley Stewards to exclude foreign crews from the regatta, but it was defeated by a large majority. On July 21, 22, and 23, 1902, a regatta for eights, organized by Lord O'Brien on the river Lee near Cork, Ireland, over a two-mile course, attained the character of an international meeting, by reason of the entry, at the instance of the German Emperor, of a strong Berlin eight. The final heat, in which this crew met Leander, afforded a fine exhibition of the different styles of British and Continental rowing; and the result, a victory for Leander by one and a quarter length clear, was in accordance with general anticipations. In order to allow the stewards to make proper inquiry into the amateur status and elegibility of foreign competitors, they have as a rule to make their entries prior to the 1st of April; but members of any club affiliated to the Union des Sociétés Françaises de Sports Athlétiques, or to the Fédération Belge des Sociétés d'Aviron, or of the Deutscher Ruder Verband, or of the Verbouden Nederlandsche Roeivereenigingen, may make their entries on or before the 1st of June.

Speaking generally, the high standard of English rowing was well maintained during the closing period of the century. The ideal style aimed at is much the same as it was at the beginning of the 'eighties, and very few coaches would now find fault with the directions for rowing laid down in the ninth edition of this work. The doctrine that the extra length of reach given by the sliding seat is to be used in addition to the long body-swing of fixed-seat rowing, and not in substitution for it, has long been preached by theorists, but it was not until some ten or fifteen years after the introduction of the sliding seat that oarsmen really learned to put it into practice. On a fixed seat the muscles of the legs do a certain amount of work, while the bulk of it falls on the muscles of the back: the sliding seat allows the muscles of the legs to be used to the fullest extent; and the primary object of a coach should be to get the correct combination of these two sets of muscles in every member of his crew. A man who has got over this difficulty and uses his slide and swing simultaneously from the moment that his blade enters the water until the moment that it leaves it is said to "slide well," and a crew which slides well but has many minor faults will in most cases travel faster than a crew which slides badly, even although the latter has got rid of nearly all the minor faults in style, and has the greater polish and more taking appearance of the two.

The art of coaching has made a distinct advance, and those who superintend the training of crews appear to make a more minute study than they did formerly, not only of the faults of a crew, but also of the best methods of pointing out those faults to their pupils, and of assisting them to effect a remedy. There have been, of course, from the earliest days a few coaches who thoroughly understood this art—for it is an art—but it is in the instructions given to college crews at the Universities and to junior crews of the metropolitan clubs that this improvement is most noticeable, although it must be admitted that the latter class do not seem to have benefited very much by the advice they have received. The value of good coaching to a crew cannot be over-estimated, for even the best oarsmen are apt unconsciously to develop faults in style, which grow upon them unless they are at once eradicated.

In 1901 Dr Warre, the headmaster of Eton, designed a boat for the Oxford crew, which was considerably shorter and broader than those generally used. She carried the crew for whom she was designed to victory, but she did not meet with universal approval. She was used again (in 1902) by a crew for whom she was much too small. With this exception, there has not been any substantial change in the lines or construction of the hulls of racing-boats. Some of our best scullers set their faith on boats of a short and broad build, but it is doubtful if they will ever entirely supersede the long narrow craft which have been in vogue since keel-less boats were first introduced. Many new internal fittings have, however, appeared from time to time. Some of them have stayed, and others have vanished as suddenly as they appeared. Sliding seats running upon "rollers" (small vulcanite wheels) have permanently superseded those which moved backwards and forwards upon oiled steel runners. Outriggers are made of tubular steel, which is at once lighter and more rigid than the old-fashioned solid metal. Swivel rowlocks are sometimes used in pair-oars and four-oars, but they are considered unsuitable to eight-oared rowing, where the beginning of the stroke has to be firmly and smartly caught.

The only universal change in the pattern of oars has been the introduction of Messrs Ayling's patent button, by which the risk of breakage at that point has been reduced to a minimum. Formerly the leather button where the oar rests in the rowlock was attached by two long nails driven into the wood, and there were many instances of the oar giving way at that point under the strain of a race. The patent button is fixed by screws to a metal plate, which is placed flush with the oar and kept in place by a tight covering of leather, and this covering is attached to the oar by two rows of small tacks, which do not penetrate more than an eighth of an inch into the wood. Since these buttons have been in use there has been no instance of an oar being broken at the button by fair rowing in any of the more important races.

The literature of rowing has been increased by three works which deal in detail with the arts of rowing, sculling, steering, and training, the measurements of boats and oars, and the history of boat-

racing since the inception of the sport; these are the volume on *Rowing* in the Isthmian Library series, the volume on *Rowing and Punting* in the Badminton Library series published by Messrs Longmans, Green, & Co., and *Oxford Rowing*, by the Rev. W. E. Sherwood. (C. M. P.)

United States.—Rowing is one of the oldest of well-defined sports in America, having been taken up in the colleges about 1840. In 1852 the first race between Yale and Harvard was rowed at Lake Winipiseogee. For a time the races were rowed in all sorts of crafts and under all kinds of rig—four-oar, six-oar, eight-oar, barges, lap streaks, &c. But after a while the universities settled down to six-oared shell racing, and later to eight-oared. The National Rowing Association of American colleges was formed in 1872, and regattas were held at Springfield on the Connecticut river. Afterwards Saratoga offered greater inducements, and the lake there was adopted. In 1875 thirteen colleges sent crews to the races at this meeting; but the organization was apparently too bulky, and the loss of Yale in 1876, and of Harvard in the following year, seemed to put an end to the interest, and the association fell to pieces. Since that time Harvard and Yale have conducted a series of annual races in eight-oared shells with coxswains, held for the most part on the Thames at New London, Connecticut; but in 1896 Yale sent her crew to the Henley Regatta in England, and in the following year Harvard, Yale, and Cornell rowed in a triangular race on the Hudson river at Poughkeepsie. In the years 1897 and 1898 Mr Rudolph C. Lehmann, the English oarsman and coach, took charge of the Harvard crews, which had for some years been consistently unsuccessful; and though the crews he coached were beaten, the system and traditions thus inculcated, together with other influences, regenerated Harvard boating. A beginning was made toward a renewal of the old general inter-collegiate regatta by races upon the Hudson river near Poughkeepsie. In 1900 and 1901 the Universities of Pennsylvania, Wisconsin, Cornell, Columbia, Georgetown, and Syracuse furnished the largest and most exciting of the regattas thus far held there. While college rowing is the oldest form of well-organized boating in the United States, there has been considerable rowing, both professional and amateur, outside the colleges. Single-scull racing was the most common professional event, but there was not always perfect confidence in the genuineness of the races. The National Amateur Association from time to time held the most satisfactory meetings, and did much to keep up the interest in amateur boating. American crews have occasionally competed abroad, mainly in England. Harvard sent a crew in 1869 to row against Oxford on the Thames; Columbia in 1878, Cornell in 1881 and 1895, Yale in 1896, and Pennsylvania in 1901 competed at Henley. Single scullers were also sent. Upon the occasion of the Centennial Exposition in 1876, English crews competed on the Schuylkill. Many attempts to arrange for other English crews, especially university crews, to visit America were unsuccessful. (W. CA.)

Rowland, Henry Augustus (1848–1901), American physicist, was born at Honesdale, Pennyslvania, on 27th November 1848. Although from an early age he exhibited marked scientific tastes and spent all his spare time in electrical and chemical experiments, it was not until he was sixteen that he was allowed to abandon the classical studies which were so distasteful to him and devote himself to scientific and mechanical pursuits. Entering the Rensselaer Polytechnic Institute at Troy, N.Y., he followed the usual engineering curriculum of the place, and graduating in 1870, soon obtained an engagement on the Western New York Railway. But the work there was not to his liking, and after a short time he gave it up for an instructorship in natural science at Wooster College, Ohio, which in turn he resigned in order to return to Troy as assistant professor of physics. Finally, in 1876, he became the first occupant of the chair of physics at the Johns Hopkins University, Baltimore, a position which he retained until his premature death on 16th April 1901. Rowland was one of the most brilliant men of science that America has produced, and must be assigned a high rank among the experimental physicists of the 19th century. It is curious that at first his merits were not perceived in his own country, and his early work, treated there with indifference, first won adequate recognition in the Eastern hemisphere. In America he was unable even to secure the publication of certain of his scientific papers; but Clerk Maxwell, when they were submitted for his consideration, at once saw their excellence, and had them printed in the *Philosophical Magazine*. So much impressed, indeed, were European physicists by his merits, that when the managers of the Johns Hopkins University asked advice in Europe as to whom they should make their professor of physics, he was pointed out in all quarters as the best man for the post, and was accordingly chosen. In the interval between his election and the assumption of his duties at Baltimore, he studied physics under Helmholtz at Berlin, and carried out a well-known research on the effect of an electrically charged body in motion, showing it to give rise to a magnetic field. His conclusions were subsequently disputed, but he reassured himself of their accuracy by a repetition of the experiments only a short time before his death. As soon as he was settled at Baltimore, two important pieces of work engaged his attention. One was a redetermination of the ohm. For this he obtained a value which was substantially different from that ascertained by the committee of the British Association appointed for the purpose, but ultimately he had the satisfaction of seeing his own result accepted as the more correct of the two. The other was a new determination of the mechanical equivalent of heat. In this he used Joule's paddle-wheel method, though with many improvements, the whole apparatus being on a larger scale and the experiments being conducted over a wider range of temperature. He obtained a result distinctly higher than Joule's final figure; and in addition he made many valuable observations on thermometrical questions and on the variation of the specific heat of water, which Joule had assumed to be the same at all temperatures. In 1882, before the Physical Society of London, he gave a description of the diffraction gratings with which his name is specially associated, and which have been of enormous advantage to astronomical spectroscopy. These gratings consist of pieces of metal or glass ruled by means of a diamond point with a very large number of parallel lines, on the extreme accuracy of which their efficiency depends. For their production, therefore, dividing engines of extraordinary trueness and delicacy must be employed, and in the construction of such machines Rowland's engineering skill brought him conspicuous success. Some account of the minute precautions and refinements observed for the elimination of error to the greatest possible extent may be found in the ninth edition of this Encyclopædia in the article SCREWS, which came from his pen, as also did DIFFRACTION GRATINGS in vol. xxvii. In addition to making gratings, Rowland also used them, and the results of his labours may be found in the elaborate *Photographic Map of the Normal Solar Spectrum* (1888) and the *Table of Solar Wave-Lengths* (1898). In the later years of his life he was engaged in developing a system of multiplex telegraphy, an account of which is given in the article TELEGRAPHY. (H. M. R.)

Roxburgh, an inland border county of Scotland, is bounded on the E. and S.E. by Northumberland, on the S.E. by Cumberland, on the S.W. by Dumfries, on the W. by Selkirk, on the N.W. by Midlothian, and on the N.E. by Berwick. It occupies the greater part of the border line between England and Scotland.

Area and Population.—In 1891 the parishes of Ashkirk, Galashiels, and Selkirk, which were shared between Roxburgh and Selkirk shires, were placed wholly in Selkirk, and the Selkirk part of the parish of Melrose was transferred to the parish of Galashiels. Of parishes divided between Berwick and Roxburgh, Earlston and Mertoun were restricted to Berwick, part of Lauder was transferred to Roxburgh, and Roberton was placed wholly in Roxburgh. According to the official estimate, the area of the county is 428,527 acres, or nearly 670 square miles. The population was, in 1881, 53,442; in 1891, 53,741; in 1891 on the above area, 53,500, of whom 24,901 were males and 28,599 females; in 1901 it was 48,793. On the old area, taking land only (425,656 acres, or 665·1 square miles), the number of persons to the square mile in 1901 was 73, and the number of acres to the person 8·7. In the registration county the population increased between 1881 and 1891 by 5·9 per cent. Between 1881 and 1891 the excess of births over deaths was 5936, and the increase of the resident population 312. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimate.
1880	838	297	1623	11·0
1890	876	246	1343	10·27
1899	773	282	1054	9·9

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	31·06	28·42	25·37	22·19	19·67
Death-rate . .	16·04	17·18	16·55	15·78	14·42
Marriage-rate .	5·68	4·84	4·64	5·02	5·26

There were 174 Gaelic-speaking persons in the county in 1891, and 43 foreigners. Valuation in 1889–90, £366,056; 1899–1900, £384,459.

Administration.—The county returns a member to Parliament, and contains Hawick (17,303), one of the Border group of parliamentary burghs and a police burgh. Jedburgh (2222), the county town, is the only royal burgh, and Kelso (4006) is the only considerable police burgh. There are 30 civil parishes, with combination poorhouses at Hawick, Jedburgh, and Kelso; and the lunatic asylum for Roxburgh, Berwick, and Selkirk is at Bowden, near Melrose. The number of paupers and dependants in September 1899 was 963. Roxburgh, Berwick, and Selkirk form a sheriffdom, and a resident sheriff-substitute sits at Jedburgh and Hawick.

Education.—Thirty-two school boards manage 63 schools, which had an average attendance of 7269 in 1898–99, while 5 voluntary schools (1 Roman Catholic and 2 Episcopal) had 563. There are secondary schools at Hawick and Kelso, and Jedburgh and Melrose public schools have secondary departments. The greater part of the "residue" grant is spent in assisting teachers to attend science and technical classes at Edinburgh University and Hawick, and in subsidizing science and art and technical classes at Hawick, Kelso, and elsewhere.

Agriculture.—Oats are the principal corn crop, and the barley acreage is about two-fifths of that under oats. The percentage of cultivated area in 1898 was 41·9. There were 16,285 acres under wood in 1895, of which 757 had been planted since 1881. Of the 1241 holdings in 1895, the date of the last return, the average size was 146 acres. The percentage under 5 acres was 21·76, between 5 and 50 acres 33·44, and over 50 acres 44·80. The number of farms between 50 and 100 acres was 100, between 100 and 300, 253, between 300 and 500, 102, and between 500 and 1000, 85, while as many as 16, a proportion exceeded in Berwickshire only, were over 1000 acres. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	184,322	48,303	27,423	57,682	50,845	69
1890	185,726	46,792	27,183	58,270	53,379	56
1895	180,962	43,380	25,312	56,745	55,408	47
1899	182,337	42,966	24,379	52,650	62,236	58

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1885	4396	18,679	5373	494,152	4174
1890	4394	18,576	5179	517,629	4286
1895	4462	17,327	4684	510,227	3938
1899	4300	17,787	4560	532,989	3260

At the census of 1891, 4895 men and 1106 women were returned as being engaged in agriculture.

Industries and Trade.—The county is the principal seat of the tweed and hosiery manufacture in the kingdom. The industries of Hawick and Jedburgh include also engineering, iron-founding, and dyeing, and fishing tackle is made on a considerable scale at Kelso. The salmon fishings on the Tweed are valuable. The industrial population in 1891 numbered 8102 men and 4445 women, of whom 2385 men and 2523 women were connected with the manufacture of textiles.

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Royan, town, arrondissement of Marennes, department of Charente Inférieure, France, 37 miles in direct line, south of Rochelle, on branch line from Pons to Tremblade. A municipal casino was opened in 1895. A statue of Eugène Pelletan (died 1884), a benefactor of the town, has been erected. Royan is the seat of a Protestant consistory. There is an active coasting trade. In 1900, 1064 vessels of 65,760 tons entered, and 1038 of 65,064 tons cleared. Population (1891), 6241; (1896), 6864 (comm.), 8258.

Rózsahegy, a market-town of Hungary, in the county of Liptó, near the Vág, with 6879 inhabitants in 1891. It has an upper gymnasium, textile manufactories, paper mill, saw mill, and other industrial establishments. Its commerce is brisk. Not far from Rózsahegy lies Koritnicza, a popular bathing-place. Population (1901), 8198.

Ruabon, a parish, town, and railway station, Denbighshire, North Wales, in the Eastern parliamentary division, near the Shropshire border, 5 miles south-west of Wrexham. In the neighbourhood there are collieries, engineering works, an iron foundry and chemical works, and an extensive industry in the manufacture of bricks, terra-cotta, encaustic and tesselated tiles, glazed bricks, and sanitary pipes. Population of civil parish (1901), 3491.

Rubinstein, Anton Grigorowitz (1830–1894), Russian pianist, born at Wechwotynetz, in Podolia, of Jewish parentage, was the son of a pencil manufacturer who migrated to Moscow. Besides his mother he had but one teacher, Alexander Villoing, of whom he declared at the end of his own career that he had never met a better. In July 1839 Rubinstein appeared in the theatre of the Petrowski Park at Moscow, and was promptly acclaimed a genius; and in the year following he went to Paris after Villoing, and played with success before Liszt. For some time after this Rubinstein travelled in Holland, Germany, and Scandinavia, and reached England in 1842, where on 20th May he made his first appearance at a Choral

Fund Concert with complete success. After a brief visit to Moscow in 1843, he went with his family (including his afterwards distinguished brother Nikolaus) to Berlin for purposes of the complete musical education which the parents had now determined to give their sons. Dehn was their master, and Mendelssohn, whom Rubinstein had met previously in London, their best friend. The sudden death of Rubinstein *père* necessitated the withdrawal of his wife and Nikolaus to Moscow, while Anton, on Dehn's advice, went to Vienna to seek a livelihood. Hence, after more hard study for nearly two years, he went with the flautist Heindl, and later alone, on a concert tour in Hungary; and the outbreak of the revolution in Vienna preventing his return there, he went *viâ* Berlin to St Petersburg, where he met with immediate and hearty encouragement, the Grand Duchess Hélène appointing him Kammervirtuos. About this time an unfortunate error of the police nearly caused his expatriation to Siberia, from which he was saved by his patroness. During the next eight years Rubinstein spent most of his time in St Petersburg studying, playing, and composing. His opera *Dmitri Donskoi* was produced there in 1851, and *Toms der Narr* in 1853. *Die Sibirischen Jäger*, written about the same time, was not produced. In Russia his success was so great, and his fame had already spread so far abroad, that on the advice of his patroness and Count Wilhorski he set out on a tour to convince foreigners of his abilities. After a visit to Hamburg, he appeared as composer, conductor, and pianist at the Gewandhaus at Leipzig, and after further travels he arrived for the second time in London in 1857, when at a Philharmonic Concert he introduced his own concerto in G. In the following year he was in London again, having in the meantime been appointed Concert Director of the Royal Russian Musical Society. In 1862 he founded the St Petersburg Conservatorium, of which for many years he remained the guiding spirit. In 1868 he began again to travel in Germany, France, and England, and remained for some time in Vienna, where he introduced a large number of his own compositions. Thence he went to America in 1872 and 1873, when he returned to Russia, and after a short rest set off once more on concert tours. In this manner the rest of his life was spent, until in 1885 he began a series of historical recitals of immense interest, which he gave in most of the chief European capitals. He died 20th November 1894.

In addition to the works already named, Rubinstein left compositions in almost every known form. Among other of his operas are *Die Kinder der Haide*, *Feramors* (*Lalla Roukh*), *Nero*, *Der Dämon*, and *Die Makkabäer*, this last perhaps more frequently played than all the others, the bane of which is the lack of dramatic point. On the subject of oratorio Rubinstein held original views, though his attempt to realize them in *Moses* and *Christus* was not completely successful, while his efforts in Berlin and London to found a Sacred Theatre failed entirely. All the same, he regarded his *Christus* as his greatest achievement. The most familiar of his five symphonies are the "Ocean" and the "Dramatic." He wrote scores on scores of pianoforte works, from complex concertos to the most commonplace *salonstücke*; abundance of concerted chamber-music; and a number of songs and duets, which enjoyed some vogue. He also published several books, including his Reminiscences and *Die geistliche Oper*. What Dr Hanslick once said of Rubinstein is perfectly true, that "people admired the Russian's bold, powerful, occasionally even rough playing, without being won over in the least by his compositions." As a composer Rubinstein is practically dead. His fame as one of the greatest of pianists, his exquisite touch and perhaps his waywardness, will live in history.

(R. H. L.)

Ruby Mines, a district in the Mandalay division of Upper Burma, lying between the Bhamo district on the north, the Shan States on the east, Mandalay district on the south, and Kalta on the west. Area, 1915 square miles; population (1891), 34,062; (1901), 87,815. In 1898–99 it had 193 villages, which paid a revenue of Rs.1,09,649. The district geographically forms part of the Shan plateau, and is to a great extent a mass of hills, with a general north and south direction. Of a total acreage of 3,504,480 acres, only 7347 were cropped in 1898–99. There were 2980 acres of current fallow, and the area remaining available for cultivation was 349,661 acres; 118,296 acres were under forest, and the remainder, 747,068 acres, were uncultivable. The population in 1891 was classified as: Buddhists, 31,227; Hindus, 884; Mahommedans, 350; and Christians, 269. Kachins and Palaungs together probably outnumbered the Burmans and Shans, but there were no exact statistics. The total rainfall in 1898–99 was 103·26 inches, taken at Mogôk. The highest shade maximum in that year was 83°, and the lowest temperature in December, 35° F. The headquarters town is Mogôk, which is reached by a cart-road from Thabeikkyin, 61 miles distant, on the Irrawaddy. The town stands in the centre of a valley, at a height of 4000 feet above sea-level. It is the centre of the ruby-mining industry. Population (1891), 5630; (1898), about 8000. The Ruby Mines Company employs about 40 Europeans and Eurasians in its works, which are situated at the north end of the town. The company has constructed a dam across the Yeni stream and set up an electric installation of about 200 horse-power, which pumps and lights the principal mine.

Rüdesheim, a town of Prussia, in the Rhine province, on the right bank of the Rhine, 19 miles by rail west by south of Wiesbaden, famous for its wine. It has three ancient towers, and an Evangelical (1855) and a Roman Catholic (1390–1400) church. Immediately above the town, on the Niederwald hill (985 feet), stands the national monument ("Germania"), designed by Schilling, commemorative of the war of 1870–71. Population (1900), 4812.

Rudini, Antonio Starabba, Marquis di (1839——), Italian statesman and Knight of the Annunziata, was born on 6th April 1839 at Palermo. In 1866 he was elected syndic of his native city, and displayed considerable personal courage in quelling a separatist insurrection organized by the reactionary party. The prestige thus acquired led to his appointment to the prefecture of Naples in 1867, and in October 1869 to the Ministry of the Interior in the Menabrea cabinet. His term of office was short, as he fell with Menabrea in the following December, and held no prominent position until, upon the death of Minghetti in 1886, he became leader of the Right. Early in 1891 he succeeded his fellow-Sicilian, Crispi, in the premiership and Ministry of Foreign Affairs by forming a coalition cabinet with a part of the Left under Nicotera; but his administration proved weak and vacillating, its only important act being the renewal of the Triple Alliance for a period of twelve years. After an attempt to modify his cabinet, he was overthrown in May 1892 by a vote of the Chamber. Upon the return of his rival, Crispi, to power in December 1893, he resumed political activity, allying himself with the Radical leader, Cavallotti, whose defamatory anti-Crispian campaign he openly encouraged. The crisis consequent upon the disaster of Adowah (1st March 1896) enabled Rudini to return to power as Premier and Minister of the Interior in a cabinet formed by the veteran Conservative, General Ricotti. He concluded peace with Abyssinia, but

endangered relations with Great Britain by the unauthorized publication of secret diplomatic correspondence in a Green-book on Abyssinian affairs. His internal policy was marked by continual yielding to Radical pressure and by persecution of Crispi. Dissolving the Chamber early in 1897 in obedience to Radical dictation, and supporting Radical candidatures in the ensuing general election, he augmented the influence of the subversive parties, and inadvertently paved the way for the outbreak of May 1898, the suppression of which, *manu militari*, entailed considerable bloodshed and necessitated the proclamation of a state of siege at Milan, Naples, Florence, and Leghorn. Indignation at the results of his policy led to his overthrow in June 1898, when, in order to prevent the advent of his Conservative opponents, he resigned office without permitting Parliament to designate a successor. During his second term of office he thrice modified his cabinet (July 1896, December 1897, May 1898) without strengthening his political position. In many respects Rudini, though leader of the Right and nominally a Conservative politician, proved a dissolving element in the Italian Conservative ranks. By his alliance with the Liberals under Nicotera in 1891, and by his understanding with the Radicals under Cavallotti in 1894–98; by his betrayal of his Conservative colleague, General Ricotti, to whom he owed the premiership in 1896; and by his vacillating action since his fall from power, he divided and demoralized a constitutional party which, with greater sincerity and less reliance upon political cleverness, he might have welded into a solid parliamentary organization.

Rudok. See TIBET.

Rudolf (otherwise known as BASSO NOROK and GALLOP), a large lake of eastern equatorial Africa, forming the centre of an inland drainage system, occupying the southern part of the Abyssinian highlands and a portion of the great equatorial plateau. The lake itself lies towards the north end of the great East African rift valley, between the parallels of 2° 26′ and 5° N., while the meridian of 36° E. runs down the centre of the northern wider part, the narrower southern portion bending slightly eastward. The length along the curved axis is 185 miles, the maximum width probably about 35, and the area roughly 3500 square miles. Its altitude is 1250 feet. Towards the south end it seems to be deep, but it is comparatively shallow in the north. Its water is brackish, but drinkable. The country bordering the lake on almost every side is sterile and forbidding, and the only permanent river which enters it is the Nianam or Omo, from the north. The southern end, for some 50 miles on the west and for a longer distance on the east, is shut in by high cliffs—the escarpments of a rugged lava-strewn country, which shows abundant signs of volcanic activity, great changes having been reported since 1889. In particular, the great volcano of Lubburua is said to have been destroyed between 1889 and 1897 by a sudden explosion, and according to native report the lake contours have considerably changed within 30 years. Farther north, on the west side, sandy plains alternate with lines of low hills, the immediate shores (on which the water appears to have encroached in very modern times) being marked by spits of sand, which in places cut off lagoons from the main body of the lake. These are the haunt of great numbers of water-birds. In 3° 8′ N. the dry bed of the Turkwell—in its upper course a large river descending the slopes of Mount Elgon—approaches the lake, which seems, however, to receive no water from it at the present day. Near the north end mountains again approach the shores, the most prominent being Mount Lubbur, an extinct volcano with a well-preserved crater, and a bold rocky escarpment below the summit. At the extreme north-west corner a bay some 35 miles long (Sanderson Gulf) is almost separated from the rest of the lake by two long points of land. On the eastern side, open arid plains, with few trees, occupy most of the northern country. Near the south end is the volcanic island of Elmolo, 10 miles long, and there are a few small islets near the middle point of the length. At the north end a level swampy plain is traversed by various arms of the lake and by the Nianam river. This river has been shown to be identical with the Omo, the course of which was long one of the most debated questions of African geography. Its northernmost feeders rise on the high plateau south of the Blue Nile, in 9° 10′ N., and being swollen by other streams from the east and west, soon form a large river running in a deep wooded valley flanked on either hand by masses of high mountains. During its lower course it makes two considerable bends to the west before finally entering the lake as a deep stream a quarter of a mile wide. Lake Rudolf (previously known on the east coast by report) was discovered in 1889 by Teleki, and has since been visited by Donaldson Smith, Bottego, Cavendish, Austin, and others.

AUTHORITIES.—*Geographical Journal*, September 1896, April 1898, August 1899.—VON HÖHNEL. *Discovery of Lakes Rudolf and Stephanie.* London, 1894.—SMITH. *Through Unknown African Countries.* London, 1897.—NEUMANN. *Elephant-Hunting in East Equatorial Africa.* London, 1898.—VANNUTELLI and CITERNI. *L'Omo.* Milan, 1899.—WELLBY, *'Twixt Sirdar and Menelik.* London, 1901. (E. HE.)

Rufiji, a large river of German East Africa, entering the sea by a considerable delta, between 7° 45′ and 8° 13′ S. Its upper basin, which extends from north to south through over 300 miles, is drained by three main branches, which unite to form the lower Rufiji. This receives no further tributary in a course of some 150 miles, so that here the width of the basin is reduced to a minimum. Of the three upper branches, the two southern, the Luvegu and the Ulanga, though shorter than the northernmost (the Ruaha), carry a greater volume of water, as they come from a more rainy region, and by their junction the Rufiji proper may be said to be formed.

The Luvegu rises in 10° 50′ S., 35° 50′ E., and flows north-west in a wooded valley, generally narrow, and bordered by a broken country in great part uninhabited and covered with thin forest. In its lower course it is a large stream—100 to 150 yards wide.

The Ulanga is formed by a number of streams descending from the outer escarpment of the high plateau which runs north-east from the head of Lake Nyasa, and in Uhehe becomes broken up in ranges of mountains. The most important headstream, the Ruhudye, rises in about 9° 30′ S., 34° 40′ E. As a whole, the Ulanga valley is broad, level, and swampy, the river running in a very winding course and sending off many diverging arms. It is navigable throughout the greater part of its course, having even in the dry season a general depth of 3 to 12 feet, with a width of 40 to 120 yards. In April and May nearly all the streams overflow their banks and cover a great part of the plain.

Just below the junction of the Luvegu and Ulanga, the Rufiji flows through a narrow pass by the Shuguli falls, and continues north-east in a fairly straight course to the junction of the Ruaha, in 7° 55′ S. The most remote branches of the Ruaha rise north of Lake Nyasa in the Livingstone mountains, and descend into a broad sun-baked valley, which seems to belong to the East African system of rift valleys. The united stream makes a wide sweep to the north of the Uhehe mountains, from which it receives various tributaries, finally flowing south-east and east to the Rufiji. A little below the junction, the Rufiji is broken by the Pangani falls (37° 42′ E.), but is thence navigable by small steamers to its delta. The country on either side is a generally level plain, inundated, on the south, in the rains, and the river varies in width from 100 to 400 yards, with an average current of 3 miles an hour. The main mouth of the river is that known as Simba Uranga, the bar of which can be crossed by ocean vessels at high water, but all the branches are very shallow as the apex of the delta is approached. Saw-mills have been established on some of them, and much of the delta is suited for rice-growing.

See BEARDALL in *Proc. R.G.S.*, 1881.—PFEIL in *Petermanns Mitteilungen*, 1886.—PRITTWITZ and ADAMS in *Mitt. aus den Deutschen Schutzgebieten*, 1898.—PRÜSSING, *Ibid.*, 1901.

Rugby, a market-town and parish of Warwickshire, England, in the Rugby parliamentary division of the county, $80\frac{1}{2}$ miles north-west of London by rail. In 1895 the parish church was completed, by the addition of a tower with a spire and eight bells, at a cost of £10,000. A free public library building was presented to the town in 1891. The books were furnished by the Rugby Institute, since dissolved. In 1895 the Rev. Herbert Armitage James, D.D., late principal of Cheltenham College, succeeded the Rev. John Percival, LL.D. (late principal of Trinity College, Oxford), on his becoming bishop of Hereford, as headmaster of Rugby School. Among modern public buildings are the municipal offices, and additions to the technical schools. Population of urban district and parish (1891), 11,262; (1901), 16,830: of parliamentary division (1891), 49,737; (1901), 56,221.

Ruhla, a town and summer resort of Germany, partly in the duchy of Saxe-Weimar and partly in the duchy of Saxe-Coburg-Gotha. It stretches $2\frac{1}{2}$ miles along the valley of the Erb, in the Thuringian Forest, 8 miles south of Eisenach. Visitors are attracted by its natural surroundings, its mineral and other baths, and by its whey and cold-water "cures." It has a staple industry in the manufacture of pipes, cigarette-holders, &c., and iron wares. In the Middle Ages this place, locally known as Die Ruhl, was famous for its armourers, subsequently for its cutlers. Population (1900), 6581, of whom 3081 belonged to the Weimar part and 3500 to the Coburg-Gotha part.

Ruhrort, a town of Prussia, in the Rhine province. It stands on the Rhine, at the confluence of the Ruhr, 24 miles by rail north of Düsseldorf, and is the principal shipping port for the coal of the Westphalian coal-field, the harbour extending $4\frac{1}{2}$ miles along the river. In 1899 the port was entered and cleared by 13,951 vessels of 6,927,000 tons. Ruhrort has iron-puddling furnaces, dye-works, tanneries, and brickworks. Population (1885), 9866; (1900), 12,407.

Rukwa (sometimes also Rikwa and Hikwa), a shallow lake in German East Africa, lying in a north-western continuation of the rift valley which contains Lake Nyasa. The sides of the valley here run in steep parallel walls 30 to 40 miles apart, from south-east to north-west, leaving between them a level plain extending from about $7\frac{1}{2}°$ to $8\frac{1}{2}°$ S. This whole area was probably once covered by the lake, but this has shrunk, apparently within quite modern times, so that the permanent water occupies only a space of 30 miles by 12 at the south end immediately under the eastern escarpment. In the rains it extends some 40 miles farther north, and the north end of the plain is likewise then covered with water to a depth of about 4 feet. The rest of the plain is a bare expanse intensely heated by the sun in the dry season, and forming a tract of foul mud near the lake shores. The principal feeder of Rukwa is the Saisi, which traverses a winding valley cut out of the high plateau between Lakes Nyasa and Tanganyika. The maximum depth of the lake is about $10\frac{1}{2}$ feet. Its water is very brackish and of a milky colour, from the mud stirred up by the wind. It contains great quantities of fish. First seen from the north by Thomson in 1880, it has since been visited by many travellers, both British and German, including Johnston, Nutt, Wallace, Ramsay, Glauning, Fülleborn, and Kohlschütter.

See especially *Proc. R.G.S.*, December 1890; *Geographical Journal*, June 1899; *Mitteilungen aus den Deutschen Schutzgebieten*, 1899, No. 4; 1900, No. 1.

RUMANIA.

RUMANIA, a kingdom of the Balkan Peninsula, bounded by Russia on the north, the Danube on the south, Hungary on the west, and the Black Sea on the east (for details, see *History*, below).

Population.

The population in 1884 was 4,648,123, and in 1899, 5,912,520, this giving a density of 117 per square mile. The excess of births over deaths in the five years from 1894 to 1899 was 370,205; but the average annual excess during the last quarter of the 19th century was 43,609, which would in forty years indicate a natural increase of 1,744,360 in the population; the actual increase, however, according to the census returns, was over two millions, which would indicate that during that period some quarter of a million strangers settled in the country. Much of this increase is due to immigration of Jews from Galicia and Russia. Of the total population, 18·8 per cent. live in towns and 81·2 per cent. in the country; 50·7 per cent. are males and 49·3 per cent. females; 55 per cent. are unmarried, 38·6 per cent. married, 6·1 per cent. widows and widowers, and 0·3 per cent. divorced.

As regards nationality, there are Rumanians, 5,469,036; foreigners, 171,063; and nondescript (principally Jews), 272,241.

The following table shows the thirty-two administrative districts into which the country is divided, their respective populations in 1899, their area in square miles, and the number of inhabitants per mile. The Dobruja, which comprises the districts of Constantza and Tulcea, is less thickly populated than the rest of the country.

District.	Area in Square Miles.	Population, 1899.	Inhabitants per Square Mile.
Argesh	1,712	205,882	120
Bacau	1,533	192,963	125·9
Botoshani	1,215	170,455	140·1
Braila	1,682	147,006	89·5
Buzeu	1,877	220,439	117·5
Constantza	2,567	135,050	52·6
Covurlui (Galatz)	1,143	144,075	126
Dimbovitza	1,334	209,440	157
Dolj (Craiova)	2,532	364,193	143·8
Dorohoi	1,089	158,605	145·6
Falciu	852	93,317	109·5
Gorj	1,813	169,324	93·3
Ilfov (Bucharest)	2,231	545,706	244·6
Jalomitza	2,500	187,193	74·8
Jassy	1,205	191,828	159·1
Mehedintzi (Turn Severin)	1,910	247,223	129·4
Muscel	1,140	113,458	99·5
Neamtz (Piatra)	1,543	146,894	93·1
Olt	1,000	142,496	133
Prahova (Ploesti)	1,800	304,376	169
Putna (Focsani)	1,254	150,410	119·9
Ramnic-Sarat	1,262	136,467	108
Roman	807	108,704	134·7
Romanatzi	1,767	202,499	114·4
Suceava	1,319	129,687	98·2
Tecuciu	983	120,026	122·1
Teleorman	1,808	236,129	130·6
Tulcea	3,329	123,192	37
Tutova	923	115,786	125·4
Vaslui	884	109,356	123·7
Valcea	1,636	189,865	116
Vlashca (Giurgevo)	1,732	200,536	115·7
	50,472	5,912,520	117

The principal towns are Bucharest, with (1900) 282,071 inhabitants, of whom 43,274 are Jews; Jassy, 78,067, with 39,441 Jews; Galatz, 62,678, including 13,970 Jews; Braila, 58,392, with 10,811 Jews; Craiova, 45,438; Ploesti, 42,687; and Botosani, 32,193, of whom 16,660 are Jews.

Constitution and government.

The government of Rumania is a hereditary and constitutional monarchy. The constitution of 1866 was modified in 1879 and 1884. All citizens of full age, paying taxes, are divided into three electoral colleges, classed according to wealth, position, and education. The first and second colleges, and in the third college those who can read and write and have an income of £12 from land, vote directly, as also do the village priests and schoolmasters; but the residue of the third college vote indirectly, *i.e.*, every fifty indirect electors select a delegate, who votes along with the direct electors. The Senate is elected by the first two colleges only. The Senate, consisting of 120 members elected for eight years, includes the heir-apparent, eight bishops, and four members elected by the universities of Jassy and Bucharest. The Chamber of Deputies consists of 183 members, elected for four years. Both senators and deputies must possess certain qualifications, and are paid. The executive is vested in a council of eight ministers, the president of which is Prime Minister. The penalty of death has been abolished, except for military offences in time of war.

The Julian calendar is used in Rumania, which, since the year 1900, is 13 days behind the Gregorian, which latter is employed in the railways and in the administration of posts and telegraphs.

Administration.

For administrative purposes the country is divided into 32 districts (see *Population*), of which Wallachia contributes 17, Moldavia 13, and the Dobruja 2. Each district (*judete*) has at its head a prefect, who is assisted by an elected council. The districts are divided into subdistricts (*plasi*), administered by subprefects, and each of these contains a certain number of communes, governed by a communal council, who elect their mayor, subject to confirmation by the Government. There are mayors and municipalities in all the large towns, and very heavy *octroi* duties, which provide the means for municipal administration. Rumania is one of the most bureaucratic countries in the world, and spends annually half a million sterling, or more than one-fourth of its entire budget, on the *personnel* of the public services, exclusive of the army and the employés of the State railways.

Justice and crime.

The judicial department is entirely independent of the executive, and the judges are irremovable. The judicial hierarchy comprises, first, a High Court of Appeal (*cour de cassation*), at Bucharest; four Courts of Appeal, at Bucharest, Craiova, Galatz, and Jassy; courts of first instance in each district; subdistrict tribunals (justices of the peace); and communal tribunals, composed of the mayor and two assessors, who have jurisdiction in minor cases. There are also commercial tribunals in the large towns. Legislation is based on the Code Napoléon, and in all criminal cases the judges are assisted by a jury. On the whole, justice works well, although sometimes very dilatorily.

Crime is apparently on the decrease. In 1893 there were 4693 persons imprisoned for various misdemeanours, whilst in 1897 there were only 2573 admissions. The average number for the last thirty years of the 19th century was 3964. Out of a total of 40,249 prisoners that passed through the prisons during the last five years of that period, no less than 14,343 were sentenced for murder and murderous assaults. Of these prisoners, only 18,055 knew how to read; of 70,702 prisoners in the ordinary gaols, 13½ per cent. were illiterate. In addition to the ordinary prison institutions of civilized countries, there are workshops in the central prisons, where the men receive payment for their labour, of which, however, the State takes a percentage.

Religion.

As regards religion, the population of Rumania is divided (1900) as follows: Orthodox (Greek), 5,408,743; Catholics and Protestants, 168,276; Mahommedans, 43,470; Armenians, 6598; Jews, 269,015; others, 16,148. The Catholics are principally found in Bucharest and in the districts of Roman and Bacau; the Mahommedans almost exclusively in the Dobruja; and the Jews in Bucharest, Braila, Galatz, Jassy, and the districts of northern Moldavia. It is estimated that the Protestants number about 13,000. The Zingari or Gypsies, who formerly numbered about 200,000, are now mostly incorporated in the Orthodox community.

The number of Orthodox churches in Rumania is 6787, of which 218 are kept up by the State, 5909 by the communes, and 660 by private individuals and pious foundations. The Roman Catholics have two bishops, 63 churches, and 80 priests; the Protestants, 12 churches and 19 clergymen; the Armenians, 16 churches; the Jews, 305 synagogues; and the Mahommedans, 260 mosques.

The Rumanian Church is autocephalous, but holds the same dogmas as the Orthodox Greek Church. It is administered by a Holy Synod, composed of the bishops of the eight dioceses. Its president is the archbishop and metropolitan of Hungary-Wallachia, primate of Rumania; the other members are the archbishop and metropolitan of Moldavia (resident at Jassy), the bishops of Ramnicu-Valcea, of Roman, Buzeu, Husi, Curtea d'Argesh, and the Lower Danube (Galatz). There are also eight bishops *in partibus*, coadjutors of the above. The metropolitans and bishops are elected by the Senate and Chamber of Deputies sitting together *ad hoc*; the former must be selected from the bishops, and the latter from the bishops *in partibus*. These, in their turn, are selected by the Minister of Public Worship from lists prepared by the Synod. The clergy are divided into two classes, the "Kalugari" or monks, and the secular clergy, who marry before taking orders. The Kalugari only are eligible for the higher dignities of the Church. Monasteries abound. There are no less than 168 scattered throughout the country, principally in the mountainous districts, which shelter 1429 monks and 2709 sisters. Many monasteries have, however, ceased to be inhabited, and have become, since the confiscation of their property (owing to flagrant abuses) in 1864, simple churches, institutions, or even prisons. The monasteries of Moldavia and Wallachia differ materially from those of western Europe. They are, generally speaking, perched in inaccessible places and strongly fortified, and served in troublous times as harbours of refuge to the inhabitants, or as rallying points to demoralized troops. The property held by the monasteries prior to 1864 amounted to more than six million acres, the greater part of which has been utilized in the formation of a peasant proprietary (see *History*).

Education.

Primary education is compulsory and free from the age of 7 to 11, but only 17·3 per cent. of the population can read and write. In the urban districts, indeed, the proportion is 42 per cent., but in the rural it sinks as low as 11·5 per cent. Secondary education is provided for in the lycées and gymnasiums for boys, and in the secondary day-schools for girls, and higher education at the universities. Both secondary and higher education are given gratuitously. In 1900 for primary rural education there were 22 boys' schools, 22 girls' schools, and 3213 mixed schools, with 3261 masters and 817 mistresses, educating 220,410 scholars, of whom 185,094 were boys and 35,316 girls. These establishments cost the State about £200,000 per annum. For primary urban education there were 386 schools, with 605 masters and 728 mistresses, educating 46,834 boys and 31,029 girls, at a cost of about £170,000 per annum. The institutions for secondary education are shown below:—

Male.

	Professors.	Scholars.
13 Classical lycées	477	7322
19 ,, gymnasiums	356	4594
11 Real lycées and gymnasiums	190	1887
5 Clergy schools	95	644
7 Normal schools	124	680
	1242	15,127

Female.

	Professors.	Scholars.
16 Professional schools	140	1429
9 Secondary day-schools	155	1733
3 Normal schools	107	680
	402	3842

To the above figures should be added 1623 boys and 1952 girls who follow the secondary course of instruction in private institutions. The total cost of secondary education is about £240,000 per annum. There are also commercial schools, schools of arts and crafts, and a school of agriculture intended for preparation for university studies.

For higher education there are two universities, one at Bucharest (founded in 1864) and the other at Jassy, each having faculties of literature and philosophy, law, science, and medicine; at Bucharest there are, besides, faculties of theology and pharmacy. The University of Bucharest has 90 professors and 2141 students, of whom 79 are women. At Jassy there are 60 professors to 423 students.

The budget of the Minister of Public Instruction, which tripled during the period 1870–1900, amounted for 1902–03 to a fraction under one million sterling, or nearly one-eighth part of the total expenditure of the country. Of this sum £8000 only is covered by students' fees (for board). The higher education, however, has produced what has been aptly termed a "prolétariat intellectuel," containing hosts of candidates for official employment, and has formed "anarchical, demagogic, and revolutionary elements," which have been of no profit to the country. It is seriously proposed, while continuing to give free education in the primary schools, that pupils attending the secondary schools and the universities should pay at least some portion of the cost of their instruction, as is the case in other countries.

Finance.

The public debt, incurred between 1864 and 1900, amounted on the 1st April 1901 to £57,957,652. Almost the whole of the public debt has been contracted abroad, mostly in Germany. It is calculated that half the existing debt will be redeemed by 1930, but it may be noted that the interest on the debt has increased by nearly 1 million sterling since 1894. Although this debt is very large in comparison with the resources of the country, none of it is due, as in so many other countries, to actual war. Preparations for war and for national defence have, however, absorbed in all £10,640,000 of the public debt; some 6½ millions has gone to making good budget deficits, and smaller sums have been spent on various public objects other than public works, it being these last which have absorbed by far the largest portion of the debt—33½ millions sterling.

The following table shows the rapid and steady increase of revenue and expenditure between 1872 and 1896, arranged for purpose of comparison in periods of five years. The State, as a result of this somewhat prodigal expenditure for so small a country, owns and itself works the entire railway system, the docks and elevators at Galatz and Braila, and a small fleet of merchant steamers. It has also the entire monopoly for the sale of tobacco, salt, playing-cards, matches, gunpowder, and cigarette paper. In an almost purely agricultural country like Rumania, a bad harvest entails an extraordinary falling off in its general revenues. This was bitterly felt in the budgets for 1899–1900 and the following year, and in 1900 the Government had to raise a fresh loan of 7 millions sterling to meet the difficulties of the situation directly occasioned by the bad harvest. One of the conditions of the loan was that no further loan should be raised for a period of five years.

Years.	Revenue.	Expenditure.
	£	£
1872–76 . . .	17,517,956	17,588,576
1877–81 . . .	24,778,500	24,490,428
1882–86 . . .	26,332,424	26,486,188
1887–91 . . .	32,603,184	31,926,734
1892–96 . . .	31,975,940	32,100,780

The debit sides of two budgets, as given below, will show the nature and increase of public expenditure in the course of the 20 years 1880–1900:—

	1880–81.	1899–1900.
	£	£
Interest on public debt .	1,869,448	3,430,299
Ministry of War . .	991,555	1,837,213
,, of Public Instruction . .	415,424	1,138,748
,, Finance . .	459,008	1,096,847
,, Interior . .	368,490	742,099
,, Public Works .	312,133	227,283
,, Justice . .	168,549	267,930
State Domains . . .	...	285,580
Foreign Office . . .	58,735	71,866
Council of Ministers . .	1,210	2,852
Totals . .	4,644,552	9,100,717

The estimated expenditure for the year 1902–03 amounted to £8,740,000, of which the largest item—£3,457,000—was required for the interest on the debt, the Ministry of War claiming £1,500,000. The estimated revenue included £2,260,000 from indirect and £1,744,000 from direct taxation, and a little over 2 millions from State monopolies. Of the receipts from direct taxation, two-fifths are produced from the land tax, and the remainder, in nearly equal proportions, from road taxes, spirit licences, taxes on professions, and a tax of 5 per cent. on all salaries. Of the receipts from indirect taxation, customs produce about three-eighths, the tax on spirits and beer a somewhat smaller sum, the remainder being made up by stamps, registration fees, and taxes on sugar, petroleum, and vineyards. Among the State monopolies, the sale of tobacco produces £1,620,000; salt, £300,000; matches, £120,000; cigarette paper, £60,000; and the river transport service, £100,000.

Army.

Conscription is in force, and the annual contingent of all recruits numbers some 36,000 men. In time of peace the army consists of four complete army corps, with headquarters at Craiova, Bucharest, Jassy, and Galatz, with an independent division in the Dobrudja, and a separate cavalry division with headquarters at Bucharest. The infantry consists of thirty-five regiments, on partly a permanent and partly a non-permanent footing, and of six battalions of chasseurs (*venatori*). The cavalry is similarly constituted to the infantry. There are six regiments of hussars (*roshiori*) and eleven territorial (*calarashi*) regiments. The artillery is divided into twelve regiments, and consists of 52 field, 8 horse, and 1 mountain batteries in time of peace; in war there are twenty additional field batteries. There are also two regiments of fortress artillery, and well-organized ammunition columns. Of engineers there are two regiments. In time of peace the permanent embodied force consists of 59,000 officers and men (in addition to an equal number of non-permanent troops, who are called out for short periods only), 11,359 horses, and 390 guns. The war footing of the active army is: infantry, 130,341 officers and men; cavalry, 14,297, with 13,044 horses; field artillery (including ammunition columns), 19,432 officers and men, 19,242 horses, and 494 guns; fortress artillery, 4000 officers and men; various (marines, engineers, pontoon train), 20,760 officers and men and 12,000 horses—total, 189,780 officers and men, 44,286 horses, and 494 guns. It is estimated that the militia should finally furnish an additional force of 100,000 men, but up to 1900 this branch of the service was not completely organized. The arrangements for mobilization are very complete, and the army is maintained in a high state of efficiency. The ordinary war budget for 1898–99 was £1,815,213, in addition to £800,000 voted for extraordinary expenditure. Rumania possesses an extensive, elaborate, and very costly system of defensive works, designed by the famous Belgian engineer General Brialmont, and completed at a cost (including armaments) of more than four millions sterling. The Sereth line, commenced in 1889, extends over a front of 45 miles, from Galatz to Focsani, and is intended to cover an army defending the country from a Russian invasion. The Bucharest fortifications (commenced 1885), consisting of 18 detached forts, with the same number of intermediate batteries, lie around the city on a circle of about 7 miles radius.

The navy is insignificant. Among the 19 small vessels, manned by 113 officers and 1993 men, are, however, 6 first-class torpedo boats.

Production and Industry: minerals.

The chief mineral wealth consists of petroleum and salt. Petroleum exists in large quantities in Rumania. From Turn Severin, on its western border, the petroleum zone can be traced at the foot of the Carpathian Mountains, skirting them in their course through the country towards Bukovina and Galicia on the north-east. Along the whole length of the zone mentioned may be seen primitive workings in the shape of comparatively shallow hand-dug wells. From 1873 the industry fell off considerably, probably on account of the American oil-field discoveries. In 1895 modifications were introduced into the mining laws, and a new stimulus given to the industry that had gradually been reviving, and from that date we find an ever-increasing development. It is claimed for Rumanian petroleum that the raw product contains 14, 15, and 23 per cent. more pure oil than American, Galician, and Caucasian oils respectively. In July 1898 there were in the four principal petroliferous districts:—

	Borings.		Hand Wells.	
	Productive.	Non-Productive or being Bored.	Productive.	Non-Productive or being Dug.
Dimbovitza .	...	...	115	40
Prahova . .	42	45	400	450
Buzeu . .	4	10	90	10
Bacau . .	40	8	340	120
Totals . .	86	63	945	620

The production in these same districts which in 1895 only reached 14,600 tons, amounted in 1897–98 to 134,180 tons, of which 93,382 tons were refined in the country—19,511 tons were exported, and 21,291 tons of residue were employed as combustibles. In the last year of the century the output amounted to 224,760 tons, of which 75,879 tons were exported.

The rock-salt strata are of large extent, reaching from the district of Suceava, in northern Moldavia, to the district of Gorj, in Wallachia, and attain a thickness in some places of 1000 feet. The production since 1875 has been :—

	Production.	Export.
1875 . . .	70,283 tons.	...
1880 . . .	73,410 ,,	...
1885 . . .	83,340 ,,	23,612 tons.
1890 . . .	107,971 ,,	34,113 ,,
1895 . . .	98,807 ,,	39,290 ,,
1898 . . .	112,650 ,,	36,045 ,,

The export is practically confined to Bulgaria, Servia, and Russia There is no doubt very varied and considerable undeveloped mineral wealth in the country, but it was long before any serious attention was paid to it. The Mining Law of 1895 has, however, been the means of attracting foreign capital and foreign specialists, and it may be confidently expected that at some no very distant period the wealth now produced above ground by agriculture, forests, vineyards, pasture, flocks, and herds will be largely supplemented by underground riches.

The total superficies is 32,302,080 acres, subdivided as follows: —40·82 per cent. is arable land, 25·76 per cent. is waste, 19·73 per cent. forest, 7·92 per cent. natural pasture, 4·28 per cent. artificial pasture, 1·06 per cent. vineyards, and 0·43 per cent. plum orchards.

Agriculture.

The accompanying table gives the mean annual area under cultivation, the produce per acre, and the total amount of the principal grain crops produced, calculated from the returns of five years, from 1894 to 1898; also the out-turn of 1899, when, owing to drought, there was almost a complete failure of the crops :—

	Surface sown. Acres.	Yield in Bushels per Acre.	Total Yield in Bushels.	Total Yield, 1899. Bushels.
Wheat .	3,618,846	15·12	54,718,403	25,258,475
Rye . .	505,605	15·81	8,073,100	1,926,925
Barley .	1,495,257	15·89	23,638,985	4,402,475
Oats . .	690,762	17·36	12,092,680	6,062,100
Maize .	4,708,282	14·34	67,534,499	26,873,893
Rapeseed .	108,241	11·56	1,299,655	440,825
Linseed .	67,161	8·69	585,055	33,275
Millet .	191,800	8·36	1,604,658	1,641,686
Beans .	308,059	9·95	3,067,754	224,069

Roughly speaking, about one-half of the cereals produced is employed in home consumption, whilst the other half is exported to foreign countries.

The vineyards have not been spared by the phylloxera, which made its first appearance in 1882, and developed seriously in 1884; but they are recovering from its effects, and the acreage under vines has risen from 126,000 acres in 1865 to 343,800 acres in 1898. The wines produced in the mountainous and hilly districts are greatly superior to those of the plains: they contain more alcohol and less tannin, and although slightly more acid, have a superior flavour. The best known vineyards are those of Cotnar and Socala (near Jassy), for white wines; Nicoreshti (Tecuciu), Odobeshti (Putna), Dealu Mare, Drancea, and Dragashani, which mostly produce red wines. The grape harvest varies enormously in different years. In 1865 the acreage under vine cultivation was only 236,910 acres, yielding 14,080,300 gallons; the production has now risen to 99,000,000 gallons.

In 1897 horses numbered 670,909; donkeys, 5214; mules, 247; horned cattle, 2,138,315; sheep, 6,847,825; goats, 286,876; and swine, 1,079,322. Of the three divisions, Wallachia, Moldavia, and Dobruja, the first is by far the most prolific of live stock, particularly sheep. Comparing these figures with similar returns of 1890, it appears that in seven years the number of horses has increased 11 per cent.; sheep and goats, 37 per cent.; swine, 14 per cent.; and that the number of horned cattle has fallen off 18 per cent.

Rumania is very rich in forests, which cover over 5,000,000 acres, or more than one-sixth of the country. Two-fifths are the property of the State; about one-half belongs to private individuals, and the remainder to private establishments and the Crown domains. The net profit derived by the State in the year 1898–99 was about £100,000, *i.e.*, about one shilling per acre. In the Crown domains forest schools have been established for the more scientific working of the forests, and it is to be hoped with more profit to the State.

About 139,000 acres are under plums, the produce of which is chiefly employed in the manufacture of *tzuica*, an ardent spirit much in vogue among the peasantry, the consumption of which is very considerable on the numerous ritual holidays of the Greek Church. The annual out-turn of this spirit is about 10,248,480 gallons, and in 1892 32,000 gallons were exported.

Fisheries.

The fisheries extend over a vast area, comprising the whole of the delta of the Danube between the Kilia and St George branches of the river, as well as the Danube itself and adjoining lakes, and the Black Sea littoral. The Government in 1895 introduced a close time, besides other measures, for the preservation of the fish. Since then the fishing industry has revived. The import of fish rose from 5981 tons in 1894 to 7583 tons in 1895, but by 1898 had dropped to 4238 tons. The export of fish rose steadily from 1315 tons in 1894 to 5562 tons in 1898. The fish exported consist principally of salted sturgeon (found in the vicinity of the Danube mouths, especially at that of St George, from which large quantities of excellent caviare are extracted), sterlet, and carp. The revenue from the State fisheries amounts to about £100,000 annually. More than half of the fish exported goes to Austria-Hungary.

Manufactures.

Up to the passing of a law in 1887 for encouraging national industries, Rumania was essentially a non-manufacturing country, but since that date much progress has been made. The law provided that any one undertaking to found an industrial establishment with a capital of at least £2000, or employing at least 25 workmen (of whom two-thirds should be Rumanians), should be admitted to certain substantial benefits, including the grant of about 12 acres of State land, exemption for a term of years from all direct taxes, freedom from customs dues for machinery and raw material imported, exemption from road taxes, reduction in cost of carriage of materials on the State railways, and preferential rights to the supply of manufactured articles to the State. Up to the end of February 1891 the number of firms which had been admitted to the benefit of this law was 84, with a total capital of about one million sterling. By the end of the century factories had increased to 178, and the capital invested to close upon three millions sterling.

Among the principal industrial establishments of Rumania are flour-mills, of which there are (1900) 7500 small local mills, besides 86 mechanical mills, of which 20 are large establishments (capital invested, £640,000), with a collective output of 2200 tons a day.

There are 43 large distilleries, each employing over 200 hands, besides many small stills. In 1898–99 the output of the 19 breweries in the country was 2½ million gallons.

The introduction in 1895 of the system of Government bounties caused a great development in the production of sugar, and there were in 1900 six large factories at work. More than half a million sterling has been invested in this industry. In 1892, 2500 acres only were under beetroot cultivation. In 1900 the area had increased to 30,720 acres.

There are 3 meat-preserving and 3 vegetable-preserving factories, 7 starch, paste, and biscuit factories, cement and lime factories, brick and basalt works, mechanical joinery works, 5 large glass factories, and 5 paper and 3 cardboard mills.

The production of chemicals and by-products has increased from 3000 tons in 1886 to 11,700 in 1898, while in the same interval the out-turn of vegetable oils has increased from 1900 to 3015 tons.

Rumania now possesses 7 iron foundries, besides factories for machines and various kinds of iron-work.

There has been considerable development of the textile industries, while domestic industry is still widespread. Tanning and leather-work is also growing in importance; but the wood industries are the most important of all branches of industry, and give employment to thousands of hands. There are 42 large saw-mills, turning out annually 25,000 waggons, jointly worth £600,000; much of which, mostly deal planking, finds its way by sea to Rotterdam and up the Rhine.

Commerce.

The great bulk of the exports consists of cereals; but other important articles are animal products (wool, hides, &c.), timber, salt, wine, and brandy (made principally from cereals and plums), and of late years there has been a rapid development of the production and export of flour and petroleum.

The following table shows the value of the import and export trade of Rumania since 1876 :—

Year.	Imports.	Exports.
	£	£
1876 . . .	6,637,340	9,410,250
1886 . . .	11,759,892	10,221,888
1896 . . .	13,516,916	12,962,266
1898 . . .	15,596,337	11,327,262
1900 . . .	8,463,439	11,200,017

The principal imports are textile goods, metals, and metal-work, such as railway material and agricultural machinery, coal, &c. The following table shows the value of the principal articles exported and imported in the years 1887, 1897; the latter year may be considered as a good average year both for exports and imports:—

	Thousands of Pounds Sterling.	
	1887.	1897.
Exports.		
Farinaceous products and their derivatives	8560	7200
Fruits, vegetables, and other plants	240	588
Animal products	104	160
Textiles	192	100
Timber	164	264
Live animals	232	92
Mineral combustibles, &c.	64	88
Hides and leather	104	60
Wine and alcohol	660	104
Metals and metal-work	84	72
Dyes, tannins, colours, &c.	4	4
Carriages, carts, &c.	4	...
Paper, cardboard, &c.	8	4
Imports.		
Farinaceous products and their derivatives	120	200
Animal products	160	220
Textiles	5520	6000
Timber	240	228
Live animals	16	108
Mineral combustibles	160	400
Hides and leather goods	720	640
Metals and metal-work	2120	2960
Dyes, tannins, colours, &c.	120	280
Carriages, carts, &c.	412	64
Paper, cardboard, &c.	480	240
Colonial products and fruits	1040	840
Minerals, glass-ware, &c.	640	300
Oils, fats, wax, &c.	200	280
Chemicals, &c.	120	220
Indiarubber, guttapercha	80	120
Preserves and confectionery	64	132

The following table shows the relative values of Rumanian trade with foreign countries, in percentages of the total value, which is also given, in the years 1889 and 1898:—

Country.	1889.	1898.
Imports from		
United Kingdom	27·80	19·55
Austria-Hungary	13·42	27·97
Germany	29·42	28·55
France	8·92	6·62
Belgium	5·25	3·62
Other countries	15·19	13·69
Total value	£14,717,763	£15,596,337
Exports to		
United Kingdom	52·89	15·33
Belgium	13·31	32·32
Austria-Hungary	5·54	30·22
Italy	8·44	7·08
Turkey	2·18	3·60
Germany	5·31	3·20
France	4·37	2·25
Other countries	7·96	5·00
Total value	£10,966,685	£11,327,262

The value of the trade between Great Britain and Rumania has varied greatly: in 1881 the value of the imports from Great Britain was £2,020,330; in 1889, £4,084,444; in 1895, £2,359,359; in 1899, £2,401,662. The exports to Great Britain amounted in 1881 to £3,289,082; 1889, £5,622,040; 1890, £6,455,420; 1895, £3,014,520; 1898, £1,498,364, but only £422,751 in 1899. The principal imports from Great Britain are tissues and textiles, coal and coke, machinery and metal goods.

Exports of cereals from Rumanian Danube ports through Sulina have been as follow in quinquennial periods 1875–99:—

	1875.	1880.	1885.	1890.	1895.	1899.
	Quarters.	Quarters.	Quarters.	Quarters.	Quarters.	Quarters.
Wheat	1,339,682	1,286,253	1,333,234	4,565,364	5,685,740	970,479
Barley	745,792	1,219,405	1,141,450	1,210,197	1,528,899	546,735
Oats	33,770	117,216	266,592	55,357	84,746	204,861
Rye	123,705	270,049	508,141	465,879	1,388,169	343,394
Maize	934,586	1,215,416	2,378,140	3,542,985	1,613,021	3,974,874
Totals*	3,257,475	4,251,331	5,902,157	10,402,023	10,806,758	6,224,150
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Flour	8090	10,239	10,494	9007	23,588	22,252

* Including other cereals not specified.

Shipping. By the Berlin Congress of 1878 and a special conference of 1883 the Danube is regarded as an international waterway from its mouth to the Iron Gates, and the interests of the several countries are specially provided for. In 1898, 1419 vessels of 1,476,119 tons cleared from Sulina, 446 of 694,773 tons being British; 190 of 174,607 tons, Greek; 126 of 156,150 tons, Austro-Hungarian; 72 of 87,583 tons, Italian; 224 of 62,455 tons, Turkish; 133 of 59,989 tons, Russian; 43 of 43,263 tons, Rumanian; 33 of 41,593 tons, French; and 25 of 30,205 tons, German. Further information about the navigation of the Danube will be found under that head.

Communications. *Railways.*—The first railway line between Bucharest and Giurgevo, a distance of 45 English miles, was constructed in 1866–69. By 1874, 636 miles were open; by 1884, 994 miles; and by 1899, 1932 miles. As will be noticed under *Finance*, the entire railway system is owned by the State. The total amount actually expended on railways has been £28,705,082, including the construction of the bridge over the Danube at Cernavoda, which cost £1,375,480. The total revenue from the railways amounted in 1898 to £2,170,056, the working expenses £1,545,345. The railways give employment to 6559 permanent officials, and to 13,570 plate-layers, navvies, &c. The number of passengers carried by rail in 1898 was 5,779,090, while the merchandise carried amounted to 47,786,888 tons.

The railway system consists of a main central line carried from Suceava, on the frontier of the Austrian province of the Bukovina, and passing south through the whole length of Moldavia, and west through Wallachia to the Austrian frontier at Verciorova, with branch lines extending on the one side up the lateral valleys of the Carpathians, and on the other to Jassy, Galatz, and other large towns on the Danube. Jassy and Galatz are also connected by a direct line. Besides the above-mentioned points of junction, the Rumanian system is connected with that of Hungary at Predeal and at Palanka, with the Russian system at Ungheni, and with the Bulgarian at Rustchuk by a steam ferry. Another line through the Dobruja connects the Rumanian system (by means of a magnificent bridge over the Danube at Cernavoda) with the rising port of Constantza (formerly Kustenji) on the Black Sea, where extensive harbour works are now in progress.

Roads.—There are roads throughout the country of varying degrees of quality, and aggregating about 12,000 miles in length. In 1897–98 £170,000 was spent in repairs to roads and bridges.

Rivers and Canals.—The Danube is navigable for vessels drawing 9 feet of water, from the Iron Gates above Turn Severin down to Braila, and from thence to the sea at Sulina for vessels drawing from 18 to 20 feet (see DANUBE). Rumania possesses no canals, but rafts of timber are brought down many of the streams which rise in the Carpathians and fall into the Danube; and the Pruth is navigable for vessels of light draught for a distance of some 300 miles from where it enters the Danube at Reni.

Post and telegraphs. Since 1890 there has been a very large development in the telegraphic and telephonic system of Rumania. The length of telegraph wire is about 4000 miles. The following figures speak for themselves:—

	Number.	
	1888–89.	1897–98.
Staff	1,474	6,245
Letter-boxes	812	4,550
Letters	12,772,976	18,498,355
Postcards	3,436,453	11,386,586
Printed matter and papers	4,907,377	29,873,428
Telegrams, inland, presented (private)	870,313	1,473,701
Telegrams (official)	105,862	147,349
" presented (foreign)	176,870	284,002
" received	136,311	253,434

Banking and credit. The principal bank, the Banque Nationale, founded in 1880 with a paid-up capital of 12 million francs (£480,000), has its headquarters at Bucharest, and branches in all the principal towns; it has the right to issue notes, repayable at sight and in gold. The reserve fund in 1890 stood at £460,000, the net profits for the same year amounted to £165,520, and the notes in circulation to £6,440,000, or rather more than double the metallic stock. Other Bucharest banks are the Banque de Roumanie, founded in 1884 with a paid-up capital of 7½ million francs (£300,000); the Banque Génerale Roumaine (1897), capital, 12 million francs (£480,000); the Crédit Belgo Roumain, capital, 5 million francs (£200,000); and the Banque d'Escompte, also with a capital of 5 million francs; Marmorosch, Blank, and Company, capital, 5 million francs; and other private banks. The Crédit Foncier Rural was founded in 1873, with the object of advancing money on mortgage of land. Since its foundation 4½ million acres of land have been hypothecated to it against advances of more than 12 millions sterling, provided by the issue of "lettres de gage" at 5 per cent. and 4 per cent., of which 10 millions were in circulation in 1897. Similar institutions exist for urban property in the cities of Bucharest and Jassy. In the former, in 1890, advances to the extent of 5½ millions sterling had been made on the security of house property. The Banque Agricole, founded by the State in 1894, with a capital of £500,000, for the purpose of advancing money on loan to small proprietors on the security of cattle, crops, wine, and other agricultural produce, does a large and profitable business, and is of great assistance to the poorer agricultural classes, besides returning a considerable revenue to the State. Government savings banks also exist in all the principal towns. On the 10th September 1898 the deposits amounted to 1¼ million sterling, furnished by 105,000 holders.

Recent History.

The present kingdom of Rumania consisted in the middle of the 19th century of two separate provinces, Wallachia and Moldavia, placed under the suzerainty of Turkey and the protectorate of Russia. It was autonomous in name, but its princes or hospodars were merely governors of provinces, acting under the orders of subordinate officials of the suzerain and protecting powers. The military occupation of the principalities by Russia immediately preceded the Crimean war, one of the principal results of which was the decision, under the Treaty of Paris, that the two countries, with their existing privileges, were placed under the collective guarantee of the Great Powers, still remaining, however, under the suzerainty of the Porte. Under the same treaty that portion of Bessarabia lying on the left bank of the Pruth and to the north of the Danube was restored to Moldavia, from which it had been taken by Russia in 1812. It was further decided to maintain the separate existence of the two principalities, but their inhabitants ardently desired a complete union, and in order to effect this Colonel Alexander Couza was in 1859 simultaneously elected prince of both Moldavia and Wallachia. In 1861 the union of the principalities was recognized by the Powers for the lifetime of Prince Couza, with a common ministry and a common assembly. The prince, by his ultra-democratic and despotic measures, succeeded in alienating the sympathy of all classes, of the clergy by the confiscation of the enormous landed property belonging to the Rumanian monasteries (whose revenues, however, principally went to feed the parent monasteries of Mount Athos); of the boyards by the abolition of the feudal obligations of the peasantry and the establishment of a class of peasant proprietors; and, finally, by the introduction of a tobacco monopoly he estranged the sympathy of the masses. His own dissolute conduct increased his unpopularity, and at last the leading statesmen in both provinces, who had long been of opinion that the welfare of the country could only be secured by having a foreign prince to rule over it, conspired to dethrone the prince, and in February 1866 he was compelled to abdicate. The same day a council of regency was formed, composed of General N. Golesco, Colonel N. Haralamba, and Lascar Catargi, with Prince John Ghika as head of the ministry. The count of Flanders, brother of the king of the Belgians, was proclaimed hospodar of the united provinces, but declined the proffered honour.

Meanwhile a conference of the Powers assembled at Paris to consider the situation, and decided by a majority of four to three that the new hospodar should be a native of the country. While the conference was discussing, the principalities were acting, and had resolved not to be baulked of their foreign prince. The choice of the country, by a happy inspiration, fell on Prince Charles of Hohenzollern: an appeal was made to a plebiscitum, and 685,969 electors voted in his favour, with only 224 dissentients. Prince Charles was the second son of the late Prince Charles Antony of Hohenzollern-Sigmaringen (famous for having from patriotic motives, and in the interest of German unity, voluntarily surrendered his principality to be merged into the kingdom of Prussia), and a cadet of the Catholic branch of the imperial family of Germany. Prince Charles was an officer in the Prussian army, 27 years of age, and was also related to the French imperial family: his nomination not only obtained the tacit consent and approval of his friend and kinsman King William of Prussia, but also the warm and more open support of Napoleon III. **Prince Charles.** The young prince was in a position of great difficulty. The king of Prussia, through his plenipotentiary at Paris, had agreed to the resolution of the conference that the hospodar to be elected should be a native of the principalities, and could not therefore openly approve of Prince Charles's election. The prince meanwhile received a telegram from Bucharest stating that five millions of Rumanians had proclaimed him their sovereign. The genius of Count Bismarck came to his aid, and acting on that statesman's advice, the prince determined to confront the Powers with a *fait accompli*. He asked for a short leave of absence, resigned his commission in the Prussian army on crossing the frontier, and hastened secretly to Rumania, under a feigned name and with a false passport; descended the Danube in an Austrian steamer, and surreptitiously landed on Rumanian soil on the 20th May at Turn Severin, where he was enthusiastically welcomed as soon as his incognito was thrown off. Travelling thence by post, the prince reached Bucharest on the 22nd May, and on the same day, in the presence of the provisional government, the deputies, the judges, and all the high officials, solemnly took the oaths to respect the laws of the country, to maintain its rights and the integrity of its territory. From that date to the present day the modern history of Rumania is indissolubly connected with its distinguished ruler, Prince Charles of Hohenzollern, afterwards King Charles I., one of the wisest and best of European sovereigns.

The *coup* suggested by Bismarck succeeded, thanks to the tact and energy of the young prince, whose first step was to commence the reorganization of the army, and to make preparations for resisting a menaced Turkish invasion, while at the same time carrying on negotiations with the Porte with the view of peaceably obtaining the recognition of his position by the sultan and the European Powers. After lengthy and complicated discussions, this object was attained, and in October the prince proceeded to Constantinople to pay his respects to his suzerain the sultan. His reception there was cordial, and he received from his majesty the firman of investiture. The principle of hereditary succession in the prince's family was agreed to, and also the right of the prince to maintain an army of 30,000 men. On the other hand, Rumania was to form an integral part of the Ottoman empire, within the limits fixed by the capitulations and the Treaty of Paris. The first Rumanian ministry formed under the new régime was composed of the leading statesmen of the country, of all political parties, care being also taken that the two provinces should be equally represented. Thus Moldavia contributed the Conservative, Lascar Catargi, the president of the council and minister of the interior; Pierre Mavrogheni, the minister of finance, also a Conservative; Prince John Ghika (Moderate Right),

minister of war; and Demetrius Stourdza (Centre), minister of public works. Wallachia, on the other hand, was represented by John Bratiano (Liberal) as minister of finance; C. A. Rosetti (Extreme Left), minister of worship; and John Cantacuzene (Centre), justice. Most of these have subsequently taken a prominent part in public affairs. Catargi died in 1899. The first business of the Assembly was the preparation of a new constitution, which was unanimously passed by the Chamber on 11th July, and on the following day the prince solemnly took the oath to maintain it. It provided for an Upper and Lower House of Representatives, and conferred on the prince the right of an absolute and unconditional veto on all measures passed by the Chambers. A few days after the proclamation of the constitution dissensions arose in the ministry. Bratiano and Rosetti could not work in harmony with the Conservative Catargi; the latter resigned, and Prince John Ghika was called on by Prince Charles to form a new ministry. The first Parliament elected under the new régime met on 27th November, but the Government of Prince Ghika could not command a majority in either house. The position was difficult in the extreme: the finances of the country were in a deplorable condition, there was an empty treasury, and the floating debt amounted to seven millions sterling; maladministration was rampant in every department of the state; the national guard were mutinous and out of hand, while the small army of regulars was badly organized and inefficient. The existence of famine and cholera added materially to the difficulties of the Government, and in March 1867 the Lower House, by a majority of three, passed the laconic resolution, "The Chamber inflicts a vote of blame on the Government." As the result of this vote M. Kretzulesco, a Moderate Conservative, was called to the head of affairs, and J. Bratiano entered the Government as minister of the interior.[1] The new ministry, of which Bratiano was the leading spirit, showed considerable energy: a concession was granted for the construction of the first Rumanian railway, viz., from Bucharest to Giurgevo on the Danube. The active army was raised to 20,000, with a reserve of 10,000 men, and a militia was formed 30,000 strong. It was further decreed that every able-bodied Rumanian between the ages of 20 and 40 was liable to serve in the army or in the landsturm, which was to consist of an additional force of 50,000 men.

Amongst other measures which were not so judicious was a decree ostensibly directed against vagabond foreigners, but in reality against the Jews, although it provided for the expulsion of all persons who were without proper means of subsistence. Large numbers of Jews were expelled from Jassy, Bacau, and other parts of northern Moldavia, and many respected proprietors and men of business were exiled and imprisoned under pretence of carrying out the new law. These harsh and unjustifiable measures created great excitement and indignation, especially in France and England, and the Emperor Napoleon wrote personally to Prince Charles, protesting against this persecution and against the minister who had caused it. The venerable Sir Moses Montefiore himself proceeded to Bucharest to interfere on behalf of his co-religionists. The country could not afford to lose the goodwill of the emperor of the French, at that time one of the most powerful factors in Europe, and in July Bratiano, although immensely popular in Rumania, found it necessary to resign office, and with him fell the rest of the cabinet.

Jewish question.

[The Jewish question has always been a thorn in the side of Rumania. When the new constitution was drawn up in 1866, one of its original provisions was that "religious belief shall be no obstacle to naturalization in Rumania." This excited so much indignation in the country that serious rioting took place at Bucharest, and the synagogue recently erected there was burned to the ground (though subsequently rebuilt at the expense of Prince Charles). The obnoxious proposition was withdrawn, and the following article was substituted, "Only Christians can become citizens of Rumania." The bitter feeling against the Jews in Rumania is not so much due to religious fanaticism as to personal interest, and to the not ungrounded fear that if given political and other rights they will gradually possess themselves of the whole soil and oust the original proprietors of the country. In many towns in northern Moldavia the Jews are in a majority, and their total numbers in the united provinces are about 300,000, *i.e.*, about $\frac{1}{18}$th of the entire population, a larger ratio than exists in any other country in the world. In most places they have the monopoly of the wine and spirit shops, and retail trade generally; and as they are always willing, like most of their race, to advance money on usury, and, moreover, are more intelligent and better educated than the ordinary peasant, there is little doubt that in a country where the large landowners are proverbially extravagant and reckless, and the peasant proprietors poor and needy, the soil would soon fall into the hands of the Jews were it not for the stringent laws which prevent all foreigners (including therein all non-naturalized Jews) from owning land outside the towns. When in addition it is considered that the Moldavian Jews, who are mostly of Polish and Russian origin, speak a foreign language, wear a distinguishing dress, and keep themselves aloof from their neighbours, the antipathy in which they are held by the Rumanians generally may be understood, although perhaps not justified. The fact, however, that no attempt has ever been made to interfere with their religion, or religious practices and customs, is a proof that this antagonism has nothing to do with religious fanaticism.

National question.

Another difficulty for Prince Charles's Government came to the front at this period, which, like the Jewish question, has been and still is a constant source of anxiety to Rumanian politicians—the so-called "national question." Outside the limits of the united provinces of Moldavia and Wallachia, now forming the kingdom of Rumania, exist more than four million people of Rumanian race, speaking the Rumanian language; of these one and a quarter million inhabit the Hungarian province of Transylvania, where they form a large majority of the population. A still larger number are to be found in the Banat and other districts west and north of Transylvania. Some 230,000 inhabit the Austrian province of Bukovina, and close upon one million are in Russian Bessarabia; they are also numerous in Servia, while some 500,000 are scattered over the European provinces of Turkey under the name of Koutzo-Vlacks. Now, these Rumanians, especially those living in the south-eastern provinces of Hungary, have always been jealous in maintaining their language, religion, and customs against encroachments from without. A Rumanian printing press was established at Brasso (Kronstadt) in 1533. In the 17th century the ancient Slave language of their religious books was replaced by Rumanian, and the inhabitants of Moldavia and Wallachia were chiefly indebted for their earlier civilization to the efforts of their compatriots in the north of the Carpathians. As early as 1791 two Rumanian bishops of Transylvania submitted to the emperor of Austria a list of grievances to which their people were subjected, and petitioned that they might receive equal administrative rights with their neighbours the Magyars, the Slaves, and the Saxons. In 1848, when the Hungarians revolted under Kossuth, and were crushed by the united forces of Austria and Russia, the Rumanians of Transylvania took an active part against their Magyar oppressors, and committed many atrocities, after which Hungary and Transylvania came under the direct, absolute, and reactionary rule of Austria. As long as this lasted the Rumanians had comparative peace, for at least they were treated no worse than the Magyars and other races: a metropolitan and two bishops were appointed, Rumanians of mark sat in the Transylvanian Diet, and the people were fairly content. But in 1867, when the federation and centralization of the Austrian empire came to an end, and was replaced by the Dual Monarchy, Transylvania again came under direct Hungarian rule, and later on was deprived of its autonomy. Ever since then the Hungarians have done their best to Magyarize the Rumanians, Saxons, and other constituent races of the kingdom. Whilst Austrian policy has been directed towards decentralization and the bestowal of a reasonable amount of independence on its various constituent nationalities, the policy of the Hungarian monarchy has been exactly the reverse. But the formation of a strong Rumanian principality in 1866 naturally encouraged the Rumanians to the north of the Carpathians in their endeavour to resist all attempts at Magyarization, and although no Irredentist movement has openly taken place, there is no doubt that secret hopes exist among large numbers on both sides of the Carpathians that at some future time the whole of the Rumanian people may be united in one common kingdom. As early as 1867 the Emperor Napoleon wrote to Prince Charles, warning him that his Government had nothing to gain by protecting the propaganda which was being undertaken in favour of a more intimate connexion with the Rumanian co-religionists of Transylvania. This was, no doubt, an allusion to the foundation at Bucharest of a "Transylvanian Society," which within a year of its foundation (1867) had 1200 adherents. Its policy was not to confine itself to the development of the culture of the Rumanians of "Central Dacia," but was also to give it a national and Latin direction, instead of the so-called Gothic and Scythian. The Hungarians maintain that the Rumanians have not much to complain of. Their Church is recognized, their bishops have seats in the National Assembly and are paid out of State funds. They are also allowed their schools, their associations, their literary societies, and their newspapers. They have the electoral franchise, and from their numbers they might, it is said, be represented by seventy deputies in the Chamber at Budapest; but the influence of the landed classes (mostly Magyars), the electoral qualifications, the arrangements of the districts, and, above all, the unfair and active interference of the Magyar officials, make it impossible for the Rumanians to obtain a fair share of representation. In 1892

[1] Under the new Government the Chambers passed a resolution conferring the honorary citizenship of Rumania on W. E. Gladstone and J. A. Roebuck, as well as on the Frenchmen Michelet and Quinet, in recognition of their efforts on behalf of the Balkan States.

they had only one deputy in the Assembly, and in that same year the Rumanians decided in future to take no part whatsoever in the elections, so that two and a half millions of people are now without a representative. Although the Rumanian communes in Hungary possess more than 2000 elementary schools, receiving no State aid, the study of the Magyar language is compulsory, and in the more advanced schools and colleges which are assisted by State funds the professors are nearly all Magyar. These schools are attended by a very small number of Rumanian students, and constitute a powerful agency for the Magyarization of the country. In 1872, 1881, 1884, 1887, and 1890 manifestoes were issued by the national party demanding autonomy, the recognition of Rumanian as the official language, universal suffrage, State subsidies for schools, &c.; and in 1892 large numbers of citizens went to Vienna to present a memorandum to the emperor, protesting against the Magyar Government and demanding separation. This step naturally excited indignation and reprisals, the more so as the Ligue Roumaine of Bucharest agitated in favour of the petitioners, who on their return to their homes in Transylvania were prosecuted and imprisoned for treason. The same fate befell several editors of national newspapers. Another result of the increased bitterness caused by this agitation was a decree of the Hungarian Government substituting Magyar names for the existing Rumanian names of districts, towns, villages, and even rivers. Nevertheless the Rumanian element continues to increase, owing mainly, it is said, to the influence of the Rumanian women, who, when married to Magyar husbands, bring up their families as Rumanians and not as Magyars.

It may well be supposed that this national question often caused very great friction between the Austro-Hungarian monarchy and the neighbouring state of Rumania, the more so as in the latter country it has been made a great party question. The national movement has found its chief support in the National Liberal party, but, whichever party is in power at Bucharest, it has to temporize in order to maintain friendly relations with the Austro-Hungarian empire on the one hand and to avoid running counter to public opinion on the other. Thus, every administration when in power is attacked by the Opposition for not giving adequate support to the national cause. M. Demetrius Stourdza, who when in Opposition was prominent in his denunciation of Magyar misrule, had when taking office in 1894 to issue a sort of manifesto explaining away his previous utterances. The question of a State subvention to the church at Brasso, which owns large properties in Rumania, has thus given rise to most heated debates in the Rumanian Parliament, as well as to very delicate negotiations with the Austro-Hungarian Government. A study of an ethnographical map shows a population of some nine millions of Rumanians forming an almost compact circular mass, of which the middle Carpathians form the centre; two-thirds of it form the kingdom of Rumania, and in spite of the present efforts to Magyarize the remaining third, it is by no means impossible that at some not very far distant period the whole may be united in one common nation.]

Kretzulesco's ministry was followed by that of Etienne Golesco. John Bratiano, however, went to Paris, where he succeeded in conciliating the French emperor, and shortly after his return he again entered the Government as minister of finance; but no ministry could reckon on a majority in the Chambers: in February various factions combined to defeat it, but the new majority was divided into three sections, and in November the prince decided to use his prerogative, and dissolved both Chambers. The elections passed off quietly, and the Chambers met on the 15th January 1868, when the speech from the throne insisted on the necessity for legislation for the army, the church, and finance. The Liberal Government had a large majority both in the Chamber and the Senate. But external pressure brought about another change of ministry: a revolution in Bulgaria, crushed with great severity by Midhat Pasha, gave rise to accusations that it had been fomented and encouraged by Rumania, and Austria showed itself bitterly hostile to the Government of Golesco and Bratiano. France, which had sent a military mission to Rumania for organizing the army, was indignant at the purchase by that country of Prussian needle-guns and the introduction of German officers to give instruction in their use, and was also angry with Prince Charles for having sent a political mission to St Petersburg with the view of establishing more favourable relations with Russia. Etienne Golesco resigned, and was succeeded as president of the council by his brother the general, while J. Bratiano became minister of the interior. An important measure was at once passed by the new ministry for the reorganization of the army, in which corporal punishment was abolished; a rural police was formed, and an important railway concession with the German financiers Strausberg and Offenheim was voted, a measure which was the cause of subsequent troubles. In June the Senate, having refused a credit to the ministers, was dissolved, and the new Senate which assembled in September was more pliable. Several useful measures were passed, including a Bill under which every able-bodied Rumanian was compelled to give three days' work in the year towards the construction of roads, or to pay a money equivalent. But foreign mistrust of Bratiano, especially in France and Prussia, reached such a point that another change in the ministry became inevitable, and on the 16th November Demetrius Ghika was called to the head of affairs, with Kogalniceano as minister of the interior. In 1869 the French military mission was recalled, and the relations between France and Rumania were greatly strained. The sympathies of the former country were entirely alienated by the endeavours of the latter to improve its relations with Russia and Prussia. During the early part of 1869 the country was quiet. At the head of Austrian foreign affairs was Count Andrassy, who sympathized with Rumania, and during his term of office the relations between the two countries greatly improved.

Postal conventions were passed with Austria and with North Germany, and the prince found leisure to preside at the military camp which he had formed at Furcani, where 12,000 men were assembled. The prince, ever since his arrival in the country, had made a point of becoming personally acquainted with all parts of his dominions, and had made himself very popular with the army and the masses, and it was a relief to him to tear himself away from the intrigues of politicians in Bucharest to receive a warm welcome from all classes in the interior. After a residence of three years in his adopted country, he felt that the time had arrived to make the tour of foreign countries, and to endeavour to improve his friendly relations with their sovereigns. Before leaving Rumania an amnesty was granted for all political and press offences, in order to show the prince's confidence that no intrigue was able to shake his hold upon the hearts of his people. In August he paid a visit to the Russian emperor Alexander at Livadia, by whom he was most kindly received and welcomed. This was followed by visits to the emperor of Austria, the king of Prussia, the king of the Belgians, and lastly the Emperor Napoleon. While staying at his ancestral home at Sigmaringen an arrangement was made, through his friend the crown prince Frederick of Prussia, for a meeting with the Princess Elizabeth of Wied. The romantic story of the meeting and rapid courtship, which lasted only a few hours, is well told in the published memoirs of the prince. The betrothal was very shortly followed by marriage (15th November 1869), and when they landed at Turn Severin they were received with the utmost enthusiasm—a strange and pleasing contrast to the prince's surreptitious disembarkation at the same spot three years previously on his first arrival in the country. The marriage was in every respect a happy one. The queen is a clever linguist, an accomplished artist, and a good musician. She has been described as a woman above the ordinary level of humanity, detached from material interests, living in the ideal, loving nature, poetry, music, painting, and all the arts, wholly devoted to noble causes, to Rumania and the Rumanians, particularly to the poor and suffering. She is well known to Europe, under the *nom de guerre* of "Carmen Sylva," as a royal authoress, who, even if she had not the advantage of rank, would still have made a name in literature. She has worked hard to protect native industries, and when living at her beautiful summer residence of Pelesch in the Carpathians she and her maids of honour wear the picturesque and lovely embroidered costumes of Rumanian women. The journey of the princely pair to Bucharest was one constant triumphal march, and their reception at the capital was in every respect worthy of the occasion. But the prince's difficulties and trials were by no means at an end: the Opposition made most violent attacks on the ministry and the dynasty, which in no wise diminished in intensity after Prince Ghika's resignation (February 1870), following a defeat on the budget. The succeeding ministry under A. Golesco was a very feeble one, and lasted only a few months, M. Jepurana being called on to form a cabinet in April. The latter's accession to power was followed by a general election, during which serious riots took place at Piteshti and Ploeshti, at both of which places collisions took place between the troops and the mob, and at the latter the national guard had to be disbanded.

The prince's marriage.

Much excitement was caused in Rumania by the outbreak of the war between Prussia and France, one of the immediate causes of which was the nomination of Prince Charles's elder brother, the crown prince of Hohenzollern, to the throne of Spain. The sympathies of the Rumanian nation were entirely on the side of their Latin sister, while those of the prince were naturally with his native country; and in spite of the opposition of the ministers, who were strictly neutral, a motion was passed in the Chamber to the effect that the sympathies of Rumania would always be with the Latin race. The excitement culminated in a revolutionary outbreak at Ploeshti, where a hot-headed deputy, Candiano Popescu, after the mob had stormed the militia barracks, issued a proclamation deposing Prince Charles and appointing General Golesco regent *ad interim*. Owing to the loyalty of the regular army the insurrection was speedily quelled, and Bratiano and Golesco, who were both believed to be implicated in the plot, were arrested, although shortly afterwards released.

Rebellion of 1870.

No doubt many influential men were involved, but the movement broke out prematurely and before due preparations had been made. It is worthy of note, as showing the magnanimity and wisdom of the prince, that Bratiano lived to render the greatest services to his prince and country, and that the rebel Popescu only a few years afterwards commanded the Rumanian battalion that successfully stormed the famous Grivitza redoubt at Plevna. But the feeling in the country was strong against the German sovereign. Six weeks later a jury acquitted the accused rebels, and the prince seriously thought of abdicating. On 7th December he wrote confidentially to the sovereigns of the guaranteeing Powers, suggesting that the future of Rumania should be regulated by a European congress, and stating that "only a strong government could remedy the internal and external evils of the country, which at present was in a most deplorable condition despite the wealth of its resources." A few days subsequently the prince learned that the German railway contractor Strausberg was unwilling or unable to pay the coupons of the railway bonds due on 1st January, which were mostly held by influential people in Germany. This threw the moral responsibility of payment on Rumania, and was a bitter blow to the prince, through whose instrumentality the loan had been placed, and whose one great consolation in life had been that it was to him that Rumania owed its railway system. He now hesitated about abdicating, as he was unwilling to forsake the country in the day of its peril. But more troubles were in store. The chief instigators of the recent rebellion succeeded in passing through the Chamber a resolution most insulting to the prince. Exciting and passionate debates ended in a vote of no confidence in the ministry. Prince John Ghika formed a new Government, and declared that his policy lay in effecting a compromise between the prince, who had lost all confidence in the country, and the representatives of the people. Matters were brought to a crisis by the Prussian Government threatening to use pressure to force the Rumanian Government to act in accordance with its guarantee, and provide for the unpaid coupons of the German railway loan. The country was financially in no condition to comply. Bitter indignation prevailed against everything German, and culminated in an attack on the German colony of Bucharest on the occasion of a banquet given on the emperor's birthday on 22nd March 1871. The mob was only dispersed by the military after having been in possession of the streets for two and a half hours, shouting "Long live the republic!"

This was more than the prince could bear. On the following morning he summoned the members of the Lieutenance Princière of 1866, and informed them of his intention to place the government in their hands. Lascar Catargi and General Golesco, the only two members present, as well as Demetrius Stourdza and other influential persons, solemnly adjured the prince to abstain from a step which they felt convinced could only bring the greatest misfortune on Rumania, and they declined to accept the responsibility. Catargi offered to unite the different sections of the Conservative party in order to conjure away the difficulties that beset the country. The prince accepted his offer. Catargi formed a ministry to which all the most respectable members of the country rallied, comprising Kretzulesco, General Tell, Mavrogheni, General Floresco, and other well-known patriots, and the hostile Chamber was dissolved. The excellent reception accorded to the prince and princess in a tour through Moldavia while the elections were pending drove all thoughts of abdication out of the prince's head. There had been a reaction in public opinion, greatly owing to the publication of a most pathetic letter from the prince, containing the reasons which had induced him to contemplate abdication. The elections took place early in May (1871), and the Government, to which all the most respectable elements in the country had rallied, had a large majority in the Chambers. When Parliament met in May the prince had a most enthusiastic reception. It was the inauguration of a new régime. Catargi's ministry was the tenth that had held office in the five years that had elapsed since the prince's arrival, but it was the first one that was stable, and was destined to last till 1876. The anti-German feeling in the country had greatly subsided, in consequence of the crushing defeat of France, and in January 1872 the Chambers passed a law by which Rumania undertook to pay the railway coupons. The German syndicate was satisfied, and the railway crisis was ended. Rumania now passed through a peaceful stage. The death of Napoleon III. in January 1873 moved the nation greatly, for the dead emperor had been the champion and protector of the national existence of Rumania in its darkest days. The universal sympathy shown with the widowed empress and the prince imperial created a certain temporary friction with the republican Government. Later in the year Rumania was well represented at the Vienna Exhibition, when the prince was most cordially received by the Austrian emperor. On leaving Vienna visits were paid to the Tsar (at Ems) and the Emperor William. On the 9th April 1874 the country was thrown into the deepest grief by the death of the Princess Marie, the only and dearly loved child of Prince Charles and the Princess Elizabeth. The universal sympathy shown on all sides to the bereaved parents helped much to strengthen the bonds by which the prince was attached to the country. In March 1875 the budget for 1876, amounting to 100 million francs, nearly double in amount that of the year 1866, was passed without difficulty, and on the 28th of the month the parliamentary session was closed. It was the first occasion in Rumania that the same Chamber had sat for the whole constitutional period of four years, and also the first time that the same ministry had opened and closed the same Chamber. The speech from the throne dwelt with satisfaction on the work that had been accomplished during the above period, viz., financial and administrative reform, regulation of the public debt, loans both external and internal successfully floated, new resources derived from stamp and licence taxes, and from the creation of a tobacco monopoly, the foundation of the State agricultural bank, organization of the State domains, the passing of a customs law with a new tariff, and the provisional settlement of the various complicated questions connected with the railways. Important reforms had also been carried out in the army, the Church, and the judicial department. During the same period international conventions had been signed with Austria, Russia, and Servia, and Rumania had joined the International Postal Union.

The Liberal Opposition under Bratiano, tired of being so long out of office, did their utmost to secure a majority against the Government in the new Chambers, the election for which took place in May. No stone was left unturned: emissaries were sent into the districts to preach revolt; in the Liberal press it was declared that all or any means were legitimate with the view of upsetting the ministry; tumultuous and riotous meetings took place at Bucharest; but in Rumania the Government which superintends the elections has always means at its command to ensure a majority, and M. Catargi, in spite of the most unscrupulous and powerful opposition, found himself with a large majority in the new Chambers, and was able before the close of the year to obtain from Parliament approval of a commercial treaty to be signed with Austria-Hungary, a most important measure, not only giving great commercial relief to the country, but being a long step forward in the direction of obtaining Rumanian independence, an aim never absent from the minds of patriotic Rumanians, and now shortly to be realized. Before obtaining it, however, the country had to pass through difficult times. The budget presented to the Chambers in March (1876) showed a deficit of 30 million francs; the Senate refused to pass it, and was dissolved; and the new elections gave but a feeble majority for the Government. Dissensions broke out in the cabinet, which was defeated in the Chambers on the budget. This was followed by the resignation of the Catargi ministry, which for five eventful and on the whole prosperous years had governed the country.

The fall of the ministry saved the country from revolution. A widespread conspiracy was on foot, fomented by the leading Liberals, for the arrest and expulsion of the prince, and the formation of a provisional government under General Dabija. The prospect of a return to power put an end to these machinations. Catargi's ministry was succeeded by a very short-lived administration under General Florescu, known as the "cabinet of the generals," which after an existence of only one month was succeeded on 8th May by a so-called "ministry of conciliation" under M. Jepureano, during whose short tenure of office a new Chamber was elected, by which the commercial treaty with Austria was ratified, under strong pressure and even menace on the part of the Austrian Government. A commission of the Chambers drew up an indictment against Catargi and his late colleagues, accusing them of violating the constitution and the public liberties, squandering the State revenues, and abuse of power when in office. Unable to stem the tide of popular passion, which was crying for impeachment, Jepureano resigned office, and M. Bratiano on 4th August was entrusted with the formation of a new Liberal cabinet, destined to guide the country through many eventful years. A prominent member of it was M. Stourdza, who subsequently succeeded Bratiano as head of the Liberal party. The programme of the new ministry was declared to include respect for the constitution and the law, honesty in the administration, great economies in expenditure, and the decentralization of the administrative services. But the reopening of the Eastern question was destined to bring to a climax the great struggle of Rumania for existence and independence as a nation, and temporarily to throw into the shade all domestic questions. The revolution in Bosnia and Herzegovina towards the close of 1875, followed a few months afterwards by the declaration of war between Turkey and the tributary states of Servia and Montenegro, were events which could not leave Rumania unconcerned. Her powerful neighbours Austria and Russia had sounded her ruler as to his intentions in case of a universal outbreak; Prince Milan of Servia had unsuccessfully begged Prince Charles to join him in declaring war against their common suzerain the sultan; and Prince Charles, although declining this tempting offer, seized the opportunity of reminding the Sublime Porte of certain unsettled disputes between them, and made various proposals, all of them

tending to the practical emancipation of his country from the subordinate position in which it was placed. The insurrection in Bulgaria, with its accompanying horrors, followed by the deposition of Sultan Murad and the succession of the Sultan Abdul Hamid, contributed to indicate the near approach of a Russo-Turkish war. Russia had shown symptoms of anger against Rumania for not having taken up a decided attitude in the approaching struggle, and the Russian ambassador Ignatieff had some months previously threatened that his Government would seize the Danube principalities as a pledge as soon as the Turks occupied Servia and Montenegro. The whole of Russia, with the exception perhaps of the Tsar himself, was bent on war. Prince Charles decided to send a mission, composed of Bratiano and Colonel Slaniceanu (the minister of war), to the imperial headquarters at Livadia. They were well received by the emperor (October 1876), but in spite of mixed threats, menaces, and cajoleries on the part of Gortschakoff, Ignatieff, and others, Bratiano returned without having definitively committed his country to active measures.

On 14th November six Russian army corps were mobilized to form the army of the south under the Grand Duke Nicholas. A few days later two secret envoys arrived at Bucharest, the one M. de Nelidoff, to negotiate on the part of the Russian Government for the passage of their army through Rumania, the other Ali Bey, to arrange on behalf of the sultan a combination with Rumania against Russia. Prince Charles cleverly temporized with both Powers. Negotiations with Russia were continued, and M. Bratiano was sent to Constantinople to put pressure upon Turkey to secure certain rights and privileges which would *de facto* have made Rumania an independent power, except that it would still have paid a fixed tribute; but the conference of the Powers assembled at that capital came to a definite end on the 19th January 1877, when the Turkish Government declined every proposal of the conference as being opposed to the "integrity, independence, and dignity of the empire." Meanwhile the Porte, in issuing Midhat Pasha's famous scheme of reforms, had greatly irritated Rumanian politicians by including their country in the same category as the other privileged provinces, and designating its inhabitants as Ottoman subjects. A secret convention was signed between Russia and Rumania on the 16th April, by which the latter allowed free passage through the country to the Russian armies, the Tsar engaging in return to maintain its political rights and to protect its integrity, while all matters of detail connected with the passage of the Russian troops were to be regulated by a special treaty. On the 23rd April Russia declared war against Turkey, and the Grand Duke Nicholas issued a proclamation to the Rumanian nation, announcing his intention of entering their territory in the hope of finding the same welcome as in former wars. The entry of Russian troops into Moldavia preceded by some hours the declaration of war, and various important strategic points were at once seized and occupied. The Rumanian Government made a platonic protest against the crossing of the frontier, and the Rumanian troops fell back as the Russians advanced; provisions and stores of all kinds were supplied to the invading army against cash payments in gold, and the railways and telegraphs were freely placed at their disposal. The Rumanian Chambers were assembled on the 26th April, and the convention with Russia was sanctioned by 69 to 25 votes in the Chamber, and by 41 to 10 in the Senate, in spite of vigorous opposition on the part of Stourdza, Carp, and Epureano. The Ottoman Government immediately broke off diplomatic relations with Rumania, and on the 11th May the Chambers of Bucharest passed a resolution that a state of war existed with Turkey. Rumania has been much blamed for joining Russia in this war against the suzerain power. There is no doubt that the prince from his first connexion with Rumania had the independence of the country in view. It is on record that in his interview with King William of Prussia in 1866, prior to his accepting the call to the principality, he stated that "although he was ready to acknowledge the Turkish suzerainty for a time, he reserved to himself the task of freeing his country by force of arms, and of gaining perfect independence on the field of battle." For eleven years he had been developing the military forces of the principality in order to be prepared for all eventualities, and when the crisis arrived he had neither the power nor the inclination to resist the passage of the Russian armies through his territory; still less had he the wish to see his country become the scene of conflict between the two great opposing Powers, which would inevitably have resulted from the maintenance of a strict neutrality. Turkey, on the other hand, hoped up to the last that Rumania would not openly join Russia against her, and it was perhaps this hope that induced her to observe a strictly defensive attitude, and to abstain from commencing hostilities against Rumania by an invasion of that country.

Russo-Turkish war.

Russia thought herself quite capable single-handed of waging a successful war against Turkey, and being quite content with the grant of a free passage through Rumania, had at first no desire to insist on her active co-operation in the field. It was arranged, therefore, that the Rumanian army should retire into Lesser Wallachia, and occupy Kalafat and other points on the left bank of the Danube as far down as Giurgevo, thus protecting that part of the country from invasion, and at the same time covering the right wing of the Russian army while it was taking up its strategic positions between Giurgevo and Galatz. As soon as the Russians were ready to occupy Giurgevo (which covered Bucharest), the Rumanians retired westward as far as the river Olt. Thanks to the development of the military resources of the country, Prince Charles was able to put into the field and take command of two corps d'armée with 48,000 men and 180 guns, with about 70,000 men of the national guard and militia in reserve. On the 27th May the bombardment of Widdin from Kalafat, under the prince's personal orders, was one of the opening events of the war, and the coolness of the prince under fire created much enthusiasm among his soldiers and people. In the course of May Russia had placed 200,000 men on the north of the Danube, but owing to heavy floods it was not till the 27th June that the main passage of the Danube was effected at Simnitza, the crossing of a small force having taken place a few days previously at Braila. But it was soon discovered that the Russians had underrated the Turkish power of resistance, and that instead of a mere military promenade to Constantinople, Russia would have to put forth all her strength to bring the war to a successful issue. General Gourko's force, after a successful raid across the Balkans, was forced to retire in the face of strongly superior numbers. General Schilder-Schuldner, after capturing Nicopoli and taking 8000 Turkish prisoners, was defeated on the 20th July by Osman Pasha at Plevna, to which place the latter had hurried from Widdin in order to prevent the main Russian army from marching to Sofia. On the 30th July the Russians, having collected 30,000 men, made the second unsuccessful attack on Plevna, losing some 8000 men in the fight, and it was at one time feared that the Russian armies might be driven back across the Danube. But Russia's failure was Rumania's opportunity, which Prince Charles was not slow in seizing. In May the Tsar had intimated that Russia had no need of the support of the Rumanian army, and that if Prince Charles's Government wished to take part in the campaign, it must do so at its own risk and expense. After the first defeat at Plevna the Russian headquarters staff requested that the Rumanian army should occupy Nicopoli and take charge of the prisoners of war: Prince Charles declined to move his troops until he should receive a positive promise that the Rumanian corps should be maintained as a separate unit, under its own officers. After the second defeat at Plevna, which was attributed by the Grand Duke Nicholas to the fact that the Rumanians had not complied with his request to occupy Nicopoli, the Grand Duke again made repeated and urgent endeavours to secure the active assistance of Prince Charles and his army, but the former would not give way until the Russians agreed to give him the undivided command of the Rumanian army. This burning question was at last settled in his favour; the Rumanian troops proceeded at once to occupy Nicopoli, and the main Rumanian army commenced crossing the Danube on the 25th August at Corabia. Prince Charles himself joined the Russian headquarters on the 20th, and the same day the Tsar conferred on the prince the command of all the Russian troops before Plevna, and the Russian General Sotoff was appointed his chief of the staff. The troops placed under his orders (including the Rumanians) amounted at first to 75,000 men with 8000 horses and 442 guns. The third and last assault on Plevna took place on the 11th September, when the Rumanian army covered itself with glory, and, with the loss of 2600 men, captured and held the famous Grivitza redoubt (the unsuccessful attack on which on the 30th July had caused the Russians a loss of 6000 men). General Skobeleff the same day captured with fearful loss the Green Hill, but was unable to maintain his position.

The heavy losses incurred by the allied armies, no less than 16,000 killed and wounded, made it evident that Plevna was not to be reduced by assault. General Todleben, the famous defender of Sebastopol, was summoned to act as second in command to Prince Charles, with Prince Imeritinski as chief of the staff. Enormous reinforcements were brought up by Russia, and it was decided to attempt to compel the surrender of the Turkish army by a blockade. On the 18th September the Rumanians attacked the second Grivitza redoubt, but were repulsed with the loss of 20 officers and 583 men killed and wounded. On the 19th October a further attempt was made, and the redoubt was captured; but the Turkish reserves eventually recaptured it, inflicting a loss of 300 killed and 707 wounded. It was not till the 10th December that Osman Pasha made his desperate but unsuccessful attempt to break through the investing armies, and was finally compelled to surrender; 40,000 men and 77 guns fell into the hands of the victors. Two divisions of the Rumanian army were now detailed to blockade the virgin fortress of Widdin, whilst a third escorted the prisoners of war to the Russian frontier. The fall of Plevna left the Russian army free to commence its victorious march to Constantinople, and on the 31st January 1878 the preliminaries of peace were signed at Adrianople, one of the provisions of which was that Rumania

should be independent and receive an increase of territory. Widdin was surrendered to the Rumanians on 24th February, when the Turkish garrison marched out with all the honours of war.

The definite treaty of peace between Russia and Turkey was signed at San Stefano on the 3rd March. But Rumania was now to learn that in politics there is no such thing as gratitude. Although anxious to be represented at the peace negotiations, this claim was disallowed by Russia. On 29th January the Rumanian agent at St Petersburg was officially informed of the intention of the Russian Government to regain possession of the Rumanian portion of Bessarabia, *i.e.*, that portion which was ceded to Moldavia by Russia after the Crimean war. Rumania was to be indemnified at the expense of Turkey by the delta of the Danube and the Dobrudja as far as Kustendjie. The motive assigned was that this territory had not been ceded to Rumania, but to Moldavia, and had been separated from Russia by a treaty (Paris) of which scarcely a single provision remained in force. Moreover, the national dignity and honour of Russia demanded the reacquisition of this district. In reply to all remonstrances Prince Gortschakoff blandly stated, "Whatever arguments you employ, they cannot modify our decision, which is unalterable." Ignatieff was sent to Bucharest to try and reconcile the prince to make this sacrifice, and hints were thrown out that under certain circumstances Prince Charles might be elected to the throne of Bulgaria. But the proposed exchange of territory roused the most bitter indignation at Bucharest. It was discussed before a secret sitting of the Chamber and the Senate on 4th February, when, amidst the greatest excitement, the representatives of the nation declared that Rumania would defend the integrity of its territory to the last, with armed force if necessary. But in the end the weaker had to submit to the stronger. Bratiano and Cogalniceano were sent to Berlin to endeavour to prevail on the representatives of the Powers there assembled in June 1878 to veto the cession of Bessarabia to Russia; but the Rumanian delegates were not permitted to attend the sittings of the Congress until the Powers had decided in favour of the Russian claim. The Treaty of Berlin in dealing with Rumania decided to recognize its independence, subject to two conditions:—First (Art. xlv.), that the principality restores to the emperor of Russia that portion of the Bessarabian territory detached from Russia by the Treaty of Paris of 1856, bounded on the west by the mid-channel of the Pruth, and on the south by the mid-channel of the Kilia branch and the Stary Stamboul mouth. Second (Art. xliv.), that in Rumania the difference of religious creeds and confessions should not be alleged against any person as a ground for exclusion or incapacity in matters relating to the enjoyment of civil and political rights, admission to public employments, functions, and honours, or the exercise of the various professions and industries in any locality whatsoever; that freedom and outward exercise of all forms of worship should be assured to all persons belonging to the Rumanian state and to foreigners, and that no hindrance should be offered to the hierarchical organization of the different communions, or to their relations with their spiritual chiefs; and, further, that the subjects and citizens of all the Powers, traders or others, should be treated in Rumania without distinction of creed, on a footing of perfect equality. Article xlvi. declared that the islands forming the delta of the Danube, the Isle of Serpents, and the province of Dobrudja, as far as a line starting from the east of Silistria and terminating on the Black Sea south of Mangalia, should be added to Rumania. Other articles defined the international position of Rumania, while Article liii. decreed that it should have a representative on the European commission of the Danube. It was a bitter blow to the Rumanians, after all the sacrifices they had made on the field of battle, to find that the recognition of their long-hoped-for independence was to depend on the performance of two conditions, both of which were deeply repugnant to the nation at large. Bratiano wrote with some truth, that the Great Powers by sacrificing Rumania were able to obtain more concessions for themselves from Russia, and Lord Beaconsfield was constrained to admit that "in politics ingratitude is often the reward of the greatest services." The Rumanians submitted eventually, but with bad grace, to the retrocession of Bessarabia. "The Russian occupation (13th October 1878) passed off uneventfully, the Rumanian officials retired without a word, and Prince Charles was spared the pain of signing his name to any document in connexion with the cession," but the transaction caused bitter animosity in Rumania against Russia; while the diplomatic protests and violent language in the Chambers also produced a deep impression on Russian official circles, which was not without fruit when the new frontier between the Dobrudja and Bulgaria was delimited by a European commission, on which occasion Russia did her utmost to thwart and resist the pretensions of Rumania, especially as regards the proposals to include Arab Tabia (a fort commanding Silistria in Rumanian territory). The Powers, with the exception of Russia, supported Rumania; and although the point was ultimately decided in 1879 in favour of the latter, yet owing to Russian opposition the boundary was not finally demarcated till 1885. The Dobrudja was quietly occupied by Rumanian troops on the 26th November 1878. It was personally visited by the prince in October 1879, and in 1880 an organic law of a liberal nature was passed and promulgated. Most of the laws and regulations existing in Rumania were made to apply to the new possession; and although Art. iv. laid down that a special law would be passed regulating the representation of the population in the Rumanian Parliament, this has never been carried out, and the Dobrudja is still unrepresented in Parliament, and is governed by prefects depending on the minister of the interior at Bucharest. At the time of its cession the province was regarded as of but little value, so much so that many Rumanian statesmen wished to decline the proffered gift, yet it has since proved a most useful acquisition, especially since the connexion (1894) of the port of Kustendjie (now called Constantza) with the Rumanian railway system by the construction of a bridge over the Danube at Tchernavoda.

Cession of Bessarabia.

But it was Art. xliv. of the Treaty of Berlin that was to cause real trouble and tremendous agitation throughout the country. It will be remembered that Art. vii. of the constitution of 1866 laid down that "only Christians can become citizens of Rumania"—in other words, all Jews were excluded from the rights of citizenship, and as no foreigner could own land in Rumania outside the towns, it follows that no Jew could become a country proprietor. The Great Powers, moved by the demands and complaints of the Jews, and desirous of removing this disqualification, legislated accordingly, as has been shown in Art. xlvi. of the Treaty of Berlin; but public opinion in Rumania, already excited by the compulsory retrocession of Bessarabia, rendered it almost impossible for any Government to legislate in accordance with the wishes of the Berlin tribunal. In the first place, it involved a change in the constitution, which could only be effected by a constituent assembly elected *ad hoc*, and it was with the greatest difficulty, and amidst the greatest excitement throughout the country, that Bratiano was able to obtain the requisite majority in favour of the election of new Chambers for this purpose. The revising chamber met on 3rd June, and sat through the entire summer, and at one time the irritation of the Powers at the unexpected delay in carrying out their decision was so great that England proposed a collective note on the subject, to be executed by the Austrian cabinet; while Prince Bismarck threatened, in case the Berlin proposition was not carried out, to refer to the suzerain power at Constantinople! The prince was confronted with the choice of a rupture with the Powers or a revolution in the country, where there was a tremendous popular outcry against all concessions to the Jews. At last, however, on 18th October, the new Chamber repealed Art. vii. of the constitution of 1866, and it thus became possible for Rumanian Jews to become naturalized and to hold land. It was further decided to admit *en bloc* to naturalization the 883 Jewish soldiers who had served in the war of independence; but with all other Jews individual naturalization was required, and this was hedged about by so many difficulties, a special vote of the Legislature being required, with a two-thirds majority in each individual case, that although the compromise thus effected was accepted by the Powers, *faute de mieux*, the result in practice has been that, from 1880 to 1884, out of 385 persons who were naturalized in Rumania, only 71 were Rumanian Jews. Since that time they have been admitted by small driblets of not more than a few individuals in a year, so that the 300,000 Jews said to inhabit Rumania have practically derived no benefit whatever from the benevolent intentions of the Powers at Berlin, and are still regarded as foreigners; and although liable to military service and to the payment of taxes, are unable to own land or possess electoral or other civil rights. However, the Powers agreed to accept the resolutions that had been passed by the Chambers as meeting the necessities of the case. The two conditions on the performance of which depended the recognition of Rumanian independence had now been carried out.

Independence.

Italy was the first of the Great Powers to formally notify its recognition of Rumanian independence (December 1879); but Bismarck succeeded in prevailing on the western Powers not to give official recognition until another matter which vitally affected Germany's financial interests had been settled in its favour. This was the never-ending railway question, in which so much German capital was engaged. Great pressure was put on the Rumanian Government to pass a law through the Chambers for the purchase of the railways from the German capitalists. This measure was most unpopular in the country, and it was difficult to induce the Chambers to agree to the proposed terms of purchase; but at last, in the end of January 1880, the necessary Bill was passed; and then, but not till then, Bismarck gave the word, and England, France, and Germany formally recognized the independence of the country on the 20th February 1880. The first British minister accredited to Rumania after its admission into the family of European states was that able diplomatist Sir William White, who for two years previously had resided at Bucharest as her Majesty's representative. Six weeks

after his nomination as minister he signed a treaty of commerce and navigation between Great Britain and Rumania. The circumstances connected with it are curious. In 1875 the Rumanians, in order to emancipate themselves from the commercial engagements formerly contracted on their behalf by the Porte, and with the desire of bringing the Great Powers to recognize the right of the principality to conclude commercial conventions, drew up a most oppressive tariff of imposts on foreign products, which was to come into force on the 1st July 1876. The Government of Austria-Hungary lost no time, and concluded a convention in June 1875, stipulating for much lower duties than those of the general tariff. Russia and Germany followed suit. England, in order to spare the susceptibilities of the Porte, would not conclude a treaty direct with Rumania, but an arrangement was come to in November 1876 provisionally securing to British trade the full benefit of the Austrian commercial tariff. This was subsequently extended to 12th May 1878, but no farther; but through Sir W. White's exertions, on the 13th August the Rumanian Legislature conferred on British productions the benefit of the most favoured nation clause until such time as a definite treaty could be concluded. This arrangement lasted until the 5th April 1880, when the definite treaty was signed.

In the autumn of 1880 Prince Charles visited Germany, and as there now appeared but little prospect of the birth of a son and heir, it became necessary to regulate the succession to the throne. Art. lxxxiii. of the constitution of 1866 decreed that, in default of male heirs in line direct of Prince Charles, the succession should pass to the eldest of his brothers or to their descendants. In case of the line becoming extinct, or of the members of the Hohenzollern family renouncing their rights, Prince Charles was accorded the power of naming his successor from one of the reigning dynasties of Europe, subject to the approval of the national representatives. The prince now (1880) negotiated and obtained from the princely house of Hohenzollern a formal assent to and acceptance of this article of the constitution. His elder brother, Prince Leopold, hereditary prince of Hohenzollern, renounced his own claim to the succession in favour of his sons, whom he declared he would bring up with the view of one of them succeeding to the throne. An intimation of this decision was laid before the Chambers on Prince Charles's return to Rumania, and was received with hearty satisfaction. Early in 1881 it was generally felt that the time had arrived for Rumania to be created a kingdom. On 13th March the Tsar Alexander was assassinated, and the Rumanian Opposition made it the occasion of accusing the Liberal Government of aiming at republican and anti-dynastic ideals. To refute this calumny the ministry proposed the elevation of the Rumanian principality into the kingdom of Rumania, amidst the enthusiastic plaudits of Chamber and Senate. The prince, in accepting the resolution, declared that it was the beginning of a new page in the volume of Rumanian national life, and the end of a period full of struggle and difficulties, but also full of virile effort and heroic deeds: the wish of the nation was the guide and goal of his life, the love and confidence of the nation by which he had been surrounded during the fifteen years he had ruled the country had made the good days brighter, and had strengthened and confirmed him during those which were evil. He accepted the kingly title to fulfil the long-cherished wish of every Rumanian, and expressed the hope, "May the first king of Rumania enjoy the same love that has supported the last prince through all his troubles! The affection of this noble and brave nation, to whom I have devoted my whole existence, is more to me than all the greatness and brilliancy of a crown." Within ten days of this declaration the new kingdom was recognized by all the Great Powers. The coronation took place at Bucharest with much pomp and ceremony on the 22nd May 1881. The ceremony was attended by the king's elder brother, the hereditary prince of Hohenzollern, and his two sons, one of whom, Prince Ferdinand, was destined later on to become heir-apparent. The royal crown was constructed of steel made from Turkish cannon captured at Plevna, while that of the queen was of pure gold, without jewels or ornaments. Delegates attended from every district in the kingdom, throughout which there was universal rejoicing. King Charles was now able to continue to work out the development of the country, comparatively, but not entirely free from fears of serious foreign complications. Relations with Russia had remained strained ever since the war, and it was not till January 1881 that the Russians appointed Prince Durosoff as minister at Bucharest after the post had been vacant for two years. The question of the Dobrudja frontier was still unsettled, and owing to Russian opposition was not finally disposed of till three years later. At one time the dispute became very acute, and Rumanian troops forcibly occupied the Arab Tabia at Silistria, from which, however, they subsequently had to retire. Difficulties also frequently arose from the enforcement of an Alien Bill passed in April 1881, which gave the Government the right to expel all aliens whose presence was considered objectionable. Much trouble was experienced in settling the claims and counter-claims about the war accounts, especially as regards the claim made by the Russian Government for a return of a sum of 3,000,000 francs advanced during the war to enable the Rumanians to mobilize, which had been considered by the latter as a free gift. A compromise was made, both parties withdrawing their claims, and a final settlement was arrived at in April 1882.

The new kingdom.

Relations with Austria-Hungary were also on a very unpleasant footing. There were two principal subjects of discord—the navigation of the Danube and the national question. As regards the former (see DANUBE), the pretensions of the Austrian Government to have a preponderating position in the "Commission mixte du Danube," which was to be the governing power of that portion of the river between Galatz and the Iron Gates (no part of which is in Austrian territory), aroused a most bitter feeling in Rumania, which found vent in the speech from the throne addressed to the Chambers on the 27th November 1881, when the king asserted that the country was ready, both for the present and in the future, to make every sacrifice that might be necessary to ensure complete freedom of navigation. This speech gave great offence in Austria, nearly causing interruption in the diplomatic relations between the two countries. Apologies were made and explanations offered in the Chambers, and the matter was amicably arranged, not without violent attacks by the Opposition on both the king and the Government of M. Bratiano for their supposed subserviency to Austria. The Danube question reached another acute stage in 1883, when, on account of Austrian opposition, Rumania, although under the Treaty of Berlin she had a representative on the European commission of the Danube, was refused permission to participate in the congress held at London to regulate the Danube question. The formation of the "Commission mixte" was then finally sanctioned, but Rumania refused to submit to arrangements which so seriously affected her interests, and to which she was not a consenting party; and although sanctioned by treaty, Rumania gained her point, and the "Commission mixte" has never come into existence. The Danube question again came prominently forward in 1899, when strong protests were made by Rumania, this time supported by Russia, against the claims of Austria-Hungary to fix the tariffs for vessels passing through the Iron Gates, and to have exclusive police supervision over that part of the river. It will be seen that the Danube and the national questions are two very delicate matters, always more or less *en évidence*, and liable to compromise the relations between the dual kingdom and Rumania, and requiring great tact in their management.

Danube question.

Another measure adopted by Rumania in 1883 caused much irritation both in Austria and Russia, viz., the decision to construct extensive fortifications both around Bucharest and on the line of the Sereth, the latter to enable the country to concentrate troops against an invasion from the north-east. Austria considered that the former were directed against her, while Russia, with more show of reason, considered the construction of the Sereth works as directed against herself. Both sets of works had been designed by General Brialmont in 1882. In March 1883 the Rumanian Chambers voted £400,000 for their commencement, and they have since been completed at a total cost (including armament of the most modern type) exceeding four million pounds sterling. Fortunately, there has never been occasion to try their efficacy against either of her powerful neighbours, but they will no doubt materially help to defend Rumanian neutrality in any future complication that may arise.

It was not till towards the end of 1883 that a better feeling began to prevail between Rumania and her western neighbour. The king in the summer had paid visits to Berlin and Vienna, whilst Bratiano had interviews with Prince Bismarck at Gastein, and subsequently with the emperor of Austria at Vienna. Between them they succeeded in convincing the emperor of their wish to be on friendly terms with both Germany and Austria, and the relations between the latter and Rumania perceptibly improved. The *entente* was still further strengthened by the visit of the Austrian heir-apparent to the Rumanian court in April 1884, a visit which caused some irritation in Russia. The king's sympathies are and always have been thoroughly German, and were naturally extended to Germany's partner in the Triple Alliance, while he could never forget the ingratitude of Russia as displayed subsequent to the war. Bratiano, too, was no doubt at this period a sincere advocate of Austrian friendship on political grounds, whilst his own experience taught him to be very suspicious of Russia. But there was a strong anti-German party in the country, especially among the old boyards and the peasantry, among whom community of creed, ancient traditional influence, the entire absence of Russian merchants in the country (and the consequent avoidance of many petty but litigious questions), all contributed to bring about a sort of passive preference for Russia, whilst the bitter disputes that had occurred with Germany on the question of railway finance had left a very hostile feeling, often very detrimental to the king's popularity, notwithstanding the fact that the latter was constantly exerting

his utmost energies to further the material development and well-being of his country.

In March 1883 the Chamber and the Senate, on the demand of the Government, after most violent discussions, decided by overwhelming majorities to proceed to a revision of the constitution, and, as a necessary consequence, fresh Chambers had to be elected for that special purpose.

Revision.

The new Chambers consisted almost entirely of supporters of the Government, only twelve members of the Opposition being elected in each house, and at the opening of the session in May sixteen out of the twenty-four declined to take any part in the proceedings of the Chambers, as a protest against the violent and illegal manner in which they asserted the elections had been conducted by the Government. The principal mover in the direction of revision was the veteran Rosetti, who had preserved the full feelings of his early democratic aspirations, and insisted on bringing forward radical measures of electoral reform, by increasing the number of peasant freeholders, and by the establishment of a single electoral college, instead of the four, arranged according to wealth, provided for by the constitution. M. Bratiano would not agree to these fundamental changes, which would practically have resulted in universal suffrage. The moderate party was successful, and revision of the constitution was effected, but on non-revolutionary principles: three electoral colleges were formed instead of four (and in consequence Rosetti, with thirty-one of his partisans, took no further part in the proceedings); a considerable addition was made to the numbers of the Senate and Chamber of Representatives; trial by jury was established for press offences, with the exception of those committed against the royal family and the sovereigns of foreign states; these were to be tried by the ordinary tribunals without jury. Another Bill was passed by the same Parliament, but not without violent opposition, endowing the Crown with State lands, giving an annual rent of £24,000, in addition to the civil list fixed in 1866 at £49,000; another measure granted free passes on the railways and an allowance of twenty-five francs a day during the sitting of Parliament to all senators and deputies. The revision of the constitution was the cause of a split between the two heads of the Liberal party, Rosetti and Bratiano. These two were united by a most intimate friendship, and had in their early days conspired together as leaders of the revolutionary movement in 1848; both were elected members of the provisional government, and had been imprisoned and exiled together for many years; they were the principal movers in the revolution which upset Prince Couza in 1866, and in the election of Prince Charles as his successor. One never acted without the other. Rosetti was said to be the soul whilst Bratiano was the voice of the same personality. Their joint action had produced the most brilliant results for the country which gave them birth, but exposed them to much hatred and obloquy, chiefly on the part of the old boyards and their adherents. Since 1876 the Liberal party, under the direction of their two popular leaders, with Bratiano as prime minister, had held office without interruption, with the exception of a few weeks in 1881 at the time of the coronation, when John Bratiano surrendered the reins of government to his elder brother Demetrius. Rosetti did not long survive the quarrel, and died on the 24th April 1885, only surviving by one year another Rumanian veteran, Prince Michel Stourdza, who had ruled Moldavia with an iron hand from the time of the Russian evacuation in 1835 until 1849. He died an exile in Paris, leaving a fortune of nearly two millions sterling. Within a few weeks of Rosetti's death in May 1885, the king lost a beloved parent and a trusted friend and counsellor by the death of Prince Charles Antony of Hohenzollern. The revising Chambers having finished their special mandate, were dissolved in September 1884, and a new Parliament assembled in November, the Government, as usual, obtaining a large majority in both houses.

The year 1885 was marked by one very important event. The independence of the Rumanian Orthodox Church was formally recognized by the œcumenical patriarch of Constantinople. The Rumanian Church had claimed its independence from very ancient times, but under the Turkish suzerainty and Phanariote hospodars Greeks were generally elected as bishops, and the influence of the Greek patriarch at Constantinople came to be more and more felt. In 1872 a law was passed by which the bishops were elected by the Senate, the Chamber of Deputies, and the synod sitting as an assembly (the only other occasion on which provision is made for such an assembly is in the event of the throne becoming vacant without any apparent heir). It was subsequently decided to consecrate the holy oil in Rumania instead of procuring it from Russia or Constantinople; but the Greek patriarch protested. Secret negotiations were entered into which came to a successful issue. The patriarch feared on the one hand that the growing influence of the Russian Church would give a colour of Slavism to the whole Church, and that a Russian might eventually be appointed œcumenical patriarch at Constantinople, while the Rumanians hoped by means of the independence of their Church to deprive the Russians of all excuse for interfering in their internal affairs under the pretext of religion. The Rumanians, although obtaining complete independence, agreed to recognize the patriarch at Constantinople as the chief dignitary of the Orthodox Church.

The remaining years of Bratiano's administration were not marked by any very important events. Since the declaration of independence he had exercised an almost dictatorial power, and anything like a powerful parliamentary Opposition had ceased to exist, but this did not prevent the most violent attacks being made on him by an unscrupulous press, and by orators at public meetings. He had been too long in power; the numerous State departments were exclusively filled with his nominees; and some pecuniary scandals, in which the minister of war and other superior officers were implicated, helped to augment his fast-growing unpopularity in the country. New parties were formed in opposition, and National Liberal and Liberal-Conservative parties combined to oppose him. The former of these maintained that the Government should be the expression of the national will, and be guided by national rights and interests at home and abroad—in fact, that it should be essentially Rumanian, and, while maintaining friendly relations with foreign Powers, should in no wise allow them to interfere with the internal affairs of the country. They also advocated reduction of expenditure and the independence of the magistracy. The Liberal-Conservatives held generally the same views, but had as their ideal of foreign policy a guaranteed neutrality. Another party which now attracted considerable attention was that of the Junimists, or Young Conservatives.

The Junimist party.

The name was taken from a literary society formed in Jassy in 1874 by Messrs P. Carp, Rosetti, and Maiorescu, and transformed into a political association in 1881. Their programme for home affairs involved the amelioration of the position of the peasantry and working classes, whose progress they considered had been overlooked, the irremovability of the magistracy, and a revision of the communal law in the sense of decentralization. In financial matters they advocated the introduction of a gold standard and the removal of the agio on gold, also the introduction of foreign capital to develop industries in the country; and as regards foreign policy, they were strong advocates of intimate and friendly relations with Austria-Hungary.

In 1886 the Government negotiated a consular convention with Germany, under which all lawsuits connected with German successions in Rumania were to be submitted to and judged by German tribunals, and reciprocally Rumanian successions in Germany were to be dealt with by Rumanian courts. As few, if any, Rumanians resided in Germany, the proposed law was manifestly much in favour of the Germans; and the Opposition, with Demetrius Bratiano (brother of the premier), Vernescu, and J. Lahovari at their head, succeeded in stirring up such an agitation throughout the country against the proposed measure that it had to be withdrawn. On the 16th of September an attempt was made on Bratiano's life by a tavern-keeper named Stoica. This caused a temporary reaction against the flood of his rapidly-increasing unpopularity, and in the autumn session he was able to carry through the Chambers a further vote of thirty million francs for the Bucharest fortifications, and to pass other important measures, including a law for increasing the powers and improving the position of the communes. Stoica was subsequently condemned to twenty years' penal servitude, but his accomplices and instigators, who were believed to be connected with the parliamentary Opposition, were acquitted. In May 1887 the king was present at the consecration of the newly-restored metropolitan church of Jassy, where he was fairly well received, in spite of the most strenuous attempts of the Opposition to stir up the populace to a demonstration against his majesty and his absolutist minister, a good deal of whose unpopularity rested on the king, who, however, shortly afterwards strengthened his position in the country by publicly announcing that the heir to the throne had been finally selected in the person of his brother's younger son, Prince Ferdinand of Hohenzollern, who had been appointed a lieutenant in the Rumanian army the previous year. An unusual proceeding in Rumania, where the greatest possible license is allowed to the press, was the prosecution of the Opposition newspaper, the *Lupta*, for violent attacks upon the king: the editor was sentenced to two years' imprisonment and a fine of 5000 francs. Elections for a new Chamber took place in February 1888, and in spite of the very strong pressure which the Government in power invariably exercises on these occasions (although always proclaiming from the housetop the absolute freedom of election), the whole of the leaders of the Opposition were elected, viz., Demetrius Bratiano, Catargi, Lahovari, Blaremberg, and Fleva; and their partisans, who in the preceding Chamber mustered only about thirty strong, now formed fully one-third of the whole house. Both Conservatives and Radicals were imbued with the same fear that Bratiano, in consequence of his dislike of Russia, would throw the country headlong into the arms of Germany and Austria.

Almost immediately after the elections Bratiano tendered his resignation to the king, who only accepted it on the under-

standing that he should form one of a new ministry under Prince Ghika: this idea proving impracticable, Bratiano returned to power. On the 26th and 27th of March very serious riots broke out in the capital: the mob, at the head of whom were some prominent leaders of the Opposition, surrounded the palace, and were only dispersed by force. On the following day the Chamber of Deputies was invaded, and one of the ushers shot dead with a revolver. Two of the leaders of the mob, Messrs Fleva and Filipescu, were arrested; and although the Chambers passed a vote of confidence in the ministry, M. Bratiano definitively retired on the 4th April, after having held the premiership for twelve eventful years. It was no doubt high time that he did so, and if he had continued much longer in office it is probable that there would have been a revolutionary movement against the dynasty. During the previous Parliament a Conservative manifesto, signed by Catargi and D. Bratiano and other leaders of the Opposition, openly threatened that if the ministers were not removed prior to the general election the responsibility would be thrown, "not on those who served the crown, but on him who bore it"; and the name of Prince George Bibescu had been openly mentioned as a possible successor. There was great distress and discontent amongst the peasantry, in spite of three million francs having been voted by the legislature for their relief, and there was much anti-dynastic agitation throughout the country, owing to the fact that an unscrupulous Opposition tried to make out that the king was responsible for all the evils that befell the country. M. Teodor Rosetti, a prominent member of the Junimist party, was now called on to form a ministry, of which Messrs Carp, Maiorescu, Prince Stirbey, and M. Germani were the principal members. Fleva and Filipescu, the leaders of the recent rioting at Bucharest, were released almost immediately after the ministers had taken office. Serious agrarian riots broke out in many parts of Wallachia; several of the landlords' houses were pillaged, and the rioters were not put down without considerable loss of life. The close of the year was marked by the visit of the prince of Wales to the king at Sinaia, and by a general amnesty granted to the peasants implicated in the agrarian riots; also by the decision of the Cour de Cassation condemning General Anghalescu, who had been minister of war under Bratiano, to three months' imprisonment, loss of his rank, and a fine of 5000 francs, as well as the restitution of 25,000 francs which the State had lost through his maladministration.

As the new ministry was unable to obtain a working majority in a Chamber that had been elected under Bratiano's auspices, it was dissolved. In the new Chamber elected in October 1888 only five members of Bratiano's party retained their seats. The house was composed of 39 Junimists, 51 Conservatives (17 of Vernesco's party), 4 Socialists, and 40 Independent Liberals. In the Senate there was a strong Conservative majority, and the presidents of both houses were elected from that party. In November the ministry was modified in a Conservative direction by the accession to its ranks of General Manu, Vernesco, and A. Lahovari, all members of the old Conservative party. A determined effort was made in the new house for the impeachment of M. Bratiano and the members of his administration. It was resisted by the ministry, as the resolutions included condemnation of Bratiano's foreign policy, and were in fact directed against the king. After a three days' debate the motion was lost by one vote: a modified proposal for impeachment, from which criticisms on foreign policy were excluded, was then brought forward in the Chamber, and passed on the 21st of February by a majority of 101 to 41. In the course of the spring session (1889) M. Carp brought forward and passed through the Chambers a Bill for the amelioration of the position of the peasantry by the distribution among them of State lands.

Peasant proprietorship.

[The question of peasant proprietorship being of great importance in an agricultural country like Rumania, it seems desirable to give a retrospective glance at previous legislation on the subject. Up to the year 1864 the greater part of the soil was owned by the Church and monasteries, and by large boyard proprietors; there was also a small class of peasant proprietors, called *mochenéni* in Wallachia, *rèsèchi* in Moldavia, living and working in family communities; but the great mass of the peasantry cultivated the lands of the large proprietors, giving a certain number of days' work to their manorial lord, in addition to a tithe of the raw produce. They received in return a plot of ground proportionate to the number of animals they owned, and had also rights of grazing and of collecting fuel in the forests. In the above year, under the Government of Prince Couza, a new law was promulgated, conferring on each peasant family freehold property in lots varying from 3 to 6 hectares (1 hectare = $2\frac{1}{2}$ acres) according to the number of oxen that they owned. The man with no cattle received the minimum; the owner of 2 oxen got 4 hectares, and the possessor of 4 received 5 or 6 hectares. The price of the land, which was calculated on the basis of the value of the forced labour to which the landlord had been entitled, was about £4, 10s. per hectare, paid to the landlord by the State as compensation, and subsequently recovered from the peasants in fifteen annual instalments. In the first distribution, which took place almost immediately after the law was passed, 280,000 families in Wallachia and about 127,000 in Moldavia became freeholders, holding nearly 4 million acres or one-third of the cultivated area of the country. These peasant plots were all declared inalienable for 30 years. The law of emancipation, although passed with the best of motives, did not to any great extent benefit the peasantry. The limited size of their farms, and the necessity for buying wood and paying for pasturage, both of which were formerly free, prevented them from obtaining complete independence of the large proprietors, on whose estates they still had to work for payment in money or kind, while their improvidence soon got them into the hands of Jewish money-lenders, who, fortunately for the peasants, were by law unable to become proprietors of the soil. In 1866 and 1872 laws were passed for still further improving the position of these small proprietors, and in 1879 a measure passed the Chambers for allotting lands to 48,000 recently married couples, and also for restoring to many peasant families lands which had been alienated.

In 1882 great difficulties arose, especially in Moldavia, in connexion with contracts for labour between the peasants and the large landowners. M. Rosetti succeeded, after violent opposition from the boyards, in passing through the Chambers measures for the relief of the peasants. But legislation, however well meant, had not succeeded in greatly ameliorating their position, and in 1889 M. Carp, the Junimist leader, passed a most important measure, by which the State domains, amounting to nearly one-third of the total area of Rumania (originally the property of the Church and the convents, confiscated by Prince Couza in 1866), were to be gradually distributed among the peasantry. The land was divided into lots of 5, 10, and 15 hectares. Peasants having no land might purchase the smaller lots on very easy terms. Those who already held less than 5 hectares might purchase up to that amount. When a change of residence became necessary to enable the peasant to take up the new allotment, the State advanced 600 francs to each family to defray expenses. The price to be paid for the land differed in different districts, and was to be paid to the State in small annual instalments. If any land remained after satisfying the wants of the peasants, it was to be sold by public auction in lots of from 20 to 25 hectares. All lots in both cases were declared inalienable for 30 years. Under M. Carp's law 1200 model farms were also formed in the Baragan, or low ground lying to the north of the Danube. As a consequence of this law and previous legislation there are now no less than 556,127 peasant proprietors in Rumania (exclusive of the Dobrudja), owning 2,390,170 hectares of land, or roughly speaking about one-half of its cultivated area. The sale of the larger lots under M. Carp's law gave rise to so many abuses that in 1896 a law was passed abolishing their further sale.]

Shortly after the passage of M. Carp's Bill through the Senate the minister of justice, M. Vernesco, made some outrageous judicial appointments without the knowledge of his colleagues, and his action being disapproved of by them, he declined either to withdraw the nominations or quit the cabinet. M. Catargi was then called on to form a purely Conservative administration, and took office, with Vernesco, Lahovari, and Manu as colleagues. This shuffle of the cards was, rightly or wrongly, attributed in great measure to the influence of M. Hitrovo, the active and energetic Russian minister at Bucharest, who ever since his arrival in 1886 had been a thorn in the side of the ministers, who had great cause for anxiety in connexion with contemporary events in Bulgaria, viz., the incorporation of eastern Rumelia, the war between Bulgaria and Servia, the subsequent kidnapping, return, and final withdrawal of Prince Alexander of Battenberg, all of which events gave rise to fears of further complications and of Russian intervention which might have involved Rumania in serious difficulties. The advent of Catargi to power was regarded as a triumph for Russia, as the sympathies of the Junimist minister had been entirely on the side of Austria. The close of the Rosetti administration was marked by a royal decree (5th April 1889) conferring on Prince Ferdinand the title of His Royal Highness Prince of Rumania, the title of Crown Prince being withheld, as he was not the direct heir to the throne. Shortly afterwards the prince took his seat in the Senate amidst great enthusiasm.

Catargi's administration did not last long. He found it difficult to command a working majority in the Chamber that had been elected after Bratiano's downfall, and resigned on the king refusing to grant a dissolution. A new ministry was formed in November 1889 by General Manu out of mixed Conservative and Junimist elements, who pulled well together on all internal measures, although somewhat divided as to their foreign policy; and much good work was effected by the new Government. The old 6 per cent. loan was converted into 4 per cent. A gold standard was introduced, whereby the agio on gold was got rid of; a satisfactory budget was passed, and the 5 per cent. tax which had been imposed, prior to the war with Turkey, on the salaries of all Government employés, was abolished. The sale of State

lands to peasants under Carp's law was actively proceeded with, half of the State lands being parcelled out, and one-fourth actually sold. All further proceedings regarding the impeachment of Bratiano and the members of his ministry were stayed by a vote of the Chamber and Senate on the 15th February, to the great satisfaction of the king, who had always stood by the minister who had served him so well. On the 24th October 1890 the king laid with much ceremony the first stone of the new railway bridge over the Danube at Tchernavoda, and large sums were voted for railway extensions and for the completion of the Bucharest and Focsani fortifications. The country also was relieved in August of the presence of M. Hitrovo, who had lost much influence while his Conservative allies were in power, as his openly expressed Pan-Slavist views had alienated all his friends among the Rumanians. General Manu's ministry was destined, like the preceding one, to a short life. There was much distress and consequent discontent in the country, especially in Moldavia, which was by no means diminished by the consideration that that province was entirely unrepresented in the cabinet. In February 1891 the Government met with a defeat in the Senate by the rejection of their proposals on public education, and General Floresco was called on to form a new ministry. L. Catargi was appointed minister of the interior, and Vernesco was named minister of finance. On the meeting of the chambers M. Carp carried a vote of no confidence in the new ministry, and the king dissolved the Chambers. The new elections (April 1891) gave a large majority to the Government, but there were elected 40 National Liberals and only 6 Junimists.

The veteran statesman John Bratiano died on the 16th May, aged 76, and the king went to his residence at Florica to visit the widow and place a wreath on the tomb of his old and faithful servant. On the 6th July Kogalniceano, another veteran, passed away. Like Bratiano, he had been implicated in the national or rather revolutionary movement in 1848, and spent many years in exile striving for the union of the two principalities. He was minister of the interior under Prince Couza, and responsible for the important measures of the suppression of the corvée, the formation of a peasant proprietary, and the confiscation of the properties of the monasteries; and later on, as minister of foreign affairs for Prince Charles, he accompanied Bratiano to Berlin to struggle in favour of the rights and interests of his country. On 22nd May 1891 the jubilee festivities (25th year's reign) of the king were celebrated with much enthusiasm throughout the country. In November, a few days after the opening of the autumn session, Floresco's ministry resigned, and Catargi was once more called on to form a new Government. His new colleagues (including Tache Ionesco, a young and promising statesman) were all Conservatives, but the Government shared the fate of many previous administrations, and before it had been ten days in office was defeated in the Chambers on a vote of no confidence. M. Catargi, however, reconstituted his cabinet by the addition to it of Messrs Carp and Ghermani, prominent Junimists; Parliament was dissolved, and in the elections which followed the Conservative-Junimist coalition obtained a large majority.

The first year of the new administration was marked by the betrothal of Prince Ferdinand of Rumania to the Princess Maria, daughter of the duke of Coburg and the Grand Duchess Alexandra of Russia, and grand-daughter of Queen Victoria and of the Tsar Alexander: the betrothal was followed by a visit of King Charles to Queen Victoria at Windsor, on which occasion his majesty was invested with the order of the Garter. The marriage took place at Sigmaringen on the 10th January 1893. Prince Carol (born on the 15th October 1893) and the Princesses Elizabeth and Maria, the issue of this marriage, have been brought up in the Orthodox faith. The well-deserved affection of the country towards the dynasty was subsequently displayed during the dangerous illnesses from typhoid fever of Prince Ferdinand in 1897 and the young Prince Carol in 1899, when spontaneous expressions of sympathy poured in from all quarters.

The new ministry during their four years' tenure of office passed several useful measures through Parliament. The State credit was improved by the conversion of the public debt, the sale of the State lands to the peasantry was actively proceeded with, greatly assisted by the establishment of an agricultural bank founded by the Government with a capital of nearly a million sterling, for the purpose of making advances to the poorer landed classes; a rural gendarmerie was formed, a law was passed making irremovable the judges of the Court of Appeal and the presidents of the tribunals, and other important judicial reforms were carried out; a mining law was passed with the object of introducing foreign capital, and the commercial marine was developed by the formation of a State ocean service of passenger and cargo steamers. Great reforms, which had been unsuccessfully attempted by former Governments, were made in the service of public instruction and in the organization of the clergy. In 1893 and 1894 commercial and extradition treaties and a trade-mark convention were made with Great Britain. The commercial treaty with Great Britain, as well as similar treaties with Austria and Germany, were for a period of ten years, expiring in 1903. In May 1894 the king inaugurated with much ceremony the opening to navigation of a new waterway in the Sulina branch of the Danube, constructed by the European commission, and in September of the following year opened for traffic the magnificent railway bridge over the Danube at Tchernavoda (constructed by the Rumanian Government at a cost of about one and a half million sterling), which connects the whole of the Rumanian railway system with the port of Constantza, where a year later he laid the first stone of the new works destined to make that port a first-class harbour. Meanwhile the Liberal Opposition was being reorganized. On the death of John Bratiano his brother Demetrius was proclaimed chief of the united Liberal party, but he survived his brother only one year, and on his death in June 1892 the veteran statesman Demetrius Stourdza was recognized as the head of the National Liberal party. M. Stourdza had commenced his political career in 1857 as secretary to the divan *ad hoc* of Moldavia; in 1866 he was minister of public works, and in 1870 of finance. He had led the anti-dynastic agitation during Lascar Catargi's first ministry. In 1877 he was a strong opponent of the Russo-Rumanian alliance, but returned to power under Bratiano in 1878, and became a faithful defender of the dynasty and a strong partisan of the Triple Alliance. A man of great talent, tremendous application, and full of energy, he was the leading spirit of the most important financial institutions of the country, and was very popular in Liberal circles. In 1894 he started a very violent agitation in favour of the Rumanians of Transylvania and the Banat, who were being persecuted by their Magyar rulers after the unsuccessful attempt to present their famous "memorandum" to the Austrian emperor. Public meetings were held all over Rumania in favour of their oppressed countrymen. Interpellated in the Senate, the Government could only reply that they were unable to interfere in the internal affairs of a neighbouring state; and although they retained their parliamentary majority, they rapidly lost ground in public estimation. Another popular Opposition cry referring to internal matters was "Rumania for the Rumanians!" The new mining law, among other concessions, gave foreigners the right to lease lands for long periods for the working of petroleum, and this was denounced by the Opposition as being hostile to national interests, and also as being against the spirit of the constitution, which prohibited foreigners from holding lands. The Bill, in spite of the Opposition, was carried by the Government in April 1895, as well as another important measure favouring the construction of local railways by private individuals. The Liberal Opposition protested, and retired from the Chamber, and took no further part in legislative proceedings. The Liberal party had been out of office for eight years, the Conservative-Junimist coalition had practically carried out their complete programme, and legislation was at a deadlock owing to the abstention of the Liberal Opposition. The popular agitation against the Government was most violent, and the king thought it high time that there should be a change of ministry, and that the Liberal party should have its turn. The three Junimist members of the cabinet tendered their resignation, but Catargi undertook to carry on the Government if the king would grant an immediate dissolution of the Chambers, anticipating by a few months its constitutional term of four years. His majesty refused his consent; the Government resigned, and M. Stourdza was called on to form a new ministry.

In December Parliament was dissolved, and the elections took place under the auspices of M. Fleva, the new minister of the interior. In no so-called constitutional country in the world has the Government so much power in influencing the elections as in Rumania. On a change of ministry the first act of the new minister of the interior is to dismiss nearly all the prefects of the thirty districts into which the country is divided. (The Dobrudja, which consists of two additional districts, does not send any representatives to the Chamber.) The under-prefects share the same fate. The communal councils are then dissolved, and new provisional members appointed under Government pressure. Then follows the general election; and as all the executive officers are partisans of the Government, and are by no means scrupulous as to the means they employ, and as the hosts of officials scattered over the country almost invariably vote on the side of the Government, the result of the election can be foretold to a certainty. In the present case, although M. Fleva ostentatiously declared that there should be no official interference with the elections, there was the somewhat startling result that, whereas in the previous Parliament the Conservatives had an overwhelming majority in both houses, five Conservatives only were elected in the new Chamber, and two in the Senate. The advent to power of the Liberal party under M. Stourdza, who had recently been making such violent attacks on the Hungarian Government, caused some anxiety in Austria-Hungary, which was dispelled, however, by public declarations at Jassy and subsequent official explanations. When once office was obtained, it was to the interest of the new Government that the agitation should subside, and this was rendered comparatively

easy, as an amnesty had been granted to the political prisoners in Transylvania.

The official opening by the emperor of Austria of the new canal through the Iron Gates of the Danube on the 27th September 1896 (one of the episodes of the Hungarian "Millennium" festivities), was the means of bringing about a great improvement in the relations between the two countries. The kings of Rumania and Servia were the honoured guests of the emperor on this occasion, and immediately afterwards the emperor paid an official visit to King Charles at Bucharest, where great preparations had been made to give his imperial majesty a befitting reception. The improved relations which resulted from this exchange of courtesies between their sovereigns were unfortunately not of very long duration. In the following autumn King Charles paid a visit to the emperor at Budapest, the Hungarian capital—a visit which was intended further to cement the friendly feeling between their respective subjects; but, most unfortunately, the king of Rumania, in conferring numerous orders and decorations on the occasion of his visit, bestowed one, probably by an oversight, on a Hungarian official who was only known to fame as a very violent anti-Rumanian writer in the Magyar press. This incident was the signal for the reopening of an acrimonious newspaper war between the two countries, and the ill-feeling caused thereby had probably much to do with reconciling the Rumanians to a visit made by their sovereign in the following year (August 1898) to his other powerful neighbour, the Tsar. Accompanied by Prince Ferdinand and M. Stourdza, he was for a fortnight the emperor's guest at Moscow, Kieff, and St Petersburg. His reception everywhere was most cordial, on the part not only of the emperor, but also of the military, who had not forgotten that the king had commanded the Russian army before Plevna. This visit was the outward symbol of a reconciliation between the Rumanians and Russians—the relations between whom had been the reverse of cordial ever since the termination of the war of 1877–78, resulting as it did in the forcible alienation of Bessarabia from one country to the other. As regards foreign relations with other Powers during M. Stourdza's administration, it may be noted that diplomatic relations were renewed with Greece after an interruption of several years. The relations of the Government with Turkey were also very friendly, and a commercial convention was signed between the two countries; at the time of the Armenian troubles the entry of Armenian refugees into Rumanian territory was rigorously prevented, ostensibly on the grounds that the Government did not wish Bucharest to become the centre of a conspiracy against a neighbour. In the Greco-Turkish war, also, much sympathy was shown to Turkey, probably with the object of obtaining friendly treatment for the numerous Koutzo-Vlach population scattered over Turkey in Europe, but the friendliness shown by Rumania was not thoroughly reciprocated. The sultan would not grant the concessions she desired with regard to the nomination of an independent bishopric for the Vlach communities, and later on in 1900 the commercial treaty was denounced by Turkey, and Rumania lost the privilege of most favoured nation treatment and of the special tariff which had previously been accorded.

As regards home politics, the overwhelming majority of the Liberal party at the elections of 1895, instead of being a source of strength, proved the very reverse. It caused the party to split up into factions, Stourdzists, Aurelianists, and Flevists, so called after the names of their respective chiefs. M. Fleva, who now held office for the first time, after having battled in the Liberal cause for twenty years, was the first to quarrel with his chief, and had to leave the ministry after only a few months' tenure of office. He was replaced as minister of the interior by M. Statesco. Some months later, shortly after the visit of the emperor of Austria, M. Stourdza himself had to retire from office in circumstances which caused a great and painful sensation throughout the country. The head of the Orthodox Church, the Metropolitan Gennadius, who had formerly taken an active part in insisting that the younger members of Prince Ferdinand's family should be brought up in the Orthodox faith, had for some years past, as *ex-officio* head of the richly-endowed philanthropic establishments founded by the Princess Brancovan, been desirous of getting the entire management of these wealthy foundations into his own hands, and had made violent attacks on the two administrators, Prince George Bibescu and Prince Stirbey, both members of the Brancovan family. In the quarrel that ensued much that was questionable in the early career of the prelate was brought to light, and he was openly accused of simony, of heresy, and other matters more suitable for a criminal court. The scandal created was so great that the Government called on the metropolitan to resign, and on his refusal to do so ordered his arraignment before the Holy Synod, by whom, after a public trial, he was found guilty of certain canonical offences, and sentenced to be deposed from his high estate. The same night, by order of the head of the Government, he was seized in his archiepiscopal residence by the police, and removed by force to a neighbouring monastery. This harsh treatment of the head of the Church led to a tremendous outcry against M. Stourdza. Indignant meetings of protest were held throughout the country, and by no one was the prime minister more eloquently and vigorously denounced than by his late colleague M. Fleva. M. Stourdza had to yield before the storm, and on the 3rd December 1896 the president of the council, M. Aurelian, was called on to reconstitute a Liberal cabinet, with the principal object of calming public opinion by the settlement of this exciting question, which was putting a stop to parliamentary and all other business. M. B. Lascar Catargi, an able and experienced public servant, was called to the ministry of the interior. M. Aurelian then appealed to the patriotic sentiments of the Conservative party to help to solve the difficulty, and with the aid of Messrs Lascar Catargi and Tache Ionescu, after a long and anxious discussion, the following decision was arrived at:—The Holy Synod was to reverse its judgment (M. Ionescu, a clever lawyer, had discovered some technical flaw which would enable the members of the Synod, all more or less subservient to their political chiefs, to go through the somewhat humiliating process of reversing their first decision), and the metropolitan was to be restored to his ecclesiastical rank and dignities, which, after holding them for a few days, he was voluntarily to resign and to receive as compensation a handsome pension. This scheme was carried out to the letter, except that the metropolitan did not receive his pension until the year 1899, when the Conservatives were again in power.

Calm was restored in the country. Monsignor Joseph Gheorgian, who had previously held the same high office, but who had retired into private life, was re-elected metropolitan, and the Liberal party was again torn by intestine quarrels. M. Aurelian and his colleagues having tasted the sweets of office, were not inclined to hand over their portfolios to M. Stourdza and his partisans. The struggle terminated in the success of M. Stourdza, who in April 1897 returned to power and remained president of the council until 1899. The discords among the Liberal party prevented the carrying out of the extensive projects of reform that had been promised by M. Stourdza's Government on its first accession to power, and but few important measures were passed—one for the reform of public instruction being the most noteworthy. The Liberal Government abstained from putting into force the mining law passed in 1895, and it remained a dead letter until the Conservatives came back into power in 1899. The Rumanian mercantile marine was expanded by the organization of a line of cargo steamers belonging to the Government to run between the Danube and Rotterdam, and considerable progress was made in the extension of railways and other public works, notably those at the port of Constantza. M. Stourdza's Government, which had risen to power mainly on the national question, was also destined to fall on it. A tremendous popular agitation was raised on the subject of certain subsidies made by the Rumanians for the support of the Rumanian schools at Kronstadt in Transylvania, and M. Stourdza was accused of too great subserviency to the Hungarian Government. The agitation culminated in street riots at Bucharest. On the same evening that M. Stourdza tendered his resignation to the king (April 1899) the veteran Conservative statesman Lascar Catargi suddenly died; and it is said that the king was preparing a summons to him to form a new ministry when the news arrived at the palace. The Conservative party held a hurried meeting, and without consulting M. Carp (the leader of the Junimist party, who had for so many years acted as a colleague of M. Catargi), they elected as their chief M. G. Gr. Cantacuzene, a gentleman of great wealth and highly respected, but not by any means a brilliant statesman. He was called on by the king to form a ministry. The Junimists, feeling hurt by the action of the Conservative party, declined to take any part in it, and M. Cantacuzene ultimately formed a ministry composed of five pure Conservatives—himself, the veteran General Manu, Tache Ionescu, General Jaques Lahovary, and his brother Jean, and four recruits from the Independent Liberal party, Messrs Fleva, Istrati, Disescu, and Gradishteanu, who now formally rallied to the Conservative party. The new ministry was hardly in office when serious agrarian riots broke out in the Olt district in Wallachia, due in great measure to Socialistic agitation. The Government acted energetically, and the revolt was promptly suppressed by the military, but not before many of the misguided peasants had paid the penalty of their folly with their lives.

In the new Chamber of Representatives elected after the change of Government there were 149 Conservatives, 13 Junimists, and 7 Liberals. But the Conservative administration had a heavy task before it, and the years 1899–1900 will long be remembered in Rumania for the economical and financial crises through which it passed, owing principally to the disastrous failure of the harvest of 1899, which caused so much distress among the poorer classes that in the autumn several thousand emigrants left the Dobrudja for foreign countries, and in 1900 at least 5000 Jews emigrated from Moldavia. The financial position of the country had hitherto on the surface been very satisfactory. The public debt, mostly placed in Germany, amounted to about 51 millions sterling, of which the interest had been regularly paid, but the facility with which money had always been borrowed gave rise to great extravagance. Expenses which ought to have been defrayed out of the ordinary budget, such

as material for railways, construction of roads and public buildings (especially in the erection, regardless of expense, of magnificent public offices at Bucharest), equipment and ammunition for the army, &c., were frequently defrayed out of the produce of the loans, and the custom had arisen when money was scarce of issuing treasury bonds. When the Conservative Government came into office they found that the payment of 2½ millions of these bonds would shortly become due, and there were no resources in the treasury to meet them. Owing to the Transvaal war and other causes the money market was most unfavourable, especially in Germany, where their loans had always hitherto been negotiated. To add to their difficulties, there was an almost entire failure of the harvest, and a certainty of a large deficit in the ordinary budget for 1898-99, since estimated at £1,200,000. The value of cereals exported in 1898 was about 9 millions sterling, in 1899 only 3½ millions; and when it is recollected that the railways and navigation services are all State property, and that the State is also the owner of the tobacco, salt, and other monopolies, which bring in on an average year some 2¼ millions, it may well be imagined that the failure of the harvest, which affects materially all these as well as other sources of revenue, is a tremendous blow to the financial position of the country. The Government managed to extricate itself from its immediate difficulties by raising a loan at Berlin of 9 millions sterling in the autumn of 1899, but on very stringent terms. Besides paying a much higher rate of interest than heretofore, it bound itself not to contract any further new loans until this one was paid off. The budget for 1900-1901, after allowing for the increase of the public debt, showed a nominal surplus of about £280,000 in a total of close on 10 millions, the expenditure of the country having nearly doubled in ten years. To balance the budget new taxes were levied to the extent of £750,000, some of which caused great discontent, notably a tax on *tzuica* or plum brandy, the injudicious and premature application of which provoked serious riots among the peasantry in the districts concerned, which were not suppressed without loss of life. The Conservative Government during its tenure of office passed several useful measures, and did one very substantial service to the country in settling by an amicable compromise with the Hungarian Government the long-vexed question concerning the subsidy granted by Rumania to the national schools at Kronstadt. The Hungarian Government, through its prime minister, M. Szell, openly announced its intention of inaugurating a more just and liberal policy towards the Rumanians of Transylvania and the Banat.

In the summer of 1900 the financial crisis was so acute that it was generally felt that M. Cantacuzene's ministry was not strong enough to cope with it. Secret negotiations took place between the Junimists and some of the Conservative ministers, the outcome of which was a public declaration of the fusion of the old and new Conservatives into one united Conservative party. M. Cantacuzene resigned the presidency of the council, although remaining the nominal head of the party, and M. Carp, who had been the leader of the Junimists, was called on by the king to form a new ministry. General Lahovary and Gradishteanu retained their portfolios. Olanescu was given the interior, and Marghiloman the ministry of foreign affairs. Messrs Arion, Filipescu, and Maiorescu were appointed ministers of public instruction, the domains, and justice, while M. Carp himself took the department of finance. Later on in the year the various factions of the Liberal party also decided to combine as National Liberals under the leadership of the veteran Stourdza. But the new ministry, which had come into power by intrigue, was soon destined to fall in the same way. One formidable adversary, the ex-demagogue and late Conservative minister, M. Fleva, had been got out of the way by being appointed to the Rumanian legation at Rome, but General Manu, M. Tache Ionescu, and M. Lahovary, other members of the late ministry, remained. They had been passed over and ignored at the time of the Conservative fusion, but soon made their power felt. The Conservatives as a whole were united in wishing to meet the financial crisis by a moderate reduction of the expenditure and a large increase of taxation, while M. Stourdza and the Liberal Opposition advocated the permanent reduction of the annual expenditure by 20,000,000 francs, which would necessitate the raising of 5,000,000 only by fresh taxation. The Conservative ex-ministers, who had a large following in the Chambers, formed a majority in the budget committee of the house, and strenuously opposed some of M. Carp's financial proposals, notably a largely increased tax on professions. The premier, unable to have his way, resigned in February 1901, and M. Cantacuzene was again called on to form a ministry, but being unable to obtain the adherence of any members of M. Carp's ministry, declined the task. A truce was agreed on and M. Carp returned to power, but only for a few days. M. Stourdza delivered a very violent speech in the Senate, attacking several of the members of M. Cantacuzene's ministry, and M. Carp, replying to an interpellation in the Chambers, declined to defend them or to accept responsibility for their past proceedings. This proved too great a strain on the loyalty of the ex-ministers and their followers, and on the 25th February the Chamber of Deputies, after a stormy sitting, rejected by 75 votes to 74 a vote of confidence in the financial policy of the Government. The majority was composed of dissenting Conservatives and of Liberals, who had, however, only eight seats in the house. M. Carp again resigned, and as the Conservatives, through party dissensions, had proved themselves quite incapable of dealing with the financial crisis, the king decided to entrust M. Stourdza with the formation of a Liberal ministry. He was summoned on the morning of the 26th, completed the ministerial list by the evening, and on the following morning (*i.e.*, within 40 hours of the passing of the hostile resolution in the Chamber) read the king's decree dissolving both the Chamber of Deputies and the Senate.

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(H. TR.)

Rumburg, the chief town of a government district in Bohemia, Austria, on the Saxon frontier, with Saxon and Austrian custom-houses. Important industrial centre, with textile industry (linen, woollen, and cotton goods, sewing thread, &c.), turnery in horn, dyeing, corn-milling, &c. Population (1890), 10,178; (1900), 10,382, all German and chiefly Roman Catholic (estimated at 3 per cent. Protestant, 1 per cent. Old Catholic, and 1 per cent. Jewish).

Runcorn, a market town and seaport, Cheshire, England, in the Northwich parliamentary division, 15 miles north-east of Chester by rail, on the south side of the Mersey. Several places of worship have been enlarged, and among new buildings are a Catholic church, seamen's institute, church house, technical institute, and free library. Runcorn is a sub-port of Manchester, with which it is connected by the Manchester Ship Canal, and has extensive wharfage and warehouse accommodation. The chief exports are coal, salt, and pitch; but there is also a large traffic in potters' materials (such as bone ash, china clay, flints, &c.), also a miscellaneous one in slates, pig-iron, ochre, and amber. A transporter bridge between Runcorn and Widnes, with a suspended car worked by electricity to convey passengers and vehicles from one side of

the river to the other—the first bridge of the kind in England—was constructed in 1902. Population of parish and urban district (1891), 20,050; (1901), 16,491.

Rupar, a town of British India, in the Umballa district of the Punjab, on the left bank of the river Sutlej, 43 miles north of Umballa; 1120 feet above the sea. Population (1881), 10,326; (1891), 8693; municipal income (1897–98), Rs.11,038. It is historically interesting as the scene of Ranjit Singh's visit to Lord William Bentinck when governor-general in 1831. Here are the head works of the Sirhind canal. It is also a centre of local trade, and has manufactures of cotton cloth and hardware. Hindu and Mahommedan fairs are held.

Rupert's Land. See North-West Territories.

Ruskin, John (1819–1900), was born in London, at Hunter Street, Brunswick Square, on 8th February 1819, being the only child of John James Ruskin and Margaret Cox. They were Scots, first cousins, the grandchildren of a certain John Ruskin, of Edinburgh (1732–1780). In *Præterita* the author professes small knowledge of his ancestry. But the memoirs published on the authority of the family trace their descent to the Adairs and Agnews of Galloway. In this family tree are men famous in arms and in the public service: Sir Andrew Agnew of Lochnaw, Admiral Sir John Ross, Field-Marshal Sir Hew Dalrymple Ross, Dr John Adair, in whose arms Wolfe died at Quebec, and the Rev. James Tweddale of Glenluce, to whom the original Covenant, now in the Glasgow Museum, had been confided. The name Ruskin is said to be a variant of Erskine, or Roskeen, or Rogerkin, and even Roughskin. It is more probably Rusking, an Anglian family, which passed northwards and became Ruskyn, Rusken, and Ruskin.

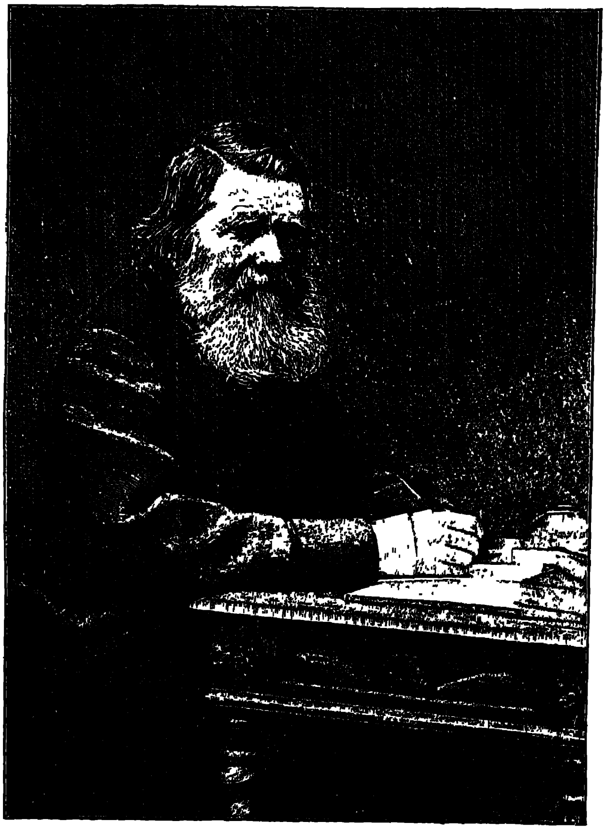
John Ruskin, the author's grandfather, a handsome lad of twenty, ran away with Catherine Tweddale, daughter of the Covenanting minister and of Catherine Adair, then a beautiful girl of sixteen. He settled in Edinburgh and engaged in the wine trade, lived liberally in the cultivated society of the city, lost his health and his fortune, and ended his days in debt. His son, John James Ruskin (1785–1864), father of the author, was sent to the High School at Edinburgh under Dr A. Adam, received a sound classical education, and was well advised by his friend Dr Thomas Brown, the eminent metaphysician. When of age, John James was sent to London to enter the wine trade. There, in 1809, he founded the sherry business of Ruskin, Telford, and Domecq; Domecq being proprietor of a famous vineyard in Spain, Telford contributing the capital of the firm, and Ruskin having sole control of the business. John James Ruskin, a typical Scot, of remarkable energy, probity, and foresight, built up a great business, paid off his father's debts, formed near London a most hospitable and cultured home, where he maintained his taste for literature and art, and lived and died, as his son proudly wrote upon his tomb, "an entirely honest merchant." He was also a man of strong brain, generous nature, and fine taste. After a delay of nine years, having at last obtained an adequate income, he married his cousin, Margaret Cox, who had already lived for eighteen years with his mother, the widow of John Ruskin of Edinburgh. When this marriage of the two cousins, who had known each other all their lives, took place in 1818, neither of them was young. John James was thirty-three and Margaret was thirty-seven. In the following year (8th February 1819) their only child, John, was born in Hunter Street, London.

Margaret Ruskin, the author's mother, was a handsome, strong, stern, able, devoted woman of the old Puritan school, Calvinist in religion, unsparing of herself and others, rigid in her ideas of duty, proud, reserved, and ungracious. She was the daughter of Captain Cox, of Yarmouth, master mariner in the herring fishery, who died young; whereupon his widow maintained herself as landlady of the King's Head Inn at Croydon. Her younger daughter married Mr Richardson, a baker, of Croydon; the elder, Margaret, married John James Ruskin. Jessie, a sister of John James, married Peter Richardson, a tanner, of Perth, so that the author had cousins of two Richardson families, unconnected with each other. In his own memoirs he speaks much more of these than of any Ruskins, Tweddales, Adairs, or Agnews. The child was brought up under a rigid system of nursing, physical, moral, and intellectual; kept without toys, not seldom whipped, watched day and night, but trained from infancy in music, drawing, reading aloud, and observation of natural objects. When he was four the family removed to a house on Herne Hill, then a country village, with a garden and rural surroundings. The father, who made long tours on business, took his wife, child, and nurse year after year across England as far as Cumberland and Scotland, visiting towns, cathedrals, castles, colleges, parks, mountains, and lakes. At five the child was taken to Keswick; at six to Paris, Brussels, and Waterloo; at seven to Perthshire. At fourteen he was taken through Flanders, along the Rhine, and through the Black Forest to Switzerland, where he first imbibed his dominant passion for the Alps. His youth was largely passed in systematic travelling in search of everything beautiful in nature or in art. And to one so precocious, stimulated by a parent of much culture, ample means, and great ambition, this resulted in an almost unexampled æsthetic education. In childhood also he began a systematic practice of composition, both in prose and verse. His mother trained him in reading the Bible, of which he read through every chapter of every book year by year; and to this study he justly attributes his early command of language and his pure sense of style. His father read to him Shakespeare, Scott, Don Quixote, Pope, and Byron, and most of the great English classics; and his attention was especially turned to the formation of sentences and to the rhythm of prose. He began to compose both in prose and verse as soon as he had learned to read and write, both of which arts he taught himself by the eye.

His first letter is dated 1823, when he was only four. In it he corrects his aunt, who had put up the wooden pillars of his Waterloo bridge "upside down." At five he was a bookworm. At seven he began a work in four volumes, with "copper-plates printed and composed by a little boy, and also drawn." His first poem, correct in rhyme and form, was written before he was seven. At nine he began "Eudosia, a poem of the Universe." From that year until his Newdigate Prize, at the age of twenty, he wrote enormous quantities of verse, and began dramas, romances, and imitations of Byron, Pope, Scott, and Shelley. What remain of these effusions have no special quality except good sense, refined feeling, accuracy of phrase, and a curious correctness of accent and rhythm. Of true poetry in the higher sense there is hardly a single line.

His schooling was irregular and not successful. At the age of eleven he was taught Latin and Greek by Dr Andrews, a scholar of Glasgow University. About the same time he had lessons in drawing and in oil painting from Runciman. French and Euclid were taught by Rowbotham. At fifteen he was sent for two years to the day school of the Rev. T. Dale of Peckham, and at seventeen he attended some courses in literature at King's College, London. In painting he had lessons from Copley Fielding and afterwards from Harding. But in the incessant

travelling, drawing, collecting specimens, and composition in prose and verse he had gained but a very moderate classical and mathematical knowledge when he matriculated at Oxford; nor could he ever learn to write tolerable Latin. As a boy he was active, lively, and docile; a good walker, but ignorant of all boyish games, as naïf and as innocent as a child; and he never could learn to dance or to ride. He was only saved by his intellect and his fine nature from turning out an arrant prig. He was regarded by his parents, and seems to have regarded himself, as a genius. As a child he had been "a savant in petticoats"; as a boy he was a poet in breeches. At the age of seventeen he saw Adèle, the French daughter of Monsieur Domecq, Mr Ruskin's partner, a lovely girl of fifteen. John fell rapturously in love with her; and, it seems, the two fathers seriously contemplated their marriage. The young poet wooed the girl with poems, romances, dramas, and mute worship, but received nothing except chilling indifference and lively ridicule. To the gay young beauty, familiar with Parisian society, the raw and serious youth was not a possible *parti*. She was sent to an English school, and he occasionally saw her. His unspoken passion lasted about three years, when she married the Baron Duquesne. Writing as an old man, long after her death, Ruskin speaks of his early love without any sort of rapture. But it is clear that it deeply coloured his life, and led to the dangerous illness which for some two years interrupted his studies and made him a wanderer over Europe.



JOHN RUSKIN.
(From a photograph by Barraud, London.)

As the father was resolved that John should have everything that money and pains could give, and was one day to be a bishop at least, he entered him at Christ Church, Oxford, as a gentleman-commoner—then an order reserved for men of wealth and rank. Ruskin's Oxford career, broken by the two years passed abroad, was not very full of incident or of usefulness. Though he never became either a scholar or a mathematician, he did enough accurate work to be placed in the honorary fourth class both in classics and in mathematics. By the young bloods of the "House" he was treated pleasantly as a raw outsider of genius. By some of the students and tutors, by Liddell, Newton, Acland, and others, he was regarded as a youth of rare promise, and he made some lifelong friendships with men of mark and of power. Both he and his college took kindly the amazing proceeding of his mother, who left her husband and her home to reside in Oxford, that she might watch over her son's health. The one success of his Oxford career was the winning the Newdigate Prize by his poem "Salsette and Elephanta," which he recited in the Sheldonian Theatre (June 1839). Two years of ill-health and absence from home ensued. And he did not become "a Graduate of Oxford" until 1842, in his twenty-fourth year, five years after his first entrance at the University.

In fact, his desultory school and college life had been little more than an interruption and hindrance to his real education—the study of nature, of art, and of literature. Long before Ruskin published books he had appeared in print. In March 1834, when he was but fifteen, Loudon's *Magazine of Natural History* published an essay of his on the strata of mountains and an inquiry as to the colour of the Rhine. He then wrote for Loudon's *Magazine of Architecture*, and verses of his were inserted in Messrs Smith and Elder's *Friendship's Offering*, by the editor, T. Pringle, who took the lad to see the poet Rogers. At seventeen he wrote for *Blackwood* a defence of Turner, which the painter, to whom it was first submitted, did not take the trouble to forward to the magazine. At eighteen he wrote a series of papers, signed Kata Phusin, *i.e.* "after Nature," for Loudon's *Magazine*, on "The Poetry of Architecture." In 1838 (he was then nineteen) Mr Loudon wrote to the father, "Your son is the greatest natural genius that ever it has been my fortune to become acquainted with."

Having recovered his health and spirits by care and foreign travel, and having taken his degree and left Oxford, Ruskin set to work steadily at Herne Hill on the more elaborate defence of Turner, which was to become his first work. *Modern Painters*, vol. i., by "a Graduate of Oxford," was published May 1843, when the author was little more than twenty-four. It produced a great and immediate sensation. It was vehemently attacked by the critics, and coolly received by the painters. Even Turner was somewhat disconcerted; but the painter was now known to both Ruskins, and they freely bought his pictures. The family then went again to the Alps, that John might study mountain formation and "Truth" in landscape. In 1845 he was again abroad in Italy, working on his *Modern Painters*, the second volume of which appeared in 1846. He had now plunged into the study of Bellini and the Venetian school, Fra Angelico and the early Tuscans, and he visited Lucca, Pisa, Florence, Padua, Verona, and Venice, passionately devoting himself to architecture, sculpture, and painting in each city of North Italy. He wrote a few essays for the *Quarterly Review* and other periodicals, and in 1849 (*æt.* 30) he published *The Seven Lamps of Architecture*, with his own etchings, which greatly increased the reputation acquired by his *Modern Painters*.

On the 10th April 1848, a day famous in the history of Chartism, Ruskin was married at Perth to Euphemia C. Gray, a lady of great beauty, of a family long intimate with the Ruskins. The marriage, we are told, was arranged by the parents of the pair, and was a somewhat hurried act. It was evidently ill-assorted, and brought no happiness to either. They travelled, lived in London, saw society, and attended a "Drawing-room" at Buckingham

Palace. But Ruskin, immersed in various studies and projects, was no husband for a brilliant woman devoted to society. No particulars of their life have been made public. In 1854 his wife left him, obtained a nullification of the marriage under Scots law, and ultimately became the wife of John Everett Millais. John Ruskin returned to his parents, with whom he resided till their death; and neither his marriage nor the annulling of it seems to have affected seriously his literary career.

Ruskin's architectural studies, of which *The Seven Lamps* was the first fruit, turned him from Turner and *Modern Painters*. He planned a book about Venice in 1845, and *The Stones of Venice* was announced in 1849 as in preparation. After intense study in Italy and at home, early in 1851 (the year of the Great Exhibition in London) the first volume of *The Stones of Venice* appeared (*æt.* 32). It was by no means a mere antiquarian and artistic study. It was a concrete expansion of the ideas of *The Seven Lamps*—that the buildings and art of a people are the expression of their religion, their morality, their national aspirations and social habits. It was, as Carlyle wrote to the author, "a *sermon* in stones," "a singular sign of the times," "a new *Renaissance.*" It appeared in the same year with the *Construction of Sheepfolds*—a plea for the reunion of Christian churches—in the same year with the essay on *Pre-Raphaelitism*, the year of Turner's death (19th December). *The Stones of Venice* was illustrated with engravings by some of the most refined artists of his time. The author spent a world of pains in having these brought up to the highest perfection of the reproductive art, and began the system of exquisite illustration, and those facsimiles of his own and other sketches, which make his works rank so high in the catalogues and price-lists of collectors. This delicate art was carried even farther in the later volumes of *Modern Painters* by the school of engravers whom Ruskin inspired and gathered round him. And these now rare and coveted pieces remain to rebuke us for our modern preference for the mechanical and unnatural *chiaroscuro* of photogravure—the successor and destroyer of the graver's art. Although Ruskin was practised in drawing from the time that he could hold a pencil, and had lessons in painting from some eminent artists, he at no time attempted to paint pictures. He said himself that he was unable to compose a picture, and he never sought to produce anything that he would call a work of original art. His drawings, of which he produced an enormous quantity, were always intended by himself to be studies or memoranda of buildings or natural objects precisely as they appeared to his eye. Clouds, mountains, landscapes, towers, churches, trees, flowers, and herbs were drawn with wonderful precision, minuteness of detail, and delicacy of hand, solely to recall some specific aspect of nature or art, of which he wished to retain a record. In his gift for recording the most subtle characters of architectural carvings and details, Ruskin has hardly been surpassed by the most distinguished painters.

In 1853 *The Stones of Venice* was completed at Herne Hill, and he began a series of *Letters* and *Notes* on pictures and architecture. In this year (*æt.* 34) he opened the long series of public lectures wherein he came forward as an oral teacher and preacher, not a little to the alarm of his parents and amidst a storm of controversy. The Edinburgh Lectures (November 1853) treated Architecture, Turner, and Pre-Raphaelitism. The Manchester Lectures (July 1857) treated the moral and social uses of art, now embodied in *A Joy for Ever*. Some other lectures are reprinted in *On the Old Road* and *The Two Paths*, 1859. These lectures did not prevent the issue of various *Notes* on the Royal Academy pictures and the Turner collections; works on the *Harbours of England*, 1856; on the *Elements of Drawing*, 1857; the *Elements of Perspective*, 1859. And at last, after prolonged labour, the fifth and final volume of *Modern Painters* was published in 1860 (*æt.* 41). This marks an epoch in the career of John Ruskin; and the year 1860 closed the series of his works on art strictly so called; indeed, this was the last of his regular works in substantial form. The last forty years of his life were devoted to expounding his views, or rather his doctrines, on social and industrial problems, on education, morals, and religion, wherein art becomes an incidental and instrumental means to a higher and more spiritual life. And his teaching was embodied in an enormous series of *Lectures*, *Letters*, *Articles*, *Selections*, and serial pamphlets. These are now collected in upwards of thirty volumes in the final edition. The entire set of Ruskin's publications amounts to more than fifty works having distinctive titles. For some years before 1860 Ruskin had been deeply stirred by reflecting on the condition of all industrial work and the evils of modern society. His lectures on art had dealt bitterly with the mode in which buildings and other works were produced. In 1854 he joined Mr F. D. Maurice, Mr T. Hughes, and several of the new school of painters, in teaching classes at the Working Men's College. But it was not until 1860 that he definitely began to propound a new social scheme, denouncing the dogmas of political economy. Four lectures on this topic appeared in the *Cornhill Magazine*, until the public disapproval led the editor, then W. M. Thackeray, to close the series. They were published in 1862 as *Unto this Last*. In the same year he wrote four papers in the same sense in *Fraser's Magazine*, then edited by J. A. Froude; but he in turn was compelled to suspend the issue. They were completed and ultimately issued under the title *Munera Pulveris*. These two small books contain the earliest and most systematic of all Ruskin's efforts to depict a new social Utopia: they contain a vehement repudiation of the orthodox formulas of the economists; and they are for the most part written in a trenchant but simple style, in striking contrast to the florid and discursive form of his works on art.

In 1864 Ruskin's father died, at the age of 79, leaving his son a large fortune and a fine property at Denmark Hill. John still lived there with his mother, aged 83, infirm, and failing in sight, to whom came as a companion their cousin, Joanna Ruskin Agnew, afterwards Mrs Arthur Severn. At the end of the year 1864 Ruskin delivered at Manchester a new series of lectures—not on art, but on reading, education, woman's work, and social morals—the expansion of his earlier treatises on economic sophisms. This afterwards was included with a Dublin lecture of 1868 under the fantastic title of *Sesame and Lilies* (perhaps the most popular of his social essays), of which 44,000 copies were issued down to 1900. He made this, in 1871, the first volume of his collected lectures and essays, the more popular and didactic form of his new Utopia of human life. It contains, with *Fors*, the most complete sketch of his conception of the place of woman in modern society. In the very characteristic preface to the new edition of 1871 he proposes never to reprint his earlier works on art; disclaims many of the views they contained, and much in their literary form; and specially regrets the narrow Protestantism by which they were pervaded. In the year 1866 he published a little book about girls, and written for girls, a mixture of morals, theology, economics, and geology, under the title of *Ethics of the Dust*; and this was followed by a more important and popular work, *The Crown of Wild Olive*. This in its ultimate form contained lectures on "Work," "Traffic," "War," and

the "Future of England." It is one of his most trenchant utterances, full of fancy, wit, eloquence, and elevated thought. But a more serious volume was *Time and Tide* (1867), a series of twenty-five letters to a workman of Sunderland upon various points in the Ruskinian Utopia. This little collection of "Thoughts," written with wonderful vivacity, ingenuity, and fervour, is the best summary of the author's social and economic programme, and contains some of his wisest and finest thoughts in the purest and most masculine English that he had at his command. In 1869 he issued the *Queen of the Air*, lectures on Greek myths, a subject he now took up, with some aid from the late Sir C. Newton. It was followed by some other occasional pieces; and in the same year he was elected Slade professor of art in the University of Oxford. He now entered on his professorial career, which continued with some intervals down to 1884, and occupied a large part of his energies. His lectures began in February 1870, and were so crowded that they had to be given in the Sheldonian Theatre, and frequently were repeated to a second audience. He was made honorary fellow of Corpus Christi, and occupied rooms in the college. In 1871 his mother died, at the age of 90, and his cousin, Miss Agnew, married Mr Arthur Severn. In that year he bought from Mr Linton, Brantwood, an old cottage and property on Coniston Lake, a lovely spot facing the mountain named the Old Man. He added greatly to the house and property, and lived in it continuously until his death in 1900. In 1871, one of the most eventful years of his life, he began *Fors Clavigera*, a small serial addressed to the working men of England, and published only by Mr George Allen, engraver, at Keston in Kent, at 7d., and afterwards at 10d., but without discount, and not through the trade. This was a medley of social, moral, and religious reflections interspersed with casual thoughts about persons, events, and art. *Fors* means alternatively Fate, Force, or Chance, bearing the *Clavis*, Club, Key, or Nail, *i.e.*, power, patience, and law. It was a desultory exposition of the Ruskinian ideal of life, manners, and society, full of wit, play, invective, and sermons on things in general. It was continued with intervals down to 1884, and contained ninety-six letters or pamphlets, partly illustrated, which originally filled eight volumes and are now reduced to four.

The early years of his Oxford professorship were occupied by severe labour, sundry travels, attacks of illness, and another cruel disappointment in love. In spite of this, he lectured, founded a museum of art, to which he gave pictures and drawings and £5000; he sought to form at Oxford a school of drawing; he started a model shop for the sale of tea, and model lodgings in Marylebone for poor tenants. At Oxford he set his pupils to work on making roads to improve the country. He now founded "St George's Guild," himself contributing £7000, the object of which was to form a model industrial and social movement, to buy lands, mills, and factories, and to start a model industry on co-operative or Socialist lines. In connexion with this was a museum for the study of art and science at Sheffield. Ruskin himself endowed the museum with works of art and money; a full account of it has been given in Mr E. T. Cook's *Studies in Ruskin* (1890), which contains the particulars of his University lectures and of his economic and social experiments. It is unnecessary to follow out the history of these somewhat unpromising attempts. None of them came to much good, except the Sheffield museum, which is an established success, and is now transferred to the town. In *Fors*, which was continued month by month for seven years, Ruskin poured out his thoughts, proposals, and rebukes on society and persons with inexhaustible fancy, wit, eloquence, and freedom, until he was attacked with a violent brain malady in the spring of 1878 (*æt.* 59); and, although he recovered in a few months sufficiently to do some occasional work, he resigned his professorship early in 1879. The next three years he spent at Brantwood, mainly in retirement, and unhappy in finding nearly all his labours interrupted by his broken health. In 1880 he was able to travel in northern France, and began the *Bible of Amiens*, finished in 1885; and he issued occasional numbers of *Fors*, the last of which appeared at Christmas 1884. In 1882 he had another serious illness, with inflammation of the brain; but he recovered sufficiently to travel to his old haunts in France and Italy—his last visit. And in the following year he was re-elected professor at Oxford and resumed his lectures; but increasing brain excitement, and indignation at the establishment of a laboratory to which vivisection was admitted, led him to resign his Oxford career, and he retired in 1884 to Brantwood, which he never left. He now suffered from frequent attacks of brain irritation and exhaustion, and had many causes of sorrow and disappointment. His lectures were published at intervals from 1870 to 1885 in *Aratra Pentelici*, *The Eagle's Nest*, *Love's Meinie*, *Ariadne Florentina*, *Val d'Arno*, *Proserpina*, *Deucalion*, *The Laws of Fesolê*, *The Bible of Amiens*, *The Art of England*, and *The Pleasures of England*, together with a series of pamphlets, letters, articles, notes, catalogues, and circulars.

In the retirement of Brantwood he began his last work, *Præterita*, a desultory autobiography with personal anecdotes and reminiscences. He was again attacked with the same mental malady in 1885, which henceforth left him fit only for occasional letters and notes. In 1887 it was found that he had exhausted (spent, and given away) the whole of the fortune he had received from his father, amounting, it is said, to something like £200,000; and he was dependent on the vast and increasing sale of his works, which produced an average income of £4000 a year, and at times on the sale of his pictures and realizable property. In 1872 a correspondent had remonstrated with him in vain as to taking "usury," *i.e.*, interest on capital lent to others for use. In 1874 Ruskin himself had begun to doubt its lawfulness. In 1876 he fiercely assailed the practice of receiving interest or rent, and he henceforth lived on his capital, which he gave freely to friends, dependants, public societies, charitable and social objects. The course of his opinions and his practice is fully explained in successive letters in *Fors*. Until 1889 he continued to write chapters of *Præterita*, which was designed to record memories of his life down to the year 1875 (*æt.* 56). It was, in fact, only completed in regular series down to 1858 (*æt.* 39), with a separate chapter as to Mrs Arthur Severn, and a fragment called *Dilecta*, containing letters and early recollections of friends, especially of Turner. These two books were published between 1885 and 1889; and except for occasional letters, notes, and prefaces, they form the last writings of the author of *Modern Painters*. His literary career thus extends over fifty years. But he has left nothing more graceful, naïf, and pathetic than his early memories in *Præterita*—a book which must rank with the most famous "Confessions" in any literature. The last ten years of his life were passed in complete retirement at Brantwood, in the loving care of the Severn family, to whom the estate was transferred, with occasional visits from friends, but with no sustained work beyond correspondence, the revision of his works, and a few notes and prefatory words to the books of others. He wished to withdraw his early art writings from circulation, but the public

demand made this practically impossible. And now the whole of his writings are under the control of Mr George Allen, in several forms and prices, including a cheap series at 5s. per volume.

The close of his life was one of entire peace and honour. He was loaded with the degrees of the universities and membership of numerous societies and academies. "Ruskin Societies" were founded in many parts of the kingdom. His works were translated and read abroad, and had an enormous circulation in Great Britain and the United States. Many volumes about his career and opinions were issued in his lifetime both at home and abroad. His 80th birthday, 8th February 1899, was celebrated by a burst of congratulations and addresses, both public and private. His strength failed gradually: his mind remained feeble but unclouded, and his spirit serene. An attack of influenza struck him down, and carried him off suddenly after only two days' illness, 20th January 1900. He was buried in Coniston churchyard by his own express wish, the family refusing the offer of a grave in Westminster Abbey.

Any complete bibliography of Ruskin's writings would demand more space than can be admitted in this sketch of his life. It is moreover unnecessary, since the admirable and copious catalogues which exist—(1) that by Thomas J. Wise and J. P. Smart, London, 1889-93; (2) that summarized, in 13 pp., by Mr W. G. Collingwood in his *Life*, London, 1900; and lastly, Mr George Allen's *List*, July 1900 (pp. 5-17)—are all easily accessible. Much less is any criticism of his works either needed or possible in this sketch. The enormous bulk of his writings and their curious range of topic make any complete review of them impracticable. His literary life may be arranged in three divisions. From 1837 to 1860 (*æt.* 18 to 41) he was occupied mainly with the arts. From 1860 to 1871 (*æt.* 41 to 52) he was principally occupied with social problems. From 1871 to 1885 (*æt.* 52 to 66) he was again drawn back largely to art by his lectures as professor, whilst prosecuting his social Utopia by speech, pen, example, and purse. But the essential break in his life was in 1860, which marks the close of his main works on art and the opening of his attempt to found a new social gospel. With regard to his views of art, he himself modified and revised them from time to time; and it is admitted that some of his judgments are founded on imperfect study and personal bias. But the essence of his teaching has triumphed in effect, and has profoundly modified the views of artists, critics, and the public, although it is but rarely accepted as complete or final. The moral of his teaching—that all living art requires *truth, nature, purity, earnestness*—has now become the axiom of all æsthetic work or judgment. John Ruskin founded the Reformation in Art.

With regard to his economic and social ideas there is far less general concurrence, though the years that have passed since *Unto this Last* appeared have seen the practical overthrow of the rigid plutonomy which he denounced. So, too, the vague and sentimental Socialism which pervades *Munera Pulveris, Time and Tide*, and *Fors* is now very much in the air, and represents the aspirations of many energetic reformers. But the negative part of Ruskin's teaching on economics, social and political problems, has been much more effective than the positive part of his teaching. It must be admitted that nearly the whole of his practical experiments to realize his dreams have come to nothing, which is not unnatural, seeing his defiance of the ordinary habits and standards of the world. A more serious defect was his practice of violently assailing philosophers, economists, and men of science, of whom he knew almost nothing, and whom he perversely misunderstood; men such as Adam Smith, Comte, Mill, Spencer, Darwin, and all who followed them. In art, Ruskin had enjoyed an unexampled training, which made him a consummate expert. In philosophy and science he was an amateur, seeking to found a new sociology and a Utopian polity out of his own inner consciousness and study of nature, of poetry, and the Bible. It is not wonderful if, in doing this, he poured forth a quantity of crude conceits and some glaring blunders. But in the most Quixotic of his schemes, and the most Laputan of his theories, his pure and chivalrous nature, his marvellous insight into the heart of things and men, and his genius to seize on all that is true, real, and noble in life, made his most startling proposals pregnant with meaning, and even his casual play full of fascination and moral suggestion.

In mastery of prose language he has never been surpassed, when he chose to curb his florid imagination and his discursive eagerness of soul. The beauty and gorgeous imagery of his art works bore away the public from the first, in spite of their heretical dogmatism and their too frequent extravagance of rhetoric. But his later economic and social pieces, such as *Unto this Last, Time and Tide, Sesame and Lilies*, are composed in the purest and most lucid of English styles. And many of his simply technical and explanatory notes have the same quality. Towards the close of his life, in *Fors* and in *Præterita*, will be found passages of tenderness, charm, and subtlety which have never been surpassed in our language.

Ruskin's life and writings have been the subject of many works composed by friends, disciples, and admirers. The principal is the *Life*, by W. G. Collingwood, his friend, neighbour, and secretary (Methuen and Company, 1900), which must be regarded as the biography authorized by Ruskin himself and the family, and is the basis of the foregoing notice. His pupil, Mr E. T. Cook, published his *Studies in Ruskin* in 1890 (G. Allen), with full details of his career as professor. Mr J. A. Hobson, in his *John Ruskin, Social Reformer* (Nisbet and Company, 2nd edition, London, 1899), has elaborately discussed his social and economic teaching, and claims him as "the greatest social teacher of his age." An analysis of his works has been published by Mrs Meynell (Blackwood and Sons, 1900). And his art theories have been discussed in numerous periodicals and essays, and at large by Professor Waldstein, of Cambridge, and in France in the eloquent work of M. Robert de la Sizeranne, *Ruskin et la Religion de la Beauté*, and quite recently by Prof. H. J. Brunhes of Fribourg—*Ruskin et la Bible*, Paris, 1901. (F. H*.)

Russell of Killowen, Charles Russell, Baron (1832-1900), Lord Chief Justice of England, was born at Newry, County Down, on the 10th November 1832. He was the elder son of Mr Arthur Russell, a Roman Catholic gentleman, who was engaged in commerce and brewing in Newry. His mother was the daughter of Mr Mullen, a Belfast merchant, and at the time of her marriage to Mr Arthur Russell was the widow of John Hamill of that city. Within a few years after the birth of Charles Russell the home was changed to Seafield House, Killowen, on the shores of Carlingford Lough, and there his early boyhood was spent. At the age of twelve he was sent to school—first at Belfast, afterwards in Newry, and finally at St Vincent's College, Castleknock, Dublin. In the latter part of 1847 he went into the office of Messrs Hamill and Denvir, solicitors in Newry, and in 1849 he was articled to Mr Denvir, one of the partners in that firm. In March 1852 Mr Denvir died, and Charles Russell's articles were transferred to Mr O'Rorke, a solicitor in Belfast. In 1854 he was admitted, and began to practise his profession. He did well. Disturbances between Roman Catholics and Orangemen were at that time prevalent in this part of Ireland, and in the legal proceedings which ensued at quarter and petty sessions young Russell distinguished himself as a bold and skilful advocate in the cause of his co-religionists. The political zeal which always formed an important element in Russell's character happily harmonized with these professional duties. After practising, however, for two years, he determined to seek a wider field for his abilities, and to become a barrister in England. It was a wise ambition, early conceived by young Russell, stimulated by his present success, and encouraged by the counsel of at least one competent adviser, Judge Jones, who was much impressed by Russell's ability in the conduct of a case at the Newry quarter sessions. He believed, moreover, that to succeed at the Irish Bar he would have (to use his own phrase) to "swallow his convictions." With this end in view Russell, whilst still practising and residing in Belfast, became a student of Trinity College, Dublin. He matriculated there in 1855, and passed examinations from time to time, but did not wait to become a graduate. In 1856 he went to London and became a student of Lincoln's Inn. He worked hard privately. He read in the chambers of Mr Bagshawe, of the Chancery Bar (afterwards a county court judge), and in the chambers of Mr Hilward, a barrister of the Northern Circuit, who in later years became one of the leaders in the Admiralty Court. He also availed himself of the lectures given

by the readers of the Inns of Court, to one of whom, Sir Henry Maine, Russell in later years often referred in terms of special praise. In 1858 he married, in Belfast, Ellen, the eldest daughter of Dr Mulholland, a physician of distinction in that city. On the 26th January 1859 he was called to the Bar, after gaining by examination a first-class honour certificate, and joined the Northern Circuit. Never was that great circuit richer in legal talent. The period of 1859–72, whilst Russell was winning his way to a silk gown, included, on the circuit—to take only the names of some of the older men—Mellish, Edward James, Brett, Quain, Manisty, Davison, Holker, Aspinall, Butt, Herschell, Benjamin, Pope, R. G. Williams, Gainsford Bruce, and Baylis. It was a meet training-ground and arena for the young Irishman, who was destined not only to become leader of his circuit, but to reach a pre-eminence amongst English advocates such as it would be difficult to match in the annals of the Bar. Except some valuable introductions to friends in London and Liverpool, which his uncle, the distinguished president of Maynooth, had given to him, Russell brought to the work of his profession no external aids. He had to rely upon himself. But the equipment was sufficient. A well-built frame; a strong, striking face, with broad forehead, keen grey eyes, and a full and sensitive mouth; a voice which, though not musical, was rich, and responded well to strong emotions, whether of indignation, or scorn, or pity; an amazing power of concentrating thought; an intellectual grasp, promptly seizing the real points of the most entangled case, and rejecting all that was secondary, or petty, or irrelevant; a faculty of lucid and forcible expression, which, without literary ornateness or grace of style, could on fit occasions rise to impassioned eloquence—all these things Russell had. But beyond and above all these was his immense personality, an embodiment of energetic will which riveted attention, dominated his audience, and bore down opposition. His successful advocacy in the Colin Campbell divorce case in 1886, and his famous cross-examination of hostile witnesses and still more famous speech before the Parnell Commission in 1888, afforded perhaps the best examples of Russell's characteristic powers. He was not a learned lawyer in the sense in which Willes, or Mellish, or Blackburn were learned lawyers; he did not possess the fine legal acumen of his great contemporary, Herschell; but he had a sufficient apprehension of legal principles. He handled a point of law with telling directness and force. His argument as the leading counsel for Great Britain in the Bering Sea Arbitration in 1893, and his address at Saratoga on International Law and International Arbitration in August 1896, were expositions of law in its practical application to matters of State which the most learned jurist must admire for their thoroughness and perspicuity.

LORD RUSSELL OF KILLOWEN.
(From a photograph by the London Stereoscopic Company.)

Russell's success, after he joined the Northern Circuit, did not, of course, come to him at once. For some time his work in court was principally in the Court of Passage at Liverpool, which he regularly attended from London. He wrote a book on its procedure, which was published in 1862. This ancient local court, possessing both common law and Admiralty jurisdiction, had as its presiding judge—then styled "assessor"—an eminent leader of the Northern Circuit, Mr Edward James. Substantial commercial cases were tried there, and of these Russell soon had a goodly portion. Steadily, and, for a barrister, speedily, Russell's fortune grew. His biographer, Mr Barry O'Brien, has given, in *The Life of Lord Russell of Killowen* (Smith, Elder, and Company, 1901), an account of Russell's fees, which shows that they were, in round figures: in 1859, £117; in 1862, £1016; in 1866, £2367; and in 1870, £4230. At the commencement of this period Russell wrote occasionally for the newspapers, and especially for the Irish press. From early boyhood onwards he maintained a keen interest in politics, and pre-eminently in the public affairs of Ireland. In 1859 he published a pamphlet entitled *The Catholic in the Workhouse*, and an article from his pen is to be found in *The Dublin Review*, vol. xlviii. p. 497. His legal work was not wholly confined to the north of England. He was employed at the Guildhall and elsewhere by solicitors of position in the City of London. He was one of the counsel engaged in the Windham lunacy case in 1861, and in the action of Saurin *v.* Starr in 1869. In 1865 he argued in *ex parte* Chavasse before Lord Westbury, L.C., and soon afterwards was honoured by him with the offer of a county court judgeship. Two subsequent judges of the High Court of Justice—Mr Justice Bigham and Mr Justice Walton—were among his pupils during this period.

In 1872 Russell took "silk," and from that date for some time he divided the best leading work of the circuit with Holker, Herschell, and Pope. In 1874 Holker became solicitor-general in the Conservative administration. In 1880 Herschell accepted the same office in a Liberal ministry, and about the same time Pope practically left the circuit, to become in a short time one of the most successful advocates at the Parliamentary Bar. Russell's success as a Q.C. during this period of his career was prodigious. He excelled in the conduct alike of commercial cases and of those involving, as he used to say, "a human interest," although undoubtedly it was the latter which more attracted him. He was seen to the least advantage in cases which involved technical or scientific detail. If his advocacy suffered a defeat, however, it was never an inglorious defeat. Those who were on the Northern Circuit at the time will not easily forget the case of Dixon *v.* Plimsoll,—a libel action brought by a Liverpool shipowner against Mr Plimsoll—tried before Baron Amphlett and a Liverpool special jury, in which Holker won a notable victory for the defendant; or Nuttall *v.* Wilde, a breach of promise action, in which Pope led brilliantly for the

successful plaintiff, and Russell's speech for the defence was one of the finest in point of passion and pathos that was ever heard upon the Northern Circuit. At the same time, with all his fighting power, Russell was eminently a sagacious adviser. No barrister knew better how and when to settle a case, where the client's true interest called for a settlement.

In 1880 a new phase of Russell's arduous life began. He was returned to Parliament as an independent Liberal member for Dundalk, a constituency which he had twice before unsuccessfully contested. From that time forward until his appointment to a lordship of appeal in succession to Lord Bowen in 1894, he sat in the House of Commons: for Dundalk until 1885, and afterwards for South Hackney, where he was returned as the Liberal member on four successive occasions—once in 1885, twice in 1886, and again in 1892. The entrance into Parliament laid upon Russell's time and labour a heavy additional tax. His was a nature which could not, in work or even in pleasure, be content to do anything lightly or by halves. He was essentially a man of action; intensity—at times almost fierce intensity—both of purpose and of devotion to its fulfilment characterized everything he did. Upon such a man parliamentary life between 1880 and 1894 necessarily entailed a severe strain. During the whole of this epoch, in home affairs, Irish business almost monopolized the political stage; and Russell was Irish to the core. From 1880 to 1886, as a private member, and as the attorney-general in Mr Gladstone's administrations of 1886 and 1892, he worked in and out of Parliament for the Liberal policy in regard to the treatment of Ireland as few men except Russell could or would work. He never spared himself. After a long day in the turmoil of the courts, he cheerfully gave a long evening to a distant and often, from the standpoint of personal notoriety, an obscure, platform. His position throughout was clear and consistent. Before 1886 on several occasions he supported the action of the Irish Nationalist party. He opposed coercion, voted for compensation for disturbance, advocated the release of political prisoners, and voted for the Maamtrasna inquiry. He wrote to the *Daily Telegraph* a series of letters on the Irish land question, which were afterwards published (Macmillan and Company, 1889) in a collected form. But he never became a member of the Irish Home Rule or of the Parnellite party; he was elected at Dundalk as an independent Liberal, and such he remained. He was proud of the kingdom in whose might and glory Ireland could claim so large a part; and when, as attorney-general in the Gladstone administration, he warmly advocated the establishment of a subordinate Parliament in Ireland, he did so because he sought the amelioration and not the destruction of Ireland's relations with the rest of that kingdom. "I am absolutely opposed," he said (*The Life of Lord Russell of Killowen*, p. 194) to the South Hackney voters, "to separation; but, reserving imperial control on all imperial questions, I think Irishmen on Irish soil should have the power of dealing in the way which seems best to them with all questions that concern them." It is impossible to say that Russell's success in the House of Commons, considerable as it was, was comparable to his success as an advocate in the courts of justice. He was listened to, always with respect and often with admiration, but he was not made for a debater; and the position of a law officer has generally not proved favourable to the attainment of parliamentary eminence. In great public affairs the law officer advises and supports, but not for him is the glory of initiating public policy.

Russell's parliamentary duties, fully as he discharged them, first as a private member and afterwards as attorney-general, were not allowed by him to obstruct his professional career. He rapidly became in London what he was already in Lancashire, the favourite leader in *nisi prius* actions. The list of *causes célèbres* in the period 1880–1894 is really a record of Russell's cases, and, for a great part, of Russell's victories. The best known of the exceptions from the latter category was the libel action Belt *v.* Lawes in 1882, which, after a trial before Baron Huddleston and a special jury lasting more than forty days, resulted in a verdict for the plaintiff, for whom Sir Hardinge Giffard (afterwards Lord Chancellor Halsbury) appeared as leading counsel. The triumph of his client in the Colin Campbell divorce suit in 1886 afforded perhaps the most brilliant instance of Russell's forensic capacity in private litigation. His fees in 1885, the year before he became attorney-general, amounted to nearly £17,000. More important, however, as well as more famous, than any of his successes in the ordinary courts of law during this period were his performances as an advocate in two public transactions of mark in British history. The first of these in point of date was the Parnell Commission of 1888–90, in which Sir Charles Russell appeared as leading counsel for Mr Parnell. The Commission held its first sitting on the 22nd of October 1888, and presented its report in February 1890. In April 1889, after 63 sittings of the Commission, in the course of which 340 witnesses had been examined, Sir Charles Russell, who had already destroyed the chief personal charge against Mr Parnell by a brilliant cross-examination, in which he proved it to have been based upon a forgery, made his great opening speech for the defence. It lasted several days, and concluded on the 12th of April. This speech, besides its merit as a wonderful piece of advocacy, possesses permanent value as an historical survey of the Irish question, during the last century, from the point of view of an Irish Liberal. It was in the same year published after careful revision by its author (Macmillan and Company, 1889). The second public transaction was the Bering Sea Arbitration, held in Paris in 1893. Sir Charles Russell, then attorney-general, with Sir Richard Webster (afterwards Lord Alverstone, L.C.J.), was the leading counsel for Great Britain. Russell, in the course of his very powerful argument before the tribunal, maintained the proposition, which he again handled in his Saratoga address to the American Bar Association in 1896, that "International law is neither more nor less than what civilized nations have agreed shall be binding on one another as international law." The award was, substantially, in favour of Great Britain. In recognition of their distinguished services the Queen bestowed upon both the leading representatives of Great Britain the honour of the Grand Cross of St Michael and St George.

In 1894 Russell's career as an advocate ended. A judgeship, if he had wished it, had been within his reach twelve years before. In 1894, on the death of Lord Bowen, he accepted the position of a lord of appeal. A month later he was appointed lord chief justice of England in succession to Lord Coleridge, to whose memory he devoted in the following September a paper in the *North American Review*. To the discharge of his functions as a judge Russell brought with him all the qualities of intellect and character which had made him so eminent as an advocate, and their greatness was not less conspicuous in his new position. Brief as was his tenure of the office, he proved himself well worthy of it. He was dignified without pompousness, quick without being irritable, and masterful without tyranny. He was scrupulously punctual. Suitors and hearers could not but be impressed by the manifest determination of the lord chief justice to get at the truth, and to do so without waste of time. If this was a fault, it was that of excessive zeal for despatch.

When, occasionally, there were flashes of impatience, they were elicited by the exhibition, as he deemed it, of want of preparation, or slovenliness, or verbosity on the part of the advocate before him. Even the youngest and most obscure practitioner could always count upon the assiduous attention of the lord chief justice to a pertinent and thoughtful argument. In 1896 Lord Russell (Pollock B. and Hawkins J. being on this occasion his colleagues on the bench) presided at the trial at bar of the leaders of the unlawful expedition into the Transvaal which is commonly known as the Jameson Raid. It was a State trial of grave importance. Russell's conduct of it, in the midst of much popular excitement, was by itself sufficient to establish his reputation as a great judge. One other event at least in his career while lord chief justice deserves a record, namely, his share in the Venezuela Arbitration in 1899. Lord Herschell, who had been nominated to act with Lord Justice Collins (afterwards master of the rolls) as a British representative on the Commission of Arbitration, of which the distinguished Russian jurist M. Marteus was president, died somewhat suddenly in America before the commencement of the proceedings. The lord chief justice accepted the invitation to take the vacant place, and performed his very onerous duty with conspicuous ability.

Nor was it only on the bench or as an international judge that Lord Russell of Killowen sought, during the last years of his busy life, to do service to his country. He signalized his zeal as a law reformer by the public advocacy of radical changes in the system of legal education in the Inns of Court, and by the promotion of measures to put down the vice of secret and illicit commissions in commercial and business life. On the former subject he delivered in 1895 an address in Lincoln's Inn Hall, under the auspices of the Council of Legal Education, which was afterwards printed and published (Wyman and Sons, Limited). In 1899, dealing with the latter question, he introduced in the House of Lords a Bill, which had its first reading. He again introduced a Bill in the session of 1890, which was read a second time, but did not become law. On the 10th August 1890 the great advocate and great judge passed quietly away at his London residence, after a short illness due to an internal malady.

In private, as in public life, Russell was always strenuous, and most attracted by things that called for the exercise of activity, whether bodily or intellectual. Inaction he disliked both for himself and in others. Though not an athlete, he took an interest in manly pastimes: he was fond of riding and of breeding horses; he liked being on the racecourse; and he enjoyed games, both of skill and of chance. A student of books he was not; he could lay no claim to wide learning or elegant scholarship; but he could appreciate a good book; he was versed in Shakespeare; and he knew and loved the poetry and the songs of his native land. When he wrote, his style, inornate, clear, and forcible, reflected the character of his thought. He was a staunch and sympathetic friend, ever ready in an unostentatious way to help, where help was really needed. While he undoubtedly exhibited at times, chiefly during the earlier part of his career, a certain brusqueness and impetuousness of speech and demeanour, those who came into contact with him recognized that such occasional outbursts never sprang from any desire to hurt, or from any unkindness of disposition. In his contests at the Bar he never made an enemy. He was a strong man, and he liked to have his way; but he was also large-hearted and without a tinge of rancour in his disposition. He was never offended by opposition. Whilst he did not himself shine as a wit or a humorist in conversation or in after-dinner oratory, he heartily enjoyed fun and humour in others; and, wherever he was, the force and distinctness of his personality never failed to impress his company. Probably no English lawyer ever excited abroad the admiration which was accorded to Lord Russell of Killowen, alike on the Continent and in America. To the United States he paid two visits, the first in 1883 and the second in 1896. On both occasions he won golden opinions, which were manifested in widespread and warm expressions of sympathy and regret when the news of the death of Lord Russell of Killowen passed across the Atlantic. Between 1894 and 1897 Lord Russell of Killowen received the degree of Doctor of Laws *honoris causâ* from the universities of Dublin, Edinburgh, and Cambridge, and from the Laval University, Quebec. In 1892 he was treasurer of Lincoln's Inn. He left surviving him, besides his widow, five sons and four daughters. His sister Katherine (in religion, Sister Mary Baptist Joseph), pioneer sister of mercy in California, had died two years before at San Francisco. (W. R. K.)

Russell, Thomas (1762–1788), English poet, was the son of John Russell, who, according to the preface to his son's poems, was an attorney at Bridport, in Dorsetshire; the poet was born, however, at Beaminster, early in 1762. His mother had been Miss Virtue Brickle, of Shaftesbury. He was educated at the grammar school of Bridport, and in 1777 proceeded to Winchester, where he stayed three years, under Dr Joseph Warton, and Thomas Warton the poetry professor. In 1780 Russell, already distinguished as a classical scholar, was elected a fellow of New College, Oxford. He was ordained in 1785. During his residence at the university he devoted himself not merely to the ancients, but, what was then extremely unusual, to French, Italian, Spanish, Portuguese, Provençal, and even German literature. His health, however, broke down, and he retired to Bristol hot wells to drink the waters; but in vain, for he died there on the 31st of July 1788. He was buried in Powerstock churchyard, Dorset. In 1789 was published a thin volume, containing his *Sonnets and Miscellaneous Poems*, now a very rare book. It contained twenty-three sonnets, of regular form, and a few paraphrases and original lyrics. The sonnets are the best, and it is by right of these that Russell takes his place as one of the most interesting precursors of the romantic school. "War, Love, the Wizard, and the Fay he sung"—in other words, he rejected entirely the narrow circle of subjects laid down for 18th-century poets. In this he was certainly influenced both by Chatterton and by Collins. But he was still more clearly the disciple of Petrarch, of Boccaccio, and of Camoens, each of whom he had carefully and enthusiastically studied. His sonnet "Suppos'd to be written at Lemnos" is his masterpiece, and was greatly admired both by Wordsworth and Landor, who said that it "authorized Russell to join the shade of Sophocles"; it has been remarked that this is unquestionably the greatest English sonnet of the 18th century. The anonymous editor of Russell's solitary volume is said to have been William Howley (1766–1848), long afterwards archbishop of Canterbury, who was a youthful bachelor of New College when Russell, who had been his tutor, died. His memoir of the poet is very prefunctory, and the fullest account of Russell is that published in 1897 by Mr T. Seccombe. As the elder by nine months of Bowles, whose schoolfellow he was at Winchester for four years, and whom he seems to have slightly preceded as a composer of sonnets, Russell takes his place as the precursor of the school of romantic poets inspired by the study of nature and of the modern literature of the Continent. (E. G.)

Russell, Sir William Howard (1821– ——), English war correspondent, was born at Lilyvale, near Tallaght, in the county of Dublin, 28th March 1821, being one of the Russells of Limerick, whose settlement in Ireland dates from the time of Richard II. After a preliminary education under Mr Geoghegan in Dublin, he entered Trinity College in 1838. Three years later he was thrown very much on his own resources, but a relative, Mr R. W. Russell, who had been sent to Ireland by *The Times*, deputed him to report the Irish elections at Longford, and his success definitely turned his attention to journalism. Coming to London in 1842, he went to Cambridge, but left before taking a degree. In the following year he was sent by *The Times* to Ireland to report the O'Connell meetings. In 1845 he was appointed to superintend the reports on the Irish railways, and was shortly afterwards sent by *The Times* to inspect the O'Connell property in the south-west of Ireland, when his plain speaking drew forth a characteristic tirade from the "Liberator." For a short period in 1847 his services were temporarily transferred to the *Morning Chronicle*, but with that exception he remained permanently connected with *The Times*. He was sent as special correspondent to Denmark in the war of 1849–50. He did not, however, at once relinquish a legal career, and was called to the Bar at the Middle Temple in 1851. On the outbreak of the Crimean war in 1853 he went out as special correspondent with the vanguard of the British expedition, and, accompanying the light division to Gallipoli, proceeded with the first detachment to Varna. It was a new departure in journalism, and Russell was the first of the great war correspondents. On the embarkation for the Crimea he was attached to the second division, and landed with it on the 14th of September. He was present at the battle of the Alma on 20th September, at the investment of Sebastopol, at Balaclava 25th October, and Inkerman 5th November.

Towards the end of May 1855 he accompanied the expedition to Kertch, and did not return to the Crimea until the following August. In September and October he described the attacks on the Malakoff and Redan, the occupation of Sebastopol, and the capture of Fort Kinburn; and when the British forces finally evacuated the Crimea in July of the following year, he was among the last who left. The popularity of *The Times'* Crimea correspondence led to its republication in two volumes under the title of *The War, 1855–56*. Russell's letters to *The Times* were mainly responsible for the enlightenment of the public at home as to the conduct of affairs at the scene of action, and his exposure of the mismanagement during the winter of 1854—the accuracy of which was afterwards fully corroborated—did more than anything else to cause the downfall of Lord Aberdeen's ministry. Apart altogether from his material, his descriptions were brilliant and powerful, and he returned home to find himself famous as "Balaclava Russell." In 1856 Russell was sent to Moscow to describe the coronation of the Tsar, and in the following year was attached to the headquarters of Lord Clyde in India. He was present at the siege and capture of Lucknow in 1858, the operations in Oude, the battle of Bareilly, and the actions in Rohilkhand, which preceded the suppression of the revolt, and he received the Indian war medal with the Lucknow clasp. The events of those stirring times are vividly recorded in *My Diary in India in 1858–59*. Next year he was sent to Italy, but too late to see any active service, for he arrived on the eve of the armistice at Villafranca. On 7th January 1860 appeared the first number of the *Army and Navy Gazette*, which he founded, and of which he is still editor and principal proprietor. When it became evident in 1861 that civil war was imminent in the United States, Russell proceeded to Washington, and reached M'Dowell's headquarters just before the first battle of Bull Run, and his account of the Federal retreat drew much hostile criticism. He published a full account of the war, in so far as he had witnessed it, in *My Diary, North and South, during the Civil War in America, 1862*. Returning to England in 1863, he described the ceremonies and festivities on the occasion of the marriage of the Prince of Wales, and remained at home until the outbreak of the Austro-Prussian war of 1866, when he proceeded to the headquarters of General Benedek and witnessed the battle of Königgrätz, 3rd July. During the interval of peace that followed he accompanied the Prince of Wales to the Nile, Constantinople, the Crimea, and Greece in 1868, and published an account of the tour in the following year, when he also contested the borough of Chelsea unsuccessfully in the Conservative interest. On the outbreak of the Franco-Prussian war in 1870, Russell repaired to the headquarters of the crown prince at Wörth, and was with him from the battle of Wörth, 6th August, and Sedan, 12th September, till the capitulation of Paris. His account of the scenes he witnessed appeared in 1874 under the title of *My Diary during the Last Great War*. His description of the burning of Paris by the Communards was not the least of his journalistic triumphs. In 1875–76 he was honorary private secretary to the Prince of Wales during his tour through India, of which he published an account in 1877. When Lord Wolseley was sent to quell the Zulu rebellion in 1879, Russell was attached to his staff as correspondent. In 1881 he went with the Duke of Sutherland's party for a tour in the United States and Canada, described in *Hesperothen*, and in 1882 he was again with Lord Wolseley in the Egyptian campaign. In 1889 he undertook to report upon the nitrate fields of Tarapaca, and published the account of his journey in the following year, under the title, *A Visit to Chile*. In 1895 he published a personal retrospect entitled *The Great War with Russia*. Sir Howard was knighted in May 1895, and was the recipient of numerous war medals and various foreign orders. He married twice, first in 1846 Miss Burrowes, who died not long afterwards, and secondly in 1884 the Countess A. Malvezzi.

RUSSIA.

The Russian empire, which represents an extensive territory in eastern Europe and northern Asia, has an area exceeding 8,660,000 square miles, thus covering one-sixth part of the land surface of the globe. The population, however, estimated in 1901 at about 135,000,000, represents only one-fourteenth of the inhabitants of the world. In 1898 the limits of the empire were extended by the "lease" from China of the Liaotung peninsula, in the Gulf of Pechili, *i.e.*, Port Arthur and Ta-lien-wan, with the adjacent seas and territory to the north. Out of this territory a separate province, Kwang-tung, was created in 1899, its area being estimated at 1224 square miles, out of which 141 square miles are occupied by a number of small islands, and the population at 250,000, including 7000 afloat and 15,000 on the islands (see map and description in *Izvestia* of the Russian Geographical Society, 1900). After the Boxer rising in China of 1901, Manchuria was also practically occupied by Russian troops, being

treated for all practical purposes as a sort of vassal territory to Russia, standing towards the empire in a position not unlike that occupied by Bokhara and Khiva. Of these two khanates, the latter (area, 22,320 square miles, population about 800,000) is practically subject to Russia; while the former (area about 92,000 square miles, population about 2,500,000) is every day becoming more and more a Russian dependency now that the railway connecting the Russian Transcaspian territory with Turkestan (Samarkand and Tashkent) has been completed. Russian influence is at the same time rapidly extending over Mongolia (*q.v.*). In Afghan Turkestan the most southern point reached by the Russian empire is, according to the International Commission, 35° 38′ 17″ N., 62° 21′ 52″ E. The total length of the frontier line of the Russian empire by land is 2800 miles in Europe and 9550 miles in Asia; by sea, 11,090 miles in Europe and about 19,590 miles in Asia.

Population.

The population of the empire, which was estimated at 74,000,000 in 1856–59, was found to be nearly 129,000,000 at the census of 1897, taken over all the empire except Finland. Thus since 1860 the population has increased 74 per cent. The increase has chiefly taken place in the large cities of Siberia, Poland, Lithuania, and Caucasia. The area and population of the various official divisions of the empire are given in the following table:—

Province.	Area: English Square Miles.	Domiciled Population, 1897.	Density per Square Mile.
1. *European Russia*—			
Arkhangelsk	331,640	347,589	1
Astrakhan	91,327	994,775	11
Bessarabia	17,619	1,933,436	113
Chernigov	20,233	2,321,900	115
Courland	10,535	672,634	64
Don, Region of	63,532	2,575,818	41
Ekaterinoslav	24,478	2,112,651	86
Esthonia	7,818	413,724	54
Grodno	14,931	1,617,859	109
Kaluga	11,942	1,185,726	99
Kazan	24,601	2,191,058	89
Kiev	19,691	3,576,125	181
Kostroma	32,490	1,429,228	44
Kovno	15,692	1,549,444	100
Kursk	17,937	2,396,577	134
Kharkov	21,041	2,509,811	119
Kherson	27,523	2,732,832	100
Livonia	18,158	1,300,640	74
Minsk	35,293	2,156,123	61
Moghilev	18,551	1,708,041	92
Moscow	12,859	2,433,356	189
Nijni-Novgorod	19,797	1,600,304	81
Novgorod	47,236	1,392,933	33
Olonets	57,439	366,715	7
Orel	18,042	2,054,749	114
Orenburg	73,816	1,609,388	22
Penza	14,997	1,491,215	99
Perm	128,211	3,003,208	24
Podolia	16,224	3,031,513	187
Poltava	19,265	2,794,727	145
Pskov	17,069	1,136,540	68
Ryazan	16,255	1,827,539	113
St Petersburg	20,760	2,107,691	123
Samara	58,321	2,763,478	46
Saratov	32,624	2,419,884	74
Simbirsk	19,110	1,549,461	81
Smolensk	21,638	1,551,068	72
Tambov	25,710	2,715,453	106
Taurida	24,497	1,443,566	62
Tula	11,954	1,432,743	120
Tver	25,225	1,812,825	73
Ufa	47,112	2,220,497	47
Vilna	16,421	1,591,912	98
Carry forward	1,569,614	80,076,756	51

Province.	Area: English Square Miles.	Domiciled Population, 1897.	Density per Square Mile.
European Russia (*continued*)—			
Brought forward	1,569,614	80,076,756	51
Vitebsk	17,440	1,502,916	89
Vladimir	18,864	1,570,733	84
Volhynia	27,743	2,997,902	109
Vologda	155,498	1,365,587	9
Voronezh	25,443	2,546,255	109
Vyatka	59,329	3,082,788	52
Yaroslav	13,751	1,072,478	78
Sea of Azov	14,520	...	...
Total, Russian Provinces	1,902,202	94,215,415	51
2. *Poland*—			
Kalisz	4,392	846,719	194
Kielce	3,897	763,746	196
Lomza	4,667	585,781	144
Lublin	6,501	1,159,463	177
Piotrkow	4,729	1,409,044	297
Plock	4,200	556,877	153
Radom	4,769	820,363	171
Siedlce	5,535	775,316	140
Suwalki	4,846	604,945	127
Warsaw	5,623	1,933,689	286
Total, Poland	49,159	9,455,943	193
Total, Russia and Poland	1,951,361	103,671,358	53
3. *Grand-Duchy of Finland*—			
Abo-Björneborg	9,333	413,351	47
Kuopio	16,499	297,120	22
Nyland	4,584	258,834	61
St Michel	8,819	183,811	28
Tavastehus	8,334	271,943	40
Uleåborg	63,957	256,730	4
Viborg	13,530	372,015	33
Vasa	16,105	429,445	30
Lake Ladoga	3,094	...	...
Total, Finland	144,255	2,483,249	20
Total, European Russia	2,095,616	106,154,607	51
4. *Russia in Asia*—			
Kuban	36,441	1,922,773	54
Stavropol	23,398	876,298	38
Terek	26,822	933,485	35
Northern Caucasia	86,661	3,732,556	43
Baku	15,095	789,659	55
Black Sea	2,836	54,228	...
Daghestan	11,332	586,636	58
Elizabethpol	16,721	871,557	52
Erivan	10,075	804,757	101
Kars	7,308	292,498	43
Kutais	13,968	1,075,861	54
Tiflis with	15,306	1,040,943	62
Zakataly	1,541		
Transcaucasia	94,182	5,516,139	64
Total, Caucasus	180,843	9,248,695	54
Akmolinsk	229,609	678,957	3
Semipalatinsk	184,631	685,197	4
Turgai	176,219	453,123	3
Uralsk	139,168	644,001	4
Lake Aral	26,166	...	...
The Steppes	755,793	2,461,278	4
Semiryechensk	152,280	990,107	7
Samarkand	26,627	857,847	32
Carry forward	178,907	1,847,954	11

Province.	Area: English Square Miles.	Domiciled Population, 1897.	Density per Square Mile.
Russia in Asia (continued)— Brought forward	178,907	1,847,954	11
Fergana	35,654	1,560,411	43
Syr-Daria	194,853	1,479,848	7
Turkestan	409,414	4,888,213	12
Transcaspian	214,237	372,193	2
Caspian Sea	169,381	...	...
Total, Central Asian dominions	1,548,825	7,721,684	5
Tobolsk	539,659	1,438,484	3
Tomsk	331,159	1,929,092	6
Western Siberia	870,818	3,367,576	4
Irkutsk	287,061	506,517	2
Transbaikalia	236,868	664,071	3
Yakutsk	1,533,397	261,731	·2
Yeniseisk	987,186	559,902	1
Eastern Siberia	3,044,512	1,992,221	·7
Amur	172,848	118,570	·9
Primorskaya	715,982	220,557	·3
Amur Region	888,830	339,127	·3
Sakhalin	29,336	28,166	1
Total Siberia	4,833,496	5,727,090	1
Total, Asiatic dominions	6,563,164	22,697,469	4
Russians in Finland, Bokhara, Khiva, and in the navy abroad	...	42,909	...
Grand Total*	8,658,780	128,894,985	15

* The areas occupied by the larger lakes and rivers (see ninth edition) are included in the above table, but they have been excluded in calculating the densities of the population.

It has been found, from a comparison of the densities of population of the various provinces in 1859 with the distribution in 1897, that the centre of density has distinctly moved southwards, towards the shores of the Black Sea, and westwards, the greatest increase having taken place in the eastern Polish and Lithuanian provinces, along the south-western border, in the prairie belt beside the Black Sea, and in Orenburg. Northern Caucasia and south-western Siberia likewise show a considerable increase. The census revealed a remarkably low proportion of men to women in several provinces. This was owing to the fact that large numbers of the men engaged in agricultural pursuits during the summer temporarily move every year into the large industrial centres for the winter. Consequently there were only 87·4 and 89·8 women to each 100 men in the provinces of St Petersburg and Taurida, but as many as 133 in Yaroslav, 119 in Tver, and 117 in Kostroma. The average number of women to each 100 men in the Russian provinces proper was 102·8; in Poland, 98·6; in Finland, 102·2; in Caucasia, 89·5; in Siberia, 95·7; and in Turkestan and the Transcaspian territory, 83·0.

The natural increase of the population per annum is very nearly 2,000,000, as will be seen from the following statistics of births and deaths, which are the latest available:—

1896.	Births.	Per 1000.	Deaths.	Per 1000.	Surplus.
European Russia and Poland	4,892,949	47·2	3,279,572	31·8	1,613,377
Finland	83,884	33·3	49,289	19·5	34,595
Siberia	266,442	46·5	186,299	32·5	80,143
Caucasus	355,508	37·0	204,023	21·2	151,485
Central Asia	107,143	...	73,462	...	33,681
Total	5,705,926	46·7	3,792,645	30·9	1,913,281
,, 1898, without Finland	5,769,218	...	3,845,968	...	1,923,350

The figures for European Russia alone (without Poland) are: 857,371 marriages, 4,692,621 births, 2,976,453 deaths; natural increase, 1,716,168.

The effects of emigration and immigration cannot be estimated with accuracy, because only those who cross the frontier with passports are taken account of. The statistics of these show that there was during the thirty-two years 1856–88 an excess of emigration over immigration of 1,146,052 in the case of Russians, and a surplus of immigration of 2,304,717 foreigners. On the other hand, in the six years 1892–97 the excess of Russian emigration over immigration was 207,353, as compared with an excess of foreign immigration over emigration of only 136,740. It is also known that the number of Russian immigrants into the United States in 1891–97 was: 292,032 from European Russia, 91,994 from Poland, and 24,977 from Finland, as compared with only 313,469 from the Russian Empire generally in 1873–90. The total emigration of Russians to America through the three chief German ports was 519,000 during the eleven years 1887–97. 29,226 went to Brazil in 1890, and about 6000 to Canada in 1898. No less than 41,108 in 1900 and 36,961 in 1901 emigrated through Hamburg alone to America. The emigration to Siberia varies much from year to year. It was about 80,000 in 1898, and from 150,000 to 200,000 during the two previous years, as also in 1901. Altogether no less than 1,150,095 persons migrated to Siberia during the years 1882–97. There is also some emigration from central Russia to the southern Urals, as also to some of the Steppe provinces.[1]

Cities.—Taken as a whole, only 13 per cent. of the population of Russia lived in towns in 1897, but in the years 1857–60 less than 10 per cent. of the population was urban. In Russia proper less than 2 per cent emigrated from the villages to the towns during the forty years ending 1897. The following table shows the urban population in the various divisions of the empire in 1897:—

	Urban Population.	Percentage of Total.
European Russia	12,027,038	12·8
Poland	2,055,892	21·7
Finland	281,216	11·0
Caucasia	1,010,615	10·9
Siberia	473,796	9·3
Central Asia	936,655	12·0
Russian Empire	16,785,212	13·0

There were only twelve cities with more than 100,000 inhabitants in 1884; in 1897 there were nineteen, namely, St Petersburg (1,267,023; 1,439,739 on 27th December 1900), Moscow (988,614; 1,035,664 in December 1900), Warsaw (638,208), Odessa (405,041), Łódź (315,209), Riga (256,197; 282,943 in 1900), Kiev (247,432), Kharkov (174,846), Tiflis (160,645), Vilna

[1] See statistics collected by State Secretary Kulomzin, 1898; *Siberia*, by the Ministry of the Interior, 1899.

(159,568), Tashkent (156,414), Saratov (137,109), Kazañ (131,508), Ekaterinoslav (121,216), Rostov-on-the-Don (119,889), Astrakhan (113,001), Baku (112,253), Tula (111,048), and Kishinev (108,796). It is interesting to note that while only three of these are in Middle Russia (Moscow, Tula, and Kazañ), eight are in South Russia, and two in Caucasia. There are thirty-seven cities with from 50,000 to 100,000 inhabitants. The mortality in most towns is so great that during the last ten years of the 19th century, in a very great number of cities, the number of deaths exceeded that of births by from 1 to 4 in the thousand.

Religion.—The approximate distribution of the population according to religion is as follows:—Greek Orthodox (including all dissenters), nearly 96,000,000; United Church and Armenians, 1,350,000; Roman Catholics, 12,200,000; Protestants, 6,750,000; Jews, 4,050,000; Mahommedans, 12,150,000; others, 2,700,000. The empire is divided into 64 bishoprics, which were in 1897 under 3 metropolitans and 62 archbishops and bishops. The number of monasteries and nunneries has considerably increased of late; in 1897 there were 497 monasteries and 268 nunneries, with 8076 monks and 6978 male aspirants, and 8942 nuns and 27,166 female aspirants. The Holy Synod received in 1900 over 23,500,000 roubles from the Imperial budget, in addition to its own considerable revenue and the private revenues of the churches and the monasteries.

Education.—Little progress has been achieved as regards education. Distrust of natural sciences, even in their technical applications, and of "Western" ideas of free democratic government—desire to make university education, and even secondary education, a privilege of the wealthier classes—neglect of primary education, coupled with suppression by the Ministry of Public Instruction of all initiative, private and public, in the matter of spreading education among the illiterate classes—these were the distinctive features of the educational policy of the last twenty years of the 19th century. Only quite recently has a change taken place in the attitude of the Government towards technical education, and a few high and middle technical schools have been opened.[1] Only recently, too, has a reform been started in secondary education with the object of revising the so-called "classical" system which has been favoured in the lyceums since the 'seventies, the complete failure of which has now been demonstrated after nearly thirty years of experiment. As to primary education, there is nothing at present to brighten its gloomy outlook; only the opening of Sunday schools, which was prohibited since 1861, was allowed in 1870, and rendered easier still some years later.

The total number of primary schools in the Russian empire (exclusive of Finland) in 1898, and their different categories, are best seen from the following table[2]:—

Under the	Number of Schools.	Number of Pupils.		
		Boys.	Girls.	Total.
Ministry of Public Instruction . . .	37,046	1,965,549	684,509	2,650,058
Holy Synod . .	40,028	1,118,404	350,085	1,476,124
Institutions of Empress Marie . . .	153	2,537	2,560	5,097
Ministry of Interior .	553	16,432	4,078	20,510
,, Navy .	4	226	153	379
,, War . .	848	30,498	13,905	46,420
Various . . .	67	2,517	2,141	4,658
Total . . .	78,699	3,136,163	1,057,431	4,203,246*

* This last sum is slightly in excess of the sum of the two preceding, as the sex of 9652 pupils is not known.

Nearly 30,000 Jewish *heders* and Mussulman *medreses* and *mektebes* must be added to the above. Besides, all soldiers are taught, at least reading, in nearly 7500 schools in the regiments. Thus, apart from the schools under the Ministry of War (Cossack *voiskos* and schools at the barracks), the great bulk of the primary schools are either under the Ministry of Public Instruction or the Holy Synod. Those under the latter body are of recent growth, the policy of the last twenty years of the 19th century having been to spend the budget allowances upon primary instruction by handing them over to the Holy Synod, which opened parish schools under the local priests. The schools under the Synod are themselves divided into two categories: parish schools, with 614,609 pupils; and reading schools, of an inferior grade, with 501,883 pupils (in European Russia). No teaching certificate is required by the teachers in either class of school, the permission of the bishop (like the French *lettre d'obédience* of 1849) being sufficient. The consequence is that, the village priests being too much occupied with their parish duties, they cannot give more than nominal attention to the schools, and the numerous pupils either exist on paper only, or are handed over to half-educated cantors, deacons, or hired teachers, very often of a low description. In fact, in 1898 the teachers in the schools of the Holy Synod were: priests, only 1203; deacons, 3399; cantors, 4232; hired teachers, 22,987. Of properly organized primary schools—besides the special ones—there are, consequently, only those under the ministries of Public Instruction and War, and the Interior, in Siberia. The distribution of the first and the third categories of these schools in 1896 is shown by the following table, the figures being below the preceding, chiefly on account of a less complete registration:—

Schools under the Ministries of Instruction and Interior.	Schools supported by			Total Number of Schools.	Number of Pupils.		
	The State.	The Local Institutions.	Factories and Private Gifts.		Boys.	Girls.	Total.
European Russia	2407	23,115	415	26,591	1,575,044	466,153	2,131,197
Poland . .	98	2,890	20	3,026	141,289	65,684	206,973
Caucasia . .	95	1,022	8	1,125	70,839	17,804	88,643
West Siberia .	31	106	2	139	25,418	7,861	33,279
East Siberia .	10	171	19	200	8,121	2,386	10,507
Turkestan . .	45	60	...	105	3,225	1,080	4,305
Amur Region .	408*	...	...	408	...	...	14,418
Total .	3094	27,373	473	31,594	1,738,354	550,008	2,280,322

* Maintained by the Ministry of the Interior, by means of moneys supplied by the local administration.

Thus the number of primary schools actually maintained by the Ministry of Public Instruction is only 2407 in European Russia, and less than 2700 throughout the whole empire, that is, less than 10 per cent. of the aggregate number of primary schools, the great bulk of the schools (as well as the normal schools for teachers) being supported by the *zemstvos* and the municipalities. Notwithstanding this, the main efforts of the ministry, and the purport of recent legislation, have been to exclude the local institutions from any share in matters affecting primary education, other than the supply of schoolhouses and current expenses. Taking the figures of the preceding table, it appears that only 4·8 per cent. of the total male and 1·6 per cent. of the total female population received primary education in 1899. The schools were distributed very unequally; in five provinces (Olonets, Esthonia, Tula, Livonia, Arkhangelsk, and Novgorod) there was only one primary school for every 638 to 983 inhabitants, while in other provinces (including Kovno, in European Russia) the proportion was even less than one school for each three thousand. One good feature of the Russian primary schools, however, is that in as many as 7247 village schools there are school gardens or fields; in 951 schools, bee-keeping, and in 322 schools, silkworm culture is taught; while in 865 schools the children receive instruction in various trades; and in 305 schools in *slöjd*. Girls are taught handwork in 4556 schools. The average number of teachers was 1 for every 27 pupils, and 44 per cent. of the teachers were women. There were in the same year 9 teachers' institutes and 76 normal schools for teachers, with 6227 pupils. The total expenditure on primary schools in 1899 was 29,612,392 roubles (about the average in recent years), of which 13 per cent. was supplied by the State, 28 per cent. by the *zemstvos*, 37 per cent. by the village communities and the municipalities, and 18 per cent. by private persons.

The middle schools of Russia (exclusive of Finland) were composed in 1899 as per table on next page.

For higher education there were only 9 universities, with 16,570 students in 1899, 2 medical academies, 6 theological academies (944 students), 4 military academies (1360), 2 philological institutes, 3 Eastern languages institutes, 4 judicial military academies, 4 veterinary institutes, 3 agricultural colleges, 2 mining institutes, 4 engineering institutes (2407 students in all the higher technical schools), 2 universities for women (930 students at St Petersburg), and 1 medical academy for women. Finland has a university of its own at Helsingfors.

[1] *Sketch of the Development of Technical Education in 1888–98*, by the Ministry of Public Instruction, 1900.

[2] *Statisque de l'enseignement primaire*, published by the Ministry of Public Instruction in 1900.

Under the	Boys.		Girls.	
	Schools.	Pupils.	Schools.	Pupils.
Ministry of Public Instruction—				
Gymnasia and progymnasia .	237	77,041	346	94,078
Realschulen	113	34,495	...	...
Girls' middle schools . .	...	...	13	432
Special schools . . .	5	1,467	..	...
Normal schools . . .	9	537	..	366
Normal seminaries and practical schools . . .	52	4,388	...	...
Institutions of the Empress Marie:				
Gymnasia and institutes .	...	...	62	20,246
Cossack *Voiskos*—				
Gymnasia and progymnasia .	67	2,845	22	1,368
Ministry of War—				
Cadet corps and special schools	35	12,556	...	...
Various Ministries—				
Agricultural schools * . .	12	1,449	...	...
Technical schools . . .	11	...	...	...
Commercial schools . .	16	...	...	...
Holy Synod—				
Seminaries	58	19,151	...	...
Girls' schools . . .	...	...	69	15,138
Normal schools . . .	14	1,100	...	...

* Lower agricultural schools, 105, with 3191 pupils.

Government.—No substantial changes have lately taken place in the fundamental laws of the empire. The fact has been brought to light that a complete scheme of constitutional government was drawn up in 1809 by Alexander I., with Speransky as collaborator, though only the first step towards carrying it out—that is, the remodelling of the Council of State in 1810—was ever taken, the Napoleonic wars preventing anything further being done in the matter. The idea, however, was not abandoned, and a new scheme was drawn up in 1818 by Novosiltseff, a personal friend of Alexander I., and the French lawyer Deschamps. The intention of the emperor was partly realized by granting a constitution to Poland in 1815, and his intention of extending to Russia the beneficial effects of free and lawful institutions was publicly announced by him in 1818 at the opening of the Diet at Warsaw. The idea of granting to Russia a consultative Assembly of a representative character (*une assemblée des notables*) reached maturity under Alexander II. in the first month of 1881, and on 17th February (1st March) 1881 the emperor confirmed a report of Count Loris Melikoff to that effect.[1]

An imperial decree summoning that Assembly was laid before Alexander II. on 1st (13th) March 1881, and its wording approved by him a few hours before his death, on condition that the decree should be laid before the Committee of Ministers on 4th (16th) March for its definitive sanction. The death of the monarch prevented this important step from being carried out. The decree was laid before the Committee of the Ministers and approved by the majority of them on 8th (20th) March, but on 29th April (11th May) Alexander III. issued a manifesto in which he wrote: "The voice of God orders Us to take in hand the work of government vigorously, in our hope in God's providence, and with faith in the power and truth of Autocratic power, which We are called upon to enforce and to protect from all attempts against it."

The powers of the Committee of Ministers, created by Alexander II. in November 1861, still remain undefined, although it must be noted that this committee has occasionally assumed the powers of a "ministry." Considerable alterations in local government were effected under Alexander III. by the laws of 12th (24th) June 1890 concerning the *zemstvos*, or councils for provincial self-government; 11th (23rd) June 1892, concerning municipal self-government; and 12th (24th) July 1889, concerning the peasants' self-government. In the *zemstvos* the influence of the nobility was increased, and the peasants were deprived of the right of electing their representatives, who are now nominated by the governor of the province from candidates elected by the peasants. At the same time the decisions of the *zemstvos* were made subject to the approval of the governors not only in the case of unlawful decisions, but in every particular. Similar limitations were applied to municipal self-government. As to the peasants, their self-government was placed under the direct control of "landchiefs" nominated by the governors, who received, moreover, the right of nominating the cantonal judges of the peasant cantonal courts (*volostnoï sudiya*), and of inflicting punishments (including corporal punishment) upon the peasants, without bringing the culprits before any court. At the same time, the justices of peace, who had been elected since 1861, were abolished in the country, and were maintained only in the two capitals and six principal cities—the judicial power being transferred to the police officers. The *zemstvos*, which were first instituted in thirty-four out of the fifty governments of European Russia, have recently been granted to three more governments; but further reductions of their powers as regards education, statistical researches about the peasants, and even the administration of famine-relief funds took place. A "lesser state of siege" continues to be maintained in the governments of St Petersburg, Moscow, Kiev, and several western provinces; in 1902 it was extended to all principal industrial towns.

Justice and Crime.—The judicial institutions introduced by the Judicial Law of 1864 also underwent certain limitations during the reign of Alexander III. The law of 20th May (1st June) 1885 considerably limited the principle of the independence of the magistrates; that of 7th (19th) July 1889 reduced the competence of the juries, special courts with "class representatives" nominated *ad hoc* being introduced instead in a number of cases; the introduction of the "landchiefs" reintroduced the principle of combining the judicial and the administrative power in the hands of the same persons. Finally, the right of sentencing persons to the so-called "administrative exile" to Siberia (including the Arctic region of Kolymsk) and other remote portions of the empire, without trial and by simple orders of the administration, which was formerly an arbitrary act of the State police, was rendered legal and brought within the province of the Minister of the Interior, the term of sentence ranging from two to five years, and being capable of being prolonged, once or more than once, for another five years by a special order of the minister. In 1889 the judicial procedure of 1864 (with the above limitations) was introduced in the Baltic provinces; in 1894–98, in the governments of Olonets, Orenburg, Ufa, and Astrakhan; in 1896, with further limitations, in Arkhangelsk; and in 1897–99 in Siberia, Turkestan, the Steppe provinces, the government of Vologda, and the Transcaspian province. The justices of peace introduced in these provinces are nominated by the Government. The criminal statistics for 1874–94, for 33 governments into which the reformed tribunals had been introduced since 1874, show that there was no increase of criminality during these years, and that for a population of 64,030,000 there were on the average 63,787 condemnations per annum, of which nearly two-thirds (39,500) were for minor crimes dealt with by the justices of peace. There is, however, a notable increase (100 to 230) in crimes against persons, and a notable decrease (100 to 72) in those against property. The proportion of criminality varies from 156 to 90 to each 100,000 of the population in the judicial districts of Poland and Revel, and from 77 to 23 to each 100,000 inhabitants in all other judicial districts.

Prisons.—In the year 1899 there were 886 lock-ups and 7 hard-labour prisons, the population of which was 640,439 men and 88,869 women. There were 12,059 inmates in the hard-labour prisons, and 1285 children in 37 reformatories. It is worthy of note that during the year there was not one single case in which flogging was applied in the hard-labour prisons of Sakhalin; but the condition of the children of the exiles on the island is very miserable, owing to a want of schools: only 834 children, out of 4954, go to school. A step of considerable importance was taken on 12th June 1900, when it was decided that exile to Siberia was to be brought to an end.

Finance.—The ordinary revenue is in excess of the ordinary expenditure, but the extraordinary expenditure not only swallows up this surplus, which exceeded 200,000,000 roubles in 1898 and 1899, but necessitates the conclusion of fresh loans every year. It must be admitted, however, that there is much to show for this extraordinary expenditure. A considerable number of new railways, including the Trans-Siberian, have been built; the old loans, at from $4\frac{1}{2}$ to 6 per cent. (3,037,675,234 roubles), have been converted into 4 per cent. loans at a cost of 72,724,063 roubles; and the value of the paper money has been settled at a permanent rate of exchange—1 rouble 50 copeks in paper for 1 rouble in gold. The paper money in circulation has also been reduced: while it was 1,121,300,000 roubles in 1896, it only amounted to 630,000,000 roubles in 1901. The guarantee fund, too, in gold, destined to cover the paper money, has increased from 750,000,000 roubles in 1896 to 807,800,000 roubles in 1901, and thus exceeds the paper money in circulation by 28 per cent. The State debt, which was increased in the 10 years 1890–99 by 893,971,568 roubles (17 per cent.), amounted to 6,225,095,992 paper roubles on 1st January 1900 (£656,547,764 in 1901; net interest paid, £25,418,303). The budget estimates have grown in proportion. The ordinary revenue, which was 952,045,496 roubles in 1890, amounted to 1,800,784,482 roubles in 1902, an increase of 89 per cent., chiefly due to (1) an increase in the revenue from new railways bought by the State (325,624,000 roubles); this is absorbed by the costs of exploitation and the payment on obligations; (2) the introduction of a State monopoly for the sale of spirits (445,807,000 roubles); (3) an

[1] Its text is given in the *Russian Encyclopædic Dictionary*, article "Russia," vol. xxvii. A, St Petersburg, 1899.

increase in the import duties (78,883,000 roubles); and (4) an increased revenue from sugar, spirits, various duties, State monopolies, State domains, and direct and indirect taxes, partly due to increased taxation, and partly to natural growth corresponding to the industrial development of the country. The expenditure, which was 1,038,690,982 roubles in 1890, was estimated at 1,946,571,976 roubles for 1902. The army and the navy were estimated to cost 420,957,521 roubles in 1902, the national debt and the railway obligations 368,460,000 roubles, the working expenses of railways and canals 435,547,758 roubles, new railways and ports 165,660,000 roubles, while public instruction had a grant of only 36,624,000 roubles. It must be observed that in the State budget considerable sums with which the Ministries of Finance, Ways and Communications, are credited and debited (335,198,000 roubles and 435,547,000 roubles respectively) are mere transfers, the Ministry of Finance retaining in its hands the sale of spirits in many provinces of the empire, while the Ministry of Ways and Communications administers the State railways, of which the gross receipts appear in the budget as revenue and the working expenses as expenditure. Turning to the question of local finance, it is found that the 34 provinces which enjoy the right of being administered by the local *zemstvos* yield a yearly revenue of from 60,000,000 to 66,000,000 roubles, while the other provinces have an aggregate revenue of about 18,000,000 roubles. The towns of European Russia proper, Poland, and Siberia have an aggregate revenue of about 75,000,000 roubles, and the village communities of European Russia proper are taxed to the amount of 62,000,000 roubles.

Army.—The system of obligatory military service for all, introduced in 1874, has been maintained, but the six years' term of service has been reduced to five, while the privileges granted to young men who have received various degrees of education have also been reduced to a small extent. During the reign of Alexander III. efforts were mainly directed towards (1) reducing the time required for the mobilization of the army; (2) increasing the immediate readiness of cavalry for war and its fitness for serving as mounted infantry (dragoon regiments taking the place of hussars and lancers); (3) strengthening the western frontier by fortresses and railways; and (4) increasing the artillery, siege, and train reserves. Further, the age releasing from service was raised from 40 to 43 years, and the *opolcheniye* (militia, *landsturm*) was reorganized. The measures taken during the reign of Nicholas II. have been chiefly directed towards increasing the fighting capacity and readiness for immediate service of the troops in Asia, and towards the better reorganization of the local irregular militia forces. Obligatory military service has also been in part extended to Finland. Broadly speaking, the army is divided into regulars, Cossacks, and militia. The peace strength of the army is estimated at 42,000 officers and 1,100,000 men (about 950,000 combatants), while the war strength is approximately 75,000 officers and 4,500,000 men. However, this latter figure is merely nominal, the available artillery and train service being much below the strength which would be required for such an army: estimates which put the military forces of Russia in time of war at 2,750,000 —irrespective of the armies which may be levied during the war itself—seem to approach more nearly the strength of the forces which could be mustered. The infantry and rifles are armed with small-bore magazine rifles, and the active artillery have steel breech-loaders with extreme ranges of from 4150 to 4700 yards.

Navy.—Owing to its geographical situation and its widely separated seas, Russia has to maintain four distinct squadrons: the Baltic, the Black Sea, the Pacific, and the Caspian. Consequently, notwithstanding a very considerable and continuous increase in the expenditure on the navy, the fleet is strong in none of these seas: the Baltic fleet is constantly being drawn upon for reinforcements for the Pacific flotilla, while the Black Sea fleet has no access to the Mediterranean. The strength of the Russian fleet in March 1902, according to the international classification of the *Statesman's Year-Book*, was:—

Class of Ship.	Baltic and other Stations.		Black Sea.		Total.
	Completed.	Building.	Completed.	Building.	
Battleships, 1st class	1	6	1	1	9
,, 2nd ,,	7	2	6	...	15
,, 3rd ,,	2	...	...	...	2
Coast defence vessels	7	1	...	...	8
Cruisers, armoured	1	1	...	...	2
,, belted or protected	15	7	...	2	24
Gunboats	30	2	8	...	41
Old armour-clads and armour gunboats	8	...	...	...	8

There were, moreover, 21 destroyers afloat and 13 building, and 45 first-class torpedo-boats afloat and 6 building, besides 41 second-class and 101 third-class boats. The torpedo-boats can be transported overland from the Baltic to the Black Sea. The total number of officers and men is about 45,000.

Fortresses.—The chief first-class fortresses of Russia are Warsaw and Novogeorgievsk in Poland, and Brest-Litovsk and Kovno in Lithuania. The second-class fortresses are Kronstadt and Sveâborg in the Gulf of Finland, Ivangorod in Poland, Libau on the Baltic Sea, Kertch on the Black Sea, and Vladivostok on the Pacific. In the third class are Viborg in Finland, Ossovets and Ust Dvinsk (or Dünamünde) in Lithuania, Sebastopol and Ochakoff on the Black Sea, and Kars and Batum in Caucasia. There are, moreover, 46 forts and fortresses unclassed, of which 6 are in Poland, 8 in West and South-West Russia, and the remainder (mere fortified posts) in the Asiatic dominions.

Agriculture.—The chief occupation of approximately seven-eighths of the population of European Russia is agriculture, but its character varies considerably according to the soil, the climate, and the geographical position of each region. From detailed researches that have lately been made by Professor Dokuchaeff and his pupils into the soils of Russia, it would seem that a sinuous line drawn across European Russia from Zhitomir to Kiev, Tula, Ryazañ, Simbirsk, and Ufa, that is, from west-south-west to east-north-east, represents a characteristic boundary separating the "northern soils" from the "southern soils." To the south of this line, as far as the sandy deserts of Astrakhan and the prairies of North Caucasia, lies the "black earth" region, covering nearly 270,000,000 acres. Forests give place to prairies, and the soil, which contains from 4 to 16 per cent. of humus, is very fertile; but the whole region suffers periodically from drought. The "northern soils," which are glacial deposits more or less redistributed by water, are much less fertile as a rule, and offer all possible varieties from a tough boulder clay to loose sand. They require heavy manuring; phosphates, which are extracted in four distinct regions of European Russia (Podolia, Central Russia, Ryazañ, and the Upper Volga), being especially beneficial. The agricultural zones are disposed parallel to the above-mentioned boundary line. The prairie zone, where cornfields and pasturages prevail, lies in the extreme south; then to the north, on both sides of the boundary line, comes the "ante-Steppe," the zone in which fields prevail, but in which there are also some forests; farther north still is the zone in which fields and meadows are intermingled with forests; and beyond that again is the forest zone. The actual distribution of fields, forests, and meadows in European Russia and Poland is best seen from the following table:—

	European Russia.		Poland.	
	Acres.	Percentage.	Acres.	Percentage.
Fields and fallow	287,868,000	26	15,933,000	53
Meadows and pasturages	174,958,000	16	5,605,000	19
Forests	425,622,000	39	6,763,000	23
Uncultivated	210,060,000	19	1,631,000	5
Total	1,098,508,000	100	29,932,000	100

The proportion of land under crops varies very much in different parts of European Russia; it is 74 and 73 per cent. in Kursk and Tula, from 45 to 70 per cent. in the two above-mentioned southern zones, from 30 to 50 per cent. in Middle Russia, from 20 to 30 per cent. in Western Russia and in the southern Urals (Ufa); from 10 to 20 per cent. in the lake region, and less than 10 per cent. in Northern and North-Eastern Russia. The highest standard of agriculture is met with in Poland and in the western governments (Baltic, Lithuanian, and South-Western), and the standard gets lower and lower as one moves eastwards. Rye and oats are the chief cereal in Central and North Central Russia. Wheat is sown in only small quantities in Western and Central Russia, but is the chief crop in the southern prairie belt. In the far north barley takes the place of oats and partly of rye. Buckwheat is sown everywhere in the middle zone, but millet takes its place to the south of the above-mentioned boundary, and maize in the extreme south-west (Podolia, Bessarabia, and Kherson), and in the Caucasus. Potatoes are extensively cultivated in the west. The use of agricultural machinery is rapidly spreading, reapers and steam threshing-machines being largely used in the "black earth" prairie belt.

Taking the whole empire, nearly six-tenths of the cultivated

area is sown every year with cereals, the areas under which in the various divisions of the empire in 1900 are shown in the following table:[1]—

Region.	Acres.
European Russia	178,963,600
Poland	10,770,000
Four governments of North Caucasia * . .	10,470,700
Four governments of Siberia † . . .	9,182,000
Four provinces of Central Asia ‡ . . .	2,131,400
Total, in 72 governments .	211,517,700

* Kuban, Stavropol, Terek, and Tchernomorsk.
† Tobolsk, Tomsk, Yeniseisk, and Irkutsk.
‡ Akmolinsk, Semipalatinsk, and Turgai; Semiryechensk of Turkestan.

The crops are now given in official documents in units of weight, and the quarter of each different grain having a different weight, which varies with the year and even the region, it is not easy to compare the present returns with those of former years. The crops of 1900, which were 10 per cent. in excess of the average crops of the preceding years, are given in the following table, in thousands of cwt.:—

Region.	Crops, in Thousands of Cwt.						
	Wheat.	Rye.	Barley.	Oats.	Various.*	Total.	Potatoes.
European Russia .	170,999	414,413	80,243	212,586	48,895	927,225	332,428
Poland . . .	10,565	33,812	7,891	•14,639	2,001	68,908	106,289
North Caucasia † .	30,508	3,751	11,617	5,005	5,035	55,915	7,151
Siberia ‡ . . .	10,807	7,927	1,272	9,977	726	30,709	9,043
Steppes § . . .	3,728	171	541	1,710	2,528	8,679	597
Total . .	226,607	460,074	101,564	243,917	59,275	1,091,436	515,508

* Mixed rye and wheat, buckwheat, and millet.
† Kuban, Stavropol, Terek, and Tchernomorsk.
‡ Irkutsk, Tobolsk, Tomsk, and Yeniseisk.
§ Akmolinsk, Semipalatinsk, Semiryechensk, and Turgai.

The yield of maize was 12,785,000 cwt. in European Russia, and 4,342,000 in northern Caucasia; the aggregate yield of peas, lentils, and beans was 18,942,000 cwt. The hay crop in 1900 was as follows:—

Region.	Area in Acres.	Yield in Thousands of Cwt.
European Russia . .	69,796,000	744,961
Poland	2,427,000	36,652
North Caucasia . .	6,684,000	77,915
Siberia	9,080,000	83,146
Steppes	2,511,000	24,425
Total .	90,498,000	967,099

Beetroot for sugar is especially cultivated in Poland, the western provinces (Kiev, Podolia, Volhynia, and Kharkov), and the south-western (Bessarabia, Kherson), as also to some extent in South Central Russia; 1,454,000 acres were under beet in 1901, and 754,760 tons of refined sugar were obtained in 277 sugar works. Tobacco is widely grown in the south (1,672,000 cwt.), and the hop crop of 1897 was 107,000 cwt. Flax is grown chiefly in Central and North-Western Russia, the yearly crop being about 10,780,000 cwt. of flax (half of which is exported) and 12,932,500 cwt. of linseed. Hemp is cultivated both for fibre (yearly yield, 5,014,000 cwt.) and seed (6,245,000 cwt.). Various other oil seeds are also grown, the yearly production of various oils being estimated at 1,000,000 cwt. The vine is grown as far north as 49° N. (Bessarabia, Crimea, Don, besides Caucasia and Central Asia), the yearly production of wine being 19,990,000 gallons in Russia, 17,000,000 in Caucasia, and 116,000 in Central Asia. Market-gardening and fruit-growing are extensively engaged in in portions of Central and South Russia, and very important works have lately been established for the manufacture of jam, pickles, and canned fruit. Turkestan, Khiva, and Bokhara supply every year about 1,160,000 cwt. of cleansed cotton, and Transcaucasia about 20,000 cwt.

The live stock in the empire in 1896 is estimated by Russian statisticians to have been as follows:—

Region.	Thousands of Head.							
	Horses.	Horned Cattle.	Sheep.	Pigs.	Goats	Camels.	Reindeer.	Total.
European Russia and Poland	20,867	27,922	48,000	10,742	1,393	26	263	109,213
Finland	271	1,103	1,067	197	14	..	130	2,782
Caucasia * . . .	1,018	5,883	12,000	960	2,000	24	..	21,885
Siberia	2,318	2,429	3,000	536	117	..	198	8,598
Steppe provinces † . .	2,461	1,215	10,000	..	146	403	..	11,225
Empire, 1896 . .	26,935	38,552	74,067	12,435	3,670	453	591	156,703
" including Turkestan, 1898	33,000	37,413	74,789	11,968	3,190	1,279	600	162,239

* Incomplete data, the figures for sheep and goats are approximate only.
† Data incomplete.

Thus in European Russia and Poland there were in 1896 23 horses, 31 horned cattle, 53 sheep, and 12 swine to every 100 inhabitants. However, even within Russia proper the live stock is very unequally distributed, there being 109 horned cattle to every 100 inhabitants in the Don province, 51 in Esthonia, and only 14 in Orel and Tula. From an enumeration taken in 41 provinces of European Russia in 1896, it appeared that 82 per cent. of the total number of horses belonged to the peasants, but that 28 per cent. of the peasant households did not own any horses, and that there were 1820 private horse-breeding establishments with about 40,000 head. The most common kind of animal is the small, weak, peasant horse; the best are found in Poland, the western governments, and in the Steppe provinces. The South Russian "bityugs" are a fine breed, and so are the Cossack horses, while the Kirghiz breed in South-Eastern Russia are especially appreciated for their endurance. Finland ponies are largely exported. The best races of horned cattle are found in Poland, the western provinces, Little Russia, and the Far North (Holmogory). Swine-breeding is in a primitive condition. Of the nearly 75,000,000 sheep kept in Russia, only about 15,000,000 belong to the fine merino breed; these yield, however, over 1,000,000 cwt. of fine wool annually; they are chiefly kept on the Black Sea prairies. The export of live stock is rapidly increasing—horses being exported to Germany, Austria, and Great Britain to the value of about £500,000 per annum, cattle to Turkey and China, sheep to France, China, and Turkey, and pigs to Germany (to the value of £325,000 annually). On the other hand, considerable quantities of cattle and sheep are imported from Central Asia. Modern dairy-farming is still new in Russia, and butter is still imported, chiefly from Finland; but it is also exported, and in increasing quantities, to Western Europe, being sent to Great Britain alone, in part *viâ* Copenhagen, to the value of £685,493 in 1900. Poultry-farming, for the supply of both the home and foreign markets, is being more and more extensively engaged in, and the export of eggs has of late developed enormously: on the average, 1,743,000,000 eggs, in each of the three years 1897–99, valued at £2,844,000, were sent out of the country.

Viewed as a whole, it must be confessed that agriculture stands at a very low level in Russia. Considerable progress was made in the fertile prairies bordering the Black Sea and the Sea of Azov, where modern agricultural machinery was largely introduced, and a very considerable number of machinery works, large and small, have grown up. But the famines which periodically visit large districts—especially in the fertile but dry prairie belt of South-Eastern Russia, and in some of the central provinces—are chiefly due to the primitive methods of husbandry employed. The misery of the peasants, who up to the present time have borne nearly all the burden of taxation, the lack of education, and the almost total absence of those institutions by means of which agricultural education is spread among the farmers in the United States, in France, and in Germany, have all hampered the development of agriculture. The general improvement of the agricultural population of the central provinces of European Russia is now the subject of a wide inquiry, from which it appears (in a summary published by A. D. Polyénoff) that within the years 1871 and 1899 the arrears in the payment of the direct taxes grew from 10 to 42 per cent. of the aggregate sum; the yearly sowings, taken per head of population, decreased by 35 per cent., and the number of horses, also per head of agricultural population, by 48 per cent., and so on—the result being a rapid growth of a totally destitute peasant class even in the most fertile provinces of European Russia. Within the last few years some efforts have been made by the Ministry of Agriculture to help the peasantry in education; but in 1899 there were only 114 agricultural and dairy schools (4 for women), with 5157 pupils; as was noticed under *Education*, farms and gardens have been widely established in connexion with the village schools; numerous agricultural societies (320, of which 80 are in the Baltic provinces) have been founded lately. The *zemstvos* have made a notable effort to improve the condition of agriculture by appointing agricultural councils and inspectors, establishing museums, meteorological stations, and depôts for the sale of agricultural machinery at cost price. Measures are also being

[1] *Résultats généraux de la Récolte en Russie en 1900.* St Petersburg, 1901.

taken to increase the very low productivity of the forests.[1] These cover a considerable area, as may be seen from the following table:—

Region.	Area under Forests. Square Miles.	Percentage of Total Area.
European Russia . . .	717,730	39·4
Poland	10,480	21·4
Finland	78,905	62·8
Caucasia *	29,605	16·3
Total . . .	836,720	38·4

* Without Erivan and Tchernomorsk.

According to more recent estimates, the areas under forests are —453,617,000 acres in European Russia, 7,358,000 acres in Poland, and 19,352,000 acres in Caucasia. Nearly 54,000,000 acres must, however, be excluded from the figures for European Russia and Poland as marsh land and land under lakes. The distribution of forests is very unequal in European Russia, the area covered by them in the various provinces varying from 89 per cent. of the total area in the north to 9 per cent. and even 2 per cent. in the south-east. The State is the chief owner of forests (almost exclusive owner in Arkhangelsk), and owns no less than 272,000,000 acres in European Russia and Poland (235,000,000 acres of good forests), while private persons own 108,000,000 acres, the peasant communities 43,000,000, and the Imperial family 13,500,000 acres.

Sericulture, which was in a flourishing condition in the 'sixties, both in the Caucasus and in Southern Russia, was reduced to a very low ebb in consequence of the silkworm disease, and was only renewed with any vigour towards the end of the 'eighties. At the beginning of the 20th century it was most developed in Transcaucasia (Kutais, Elisabethpol), and extended into Northern Caucasia; from 100,000 to 130,000 cwt. of cocoons, valued at £400,000 to £600,000, is obtained annually, and sent to Moscow (mainly) and France. Sericulture is taught in a number of special schools and in a great number of village schools. It is widely engaged in in Turkestan, and to some extent in the Transcaspian territory, Khiva, and Bokhara. Attempts are being made to re-establish the silkworm industry in South Russia, where at present only 800 to 1000 cwt. of cocoons are obtained per annum, and in Poland. Altogether about 250,000 cwt. of cocoons, representing about 13,000 cwt. of silk of the value of £850,000 to £900,000, are obtained annually in the Russian empire. The cotton plant is widely cultivated in Turkestan, 840,000 cwt. of cleaned cotton, representing 2,080,000 cwt. of raw cotton, being obtained in 1899; to this must be added 322,000 cwt. from Bokhara and Khiva, and 408,000 cwt. from Transcaucasia (1898).

Fishing.—Fish continues to form an important article of national food, and to provide an important part of the national income. Along the Murman coast of the Arctic Ocean and in the White Sea (where nearly 40,000,000 herrings are caught annually) the yearly produce is estimated at 370,000 cwt., of the value of about £140,000. In the Baltic Sea, as well as in the lakes of its basin (Ladoga, Onega, Ilmeñ, &c.), the yearly value is estimated at £200,000. Of anchovies alone 10,000,000 jars are prepared annually, while salted fish is the chief, next after bread, food of large masses of the population. The Black Sea fisheries yield 925,000 cwt., valued at £300,000 per annum. The value of the fish has much increased lately owing to the introduction of cold storage; as a result of the employment of this method of packing, the fish is now exported in a fresh state from the Black Sea to all parts of South-West Russia, and even to Moscow. The annual yield of the Azov Sea fisheries is valued at £600,000. In the Volga section of the Caspian Sea about 930,000,000 fish are caught annually, of a value of about £1,100,000; in the Ural section 836,500 cwt. of fish and 29,000 cwt. of caviare are obtained. The total value of the Caspian fisheries is estimated at £3,000,000 per annum. Taking the Lake Aral and Siberian river fisheries into account, it is estimated that altogether more than 1,100,000 tons of fish are obtained every year (in addition to 200,000 cwt. of caviare, 230,000 cwt. of fine conserves, and 1700 cwt. of glue), yielding a revenue to the State of £330,000, and requiring for its preservation over 200,000 tons of salt.[2] In addition, from 13,000 to 60,000 seals and about 200 whales are killed annually off the Murman coast.

Industry.—The growth of Russian industry is shown in the following table, which compares the returns for 1887 and 1897 of all factories throughout the empire of which the annual production was valued at more than 2000 roubles:—

Branch of Industry.	1887. Number of Workers.	1887. Yearly Returns. Roubles.	1897. Number of Factories.	1897. Number of Workers.	1897. Yearly Returns. Roubles.
Textiles . .	399,178	463,044,000	4,449	642,520	946,296,000
Food products .	205,223	375,286,000	16,512	255,357	648,116,000
Animal products .	38,876	79,495,000	4,238	64,418	132,058,000
Wood . . .	30,703	25,688,000	2,357	86,273	102,897,000
Paper . . .	19,491	21,030,000	532	46,190	45,490,000
Chemical products	21,134	21,059,000	769	35,320	59,555,000
Ceramics . .	67,346	28,965,000	3,413	143,291	82,590,000
Mining and metals	390,915	156,012,000	3,412	544,333	303,749,000
Metal goods . .	103,300	112,618,000	2,412	214,311	310,626,000
Various . . .	41,882	50,852,000	935	66,249	117,767,000
Total .	1,318,048	1,334,049,000	39,059	2,098,262	2,839,144,000

The following table shows the growth of the mining industry in greater detail:—

Metal.	1887. Production.	1887. Value. Roubles.	1897. Production.	1897. Value. Roubles.
Gold . . .	34,840 kilos	40,413,000	38,182 kilos	43,072,000
Silver . . .	15,020 ,,	..	4,390 ,,	386,000
Platinum . .	4,406 ,,	2,018,000	5,586 ,,	3,095,000
Copper . .	4,783 tons	3,504,000	5,192 tons	4,639,000
Zinc . . .	3,720 ,,	884,000	4,505 ,,	1,373,000
Lead . . .	983 ,,	120,000	442 ,,	58,000
Mercury . .	64 ,,	..	623 ,,	..
Salt . . .	1,157,000 ,,	5,649,000	1,562,000 ,,	6,778,000
Coal . . .	4,534,000 ,,	13,839,000	11,203,000 ,,	38,045,000
Pig iron . .	594,000 ,,	25,405,000	1,848,000 ,,	77,731,000
Iron . . .	362,000 ,,	35,388,000	490,000 ,,	50,033,000
Steel . . .	157,000 ,,	22,094,000	920,000 ,,	125,942,000
Raw naphtha .	2,733,000 ,,	5,006,000	7,831,000 ,,	36,558,000
Naphtha products	..	18,317,000	..	45,735,000

Nearly all these figures showed an increase in 1899, the output being: gold 38,776, silver 4637, and platinum 5962 kilograms; copper 6495 (1898), zinc 7419, lead 238, mercury 357, salt 1,643,000, coal 13,705,000, pig iron 2,680,000, iron 573,000, steel 1,314,000, and naphtha 8,827,000 tons; also manganese ore, 319,400 tons. Though still in its infancy, the chemical industry is making rapid progress in Russia. In 1890 there were only two soda works, but seven years later there were ten such works and about thirty other chemical works, which yielded in 1899 over 82,000 tons of carbonated soda. With the natural resources of Russia, and the awakening interest of its people in the industrial possibilities that lie before them, this branch of industry, as well as that connected with the utilization of the vast supplies of raw naphtha still waiting to be tapped, is sure to advance by leaps and bounds. Unfortunately, the extravagant prices which Russia has to pay for iron and all iron goods, owing to its prohibitive tariffs, combined with the obstacles laid in the way of spreading education, hamper the development of all industries.[3] The cotton industry uses nearly 270,000 tons of raw cotton annually, 100,000 tons of which are supplied by Central Asia and Transcaucasia: it represents 6,500,000 spindles and 200,000 power looms, and excels chiefly in the production of red and printed cottons. Since 1880 power looms have been made in Russia itself. And while the total value of all imports in cottons is only about 5,900,000 roubles, the exports to Persia, China, and Turkey are valued at 8,000,000 roubles; every year, too, the home market absorbs more and more cotton goods. The woollen industry is rapidly growing, but it cannot yet satisfy the local demands, and even raw wool continues to be imported. In the flax mills there are 300,000 spindles and 15,000 power looms. The tendency is to produce the finest flax tissues as well as the coarser. Of the 200,000 tons of hemp grown every year, nearly 50,000 tons are retained for home use, and, further, about 1500 tons of Italian and Manila hemp and 18,500 tons of jute are imported for the mills. The silk mills employ silk obtained from the Caucasus, Italy, and France. The sudden growth of the silk industry will be seen when it is stated that whereas in 1879–88 the import of all sorts of raw silk averaged only 79 tons per annum, in 1896–98 the average yearly importation was 1248 tons. The growth of the sugar industry is shown by the

[1] See *Russian Forests*, published by the Ministry of Agriculture, 1900; *Report of the Forestry Department* for 1899; *Works (Trudy)* of the Committee of Prof. Dokuchaeff, 1898; *Irrigation, Industrial Hunting*, by A. Silantieff, and a number of other official publications of the Ministry of Agriculture.

[2] See *Researches into the State of Fisheries in Russia*, 9 vols., edited by Minister of Finance, 1896 (Russian); Kusnetzow's *Fischerei und Thiererbeutung in den Gewässern Russlands*, 1898.

[3] See *The Iron Industry of the World*, *The Cotton Industry of Russia*, and *The Influence of Railways upon Agriculture, Industry, and Trade*, by Anton Radzig. St Petersburg, 1891–96.

fact that in 1888–93 the average annual production of raw sugar was 925,540 metric tons, and of the refineries, 444,520 tons; in the years 1894–98 the figures were 1,159,200 and 620,640 tons respectively; while in 1900 the refineries yielded 670,680 tons in European Russia and 74,920 tons in Poland. In 1899–1900 there were in the empire 2025 distilleries, which used 2,500,000 tons of cereals and 1,800,000 tons of potatoes, the yield being 86,094,000 gallons of pure alcohol. The yearly consumption of spirits per head of population, which was 13·6 pints in 1889, steadily decreased to 10·8 pints in 1898. Of beer, which is chiefly made in Poland and the Baltic provinces, 124,080,000 gallons were produced in 1897–98. Tanneries exist in nearly every province of Russia, but it is especially at Warsaw and St Petersburg, and after these at Moscow, that the largest and best modern tanneries and shoe and glove factories are established. The governments of Orel (shoe factories), Kherson, Vyatka, Nijni Novgorod, Perm, Kiev, and Kazañ rank next in this respect. Furniture factories are greatly developing; and in 1899 the paper industry was represented by 184 factories in Russia and Poland and 12 in Finland, the yearly production having increased in Finland from 12,000 metric tons in 1890 to 27,200 tons in 1899, and in Russia from 80,000 tons in 1887 to 192,000 tons in 1899. The growth of mechanical works has also been great, as may be seen from the following table:—

Year.	Factories.	Number of Workers.	Yearly Returns.
1870	198	30,000	£2,900,000
1885	336	42,772	4,100,000
1897	682	120,339	14,200,000

The yearly production includes about 400,000 tons of rails per annum, and 700 railway steam engines, 66,000 tons of iron and steel wire, 23,000 tons of pipes.[1]

The relative industrial importance of the leading manufacturing provinces of the Russian Empire is shown in the following table, which gives the returns for 1897 of all factories and mining industries in the governments enumerated (P stands for Poland, and C for Caucasia):—

	Millions of Roubles.		Millions of Roubles.
Moscow	380·0	Kostroma	61·1
St Petersburg . . .	289·6	Kharkov	44·5
Piotrkow (P) . . .	256·8	Nijni-Novgorod . .	44·1
Vladimir . . .	206·6	Don	39·5
Ekaterinoslav . . .	155·7	Orel	38·7
Warsaw (P) . . .	106·3	Podolia	37·1
Livonia	88·2	Saratov	34·4
Perm	87·1	Tver	32·7
Baku (C) . . .	82·6	All others less than 30,000,000 roubles.	
Kiev	74·4		
Kherson	62·8		

Far from being destroyed by the competition of the factories, the domestic industries, while undergoing certain modifications required by the new conditions, have well maintained their ground, even new branches of petty trade having sprung up in some districts. Among these new branches the manufacture of agricultural machinery (thrashing machines in Ryazan, Vyatka, and Perm; ploughs in Smolensk, &c.) deserves notice. Cotton-weaving alone, in the Moscow central region, still gives occupation to more than 60,000 families; and furniture-making has lately developed on a large scale in several provinces.

Commerce.—It is impossible to give even an approximate estimate of the value of the internal trade in Russia. The chief fairs are held at Nijni-Novgorod and Irbit in Siberia. The yearly returns of goods actually sold at these two fairs are as follows (000 omitted):—

Fair.	1881–90.	1891–95.	1896.	1897.	1898.	1899.
	Roubles.	Roubles.	Roubles	Roubles.	Roubles.	Rouble
Nijni-Novgorod	187,127	151,958	153,338	142,664	128,721	170,000
Irbit .	56,700	36,200	41,000	41,000	30,300	31,600

The value of the commercial transactions which take place at both these fairs greatly exceeds the above figures. Altogether, no less than 16,604 fairs are held in Russia (European Russia 14,048, Poland 1877, Caucasia 143, Siberia 447, and Central Asia 89). Of these, 30 show returns of goods imported to the value of over 1,000,000 roubles each, 41 from 500,000 to 1,000,000, and 437 from 100,000 to 500,000 roubles each, while 7363 fairs show returns of less than 5000 roubles each.

On 1st January 1898 there were in Russia 1146 shareholders' companies, with a capital of 2,061,000,000 roubles, of which 938 were industrial and 208 commercial, banking, and insurance companies. 115, with an aggregate capital of 337,000,000 roubles, were foreign companies; 23 more foreign companies (capital 96,000,000 roubles) were formed in 1898.

The external trade of the Russian empire (bullion not included, nor the external trade of Finland) since the year 1886 is shown in the following table:—

Year.	Exports.	Imports.
	Paper Roubles.	Paper Roubles.
1886–90, average . .	675,200,000	415,100,000
1891–95, ,, . .	636,515,000*	468,961,000
1896	688,572,000	589,810,000
1897	726,624,000	559,998,000
1898	732,673,000	617,459,000
1899	626,475,000	642,778,000
1900†	688,552,000	572,184,000

* 1891 and 1892, famine years.
† European frontier and trade with Finland only.

The chief exports pass across the "European frontier," which includes the Black Sea ports of the Caucasus. The relative importance of trade with Europe, Finland, and Asia is shown by the following table:—

	1895.	1896.	1897.	1898.	1899.
	1000 Roubles.	1000 Roubles.	1000 Roubles.	1000 Roubles.	1000 Roubles.
Exports.					
Across European frontier . .	652,262	649,709	673,900	675,600	566,533*
Across Asiatic frontier . .	21,307	21,208	22,300	23,800	25,334
To Finland .	15,514	17,655	30,400	33,300	35,116
Total . .	689,083	688,572	726,600	732,700	626,983
Further, to Russian Manchuria . .	23,771	24,600	24,900	26,700	...
Imports.					
Across European frontier . .	457,800	514,600	489,500	541,500	576,882
Across Asiatic frontier . .	47,600	50,400	51,400	55,400	53,374
From Finland .	20,700	20,500	19,100	20,600	20,229
Total . .	526,100	585,500	560,000	617,500	650,485
Gold and silver in money and ingots.					
Exported . .	2,063	3,101	12,740	4,868	50,810
Imported . .	56,394	177,599	209,117	131,489	82,221

* Bad crops.

The character of the trade passing across the "European frontier" is as follows:—

	1896.	1897.	1898.	1899.	1900.
	1000 Roubles.	1000 Roubles.	1000 Roubles.	1000 Roubles.	1000 Roubles.
Exports.					
Articles of food .	381,525	413,635	433,496	317,170	381,215
Raw and half-manufactured articles . .	257,839	254,594	238,397	249,873	269,942
Animals . .	15,144	17,092	16,848	17,254	17,900
Manufactured goods . .	12,906	19,026	21,243	17,352	19,495
Total . .	667,414	704,347	709,984	601,649	688,552
Imports.					
Articles of food .	69,803	64,058	69,803	73,441	79,780
Raw and half-manufactured articles . .	306,656	291,622	302,134	301,376	304,579
Animals . .	2,278	1,620	1,511	1,802	1,136
Manufactured goods . .	161,528	151,231	188,565	217,856	187,001
Total . .	520,265	508,531	562,013	594,475	572,496

[1] For all information concerning the development and geographical distribution of industries, see Kovalevsky's *La Russie à la fin du xixe siècle*, Paris, 1900 (official publication): B. F. Brandt's *Foreign Capital: Its Influence*, 2 parts, 1899 (Russian); and numerous official publications of the Ministries of Finance, Agriculture, and Trade.

The chief articles of export across the "European frontier" are grain and flour, the figures for which were 147,468,860 cwt., valued at 370,463,000 roubles, in 1898; 111,143,000 cwt., valued at 259,022 roubles, in 1899; and 135,040,000 cwt., valued at 304,698 roubles, in 1900. Then come flax and hemp to the value of 58,518,000 roubles, in 1900; dairy produce and eggs, 45,292,000 roubles; timber and wooden goods, 58,384,000 roubles; naphtha and naphtha oils, 45,973,000 roubles; animals, 17,900,000 roubles; oil-cakes, 15,540,000 roubles; bristles, hair, and feathers, 7,343,000 roubles; sugar, 16,330,000 roubles; and manufactured goods, 19,495,000 roubles. The chief imports in 1900 across the same frontier were machinery, 76,665,000 roubles; raw cotton, 63,201,000; raw wool and wool yarn, 21,759,000 roubles; raw silk and silk yarn, 13,282,000 roubles; raw metals, 36,673,000 roubles; metal goods, 29,022,000 roubles; coal and coke, 42,589,000 roubles; chemicals and colours, 23,586,000 roubles; and tea, 23,639,000 roubles.

In the trade with Asia the chief exports were, in 1898, naphtha and naphtha oils, 21,260,000 roubles; cereals, 16,125,000 roubles; cottons, 9,023,000 roubles; and sugar, 6,309,000 roubles; while the chief imports were tea, 24,496,000 roubles; textiles, 5,578,000 roubles; and machinery (to Russian Manchuria), 4,716,000 roubles.

The chief external trade was formerly with Great Britain, but is now with Germany, the exports to which—chiefly grain, flax, timber, eggs, hemp, live fowls, tea, hides, bristles, and linseed—amounted to 187,515,000 roubles in 1900, while the imports from which—chiefly machinery, woollen yarn, raw wool, and iron goods—amounted to 215,416,000 roubles in the same year. The discrepancy between the British and the Russian returns of the trade between the two countries is so great as to be worthy of notice. These differences for the 20 years ending 1900 are exemplified in the following table:—

	British Returns.		Russian Returns.	
	Exported to Russia.	Imported from Russia.	Imported from Great Britain.	Exported to Great Britain.
	£*	£*	Paper Roubles.*	Paper Roubles.*
1881–90 average	7,783,000	19,687,000	108,850,000	198,350,000
1891–95 average	9,931,000	21,429,000	111,039,000	160,744,000
1896	7,185,180	22,667,440	111,041,000	160,903,000
1897	7,513,160	22,284,360	102,016,000	150,908,000
1898	9,227,970	19,489,510	115,082,000	139,906,000
1899	11,720,330	18,711,170	129,353,000	129,168,000
1900	11,001,300	21,974,952	128,176,000	145,564,000

* One pound sterling=9·87, or practically 10, paper roubles.

The chief exports to the United Kingdom are grain, flax, hemp, and eggs, while the chief imports are machinery, metals, coal, and raw cotton in transit. France ranks third in the foreign trade of Russia; in 1900 the exports thereto (grain, timber, oil seeds, and flax) were valued at 57,444,000 roubles, and the imports therefrom (wine, raw silk, and wool) at 31,228,000 roubles. The trade with Holland has been on the increase, but the exports to that country, which reached 72,257,000 roubles in 1898, only totalled 69,192,000 roubles in 1900. In the trade with the United States the goods exported from Russia are insignificant, but those imported into Russia (chiefly machinery) reached 50,059,000 roubles in 1898 and 43,615,000 roubles in 1900.[1] The trade with China (imports therefrom 40,000,000 roubles on the average; exports thereto only 5,000,000 roubles) is mainly dependent on the importation of tea (32,000,000 roubles in 1897); some cottons and silks are also imported. Considerable quantities of Ceylon teas were imported lately. Even in her trade with Persia, Russia imports more fruit, rice, cotton, silks, and woollens (to the value of 18,000,000 roubles) than she exports (15,000,000 roubles, half of which represents sugar, and the remainder cottons and other manufactured goods). It may be added that in international trade Russia occupies the sixth place (after Great Britain, Germany, the United States, France, and Holland), her commerce representing 6 per cent. of that of the world.

On 1st January 1899 the mercantile fleet of Russia, including Finland, consisted of only 657 steamers of 299,700 tons, and 2143 sailing vessels of 254,100 tons. In 1900 the ports of the Baltic, the Black and the White Seas, were entered by 10 573 vessels above 20 tons, 8,549,000 tons in all; but only 5518 vessels (4,097,000 tons) came loaded with goods, the remainder coming with ballast to take goods for export. The Caspian ports were entered by 943 vessels, and Vladivostok by 384 vessels, only one-tenth of which were under the Russian flag. And 66,723 vessels engaged in the coasting trade entered the Russian ports in 1898. Inland navigation, however, is, as in the United States, immense and quite out of proportion to the foreign shipping. The total length of rivers available for carrying trade throughout the empire is 101,000 miles, of which 46,000 miles are used for floating rafts, and 55,000 are navigable by craft; 33,000 miles are navigable by steamers. European Russia alone, without Finland, has 24,432 miles of navigable rivers (16,590 miles by steamers). There are, further, 507 miles of canals and 711 miles of canalized rivers. In 1895 the fleet on the rivers of Russia proper and Poland (on the Volga it had doubled in 10 years) numbered 2539 steamers, of 129,760 nominal horse-power and with an aggregate capacity of 198,000 tons (2894 steamers in 1897); there were also 20,580 other vessels, aggregating 8,504,300 tons. Both categories together employed no less than 118,297 persons. Nearly 125 steamers are added every year to this fleet (173, all built in Russia, in 1897), and about 5500 various vessels, of which the greater number are destroyed every year. In 1899, 167,204 vessels and 260,144 rafts were loaded at the river ports of Russia proper, the total weight of the merchandise thus transported being 30,380,000 tons (about 12,240,000 by raft), of a total estimated value—much below the real value—of 468,582,000 roubles. Timber, fuel wood, corn, and naphtha supply the chief loads (22,800,000 tons). The rivers of West Siberia were navigated in 1896 by 114 steamers of 5000 tons, and 369 barges; those of East Siberia (Lena, Yenisei) by 41 steamers of 2000 tons; and the Amur by 116 steamers of 4300 tons, and 145 barges.

Shipping and navigation.

A considerable number of new railways, some of which are of great importance to the empire, were built during the last twenty years of the 19th century. At the same time the chief lines of railways, which had been built by public companies with a State guarantee, and which represented a loss to the empire of about 30,000,000 roubles per annum, as well as a growing indebtedness, were bought by the State, which derives a small net profit from its railways, although several of the later lines, while imperative for State purposes must necessarily yield but a very small revenue, or be worked at a loss.

Railways.

On 1st January 1883 there were 14,316 miles of railways in Russia, Poland, and Caucasia, 734 miles in Finland, and 141 in the Transcaspian region—a total of 15,191 miles, of which 738 miles belonged to the State and the remainder to public companies. On 1st June 1900, 33,425 miles of railways were opened to traffic, 22,712 miles being owned by the State and 10,713 miles by public companies; there were also 2904 miles of line under construction (1110 miles owned by the State); and over and above all, 1600 miles in Manchuria and 1586 miles in Finland.

The most important of the new railways is the Trans-Siberian, of which the first section, Chelyabinsk to Omsk, was opened in December 1895, and which in 1901 was virtually completed right through to Sryetensk, on the Shilka, the head of navigation on the Shilka and the Amur, 2804 miles from Chelyabinsk and 4168 miles from Moscow, *viâ* Samara and Chelyabinsk. There is only one interruption in that line—Lake Baikal, the railway round the lake being under construction. At the Pacific end of the Trans-Siberian Railway a line connecting the Pacific town and fortress of Vladivostok with Khabarovsk, at the junction of the Amur and the Usuri, was first of all built, following the very thinly-inhabited valley of the Usuri, which, owing to natural conditions, can never become the seat of a numerous agricultural population. But it was soon found that the cost of the section required to complete the railway along this route, that is, of a line between Sryetensk and Khabarovsk, along the Shilka (240 miles) and the Amur (1320), would be enormous, while neither the wild mountainous tracts on the lower Shilka (Gazimur range) and upper Amur (high plateau), nor the marshy, often inundated region between Khabarovsk and the Little Khingan (250 miles), could ever be the seat of a numerous agricultural or mining population. Consequently a company was formed by the Russian Government in 1896 to construct, with the consent of the Chinese Government, a railway from Vladivostok right across Manchuria to Kaidalovo, a point in Transbaikalia on the Sryetensk line, near to Chita. This runs for 330 miles on Russian territory and for 951 miles on Manchurian territory, and passes through the Manchurian towns of Tsitsikar, Harbin on the Sungari, and Ninguta. Plans were also made for a branch line, from Kharbin to Port Arthur, *viâ* Bedune, Mukden, and Niuchwang. The first portion of the Trans-Manchurian railway, built by Russian engineers, with Chinese labour, and under the protection of Russian troops, was in a fair way of progress before the Boxer uprising; and though the troubled state of the country compelled operations to be suspended for some time in 1900–01, work was recommenced in the summer of the latter year. Both sections,

[1] According to the official returns of the U.S. Treasury Department, the total exports from the Russian empire to the United States in 1901 amounted to $7,034,421 (£1,406,884), and the imports into the Russian empire from the United States amounted to $9,545,904 (£1,909,181).

Kaidalovo–Vladivostok and Harbin–Port Arthur, are now (1902) virtually completed. At the same time, several secondary lines were built in connexion with the Trans-Siberian line. Chelyabinsk has also been connected by a transverse line with the Middle Urals Railway, which connects Perm, the head of navigation in the Volga basin, with Tyumen, the head of navigation on the Ob and Irtysh, passing through Ekaterinburg and other mining centres of the Middle Urals. Tomsk is now connected with the main line, and various lines are being built in the Urals. A railway has also been built to connect Perm with Kotlas, near the junction of the Sukhona with the Yug, at the head of the Northern Dvina. Throughout its length, which is 538 miles, it passes through a very thinly populated region, but it is hoped that it will provide an outlet for Siberian grain and other produce in the direction of the White Sea. The traffic along the Trans-Siberian line is rapidly growing, and in 1899 the exports had attained 280,000 tons, chiefly grain, butter, meat, cattle, hides, &c.

Another line of great strategic, and apparently of commercial, importance has been built across the Transcaspian territory to Fergana. Starting from Uzunada and Krasnovodsk, it runs first south-east to Merv (604 miles), with a branch line (194 miles) to Kushka, near Herat, then north-east across the desert to Charjui, on the Amur river, Bukhara, and the Russian fort Kattykurgan, and then to Samarkand, Kokand, and Andijan in Ferghana, 1267 miles from Merv, with a branch to Tashkent (204 miles), and another to New Marghilan and Kuva (about 50 miles). This great railway, 2319 miles long with the above-mentioned branches, was partly built by the military railway battalions, and has already become an important line of traffic for the export of raw cotton from Central Asia to Russia. A line of steamers runs from Uzunada in regular communication with the Caucasus at Baku. The Central Asian line is going to be connected now by another line of great importance, from Tashkent down the Syr-Daria to Kazalinsk, and thence to Orenburg.

A third line of great importance that has lately been completed is the junction line between the Transcaucasian railway—which runs from Batum and Poti to Baku, *viâ* Tiflis, with a branch line to Kars—and the railway system of Russia proper. This junction has been effected not across the main Caucasus Range, but at its eastern extremity, that is, *viâ* the Caspian ports of Baku and Petrovsk, which are connected with Vladikavkaz (Beslan junction). The Black Sea port of Novorossiysk, in Western Caucasia, having been connected with the Rostoff–Vladikavkaz line, has consequently also been brought into touch with the Russian railways. A number of important railways have also been built in Russia proper, especially on the western frontier. The Volga is now reached from Central Russia by seven lines of railways, including one to Kazañ, and three main lines radiate from the Volga eastwards (one to Siberia and two to the Ural river), while the upper Volga (Yaroslavl) is connected with Arkhangelsk by a line 523 miles long. A zone tariff was introduced on the Russian railways in 1894, and the cost of long journeys was considerably reduced; a journey of 1000 versts (623 miles) can be made third class at a cost of only about 17 shillings, while for less than twice as much 1990 miles can be covered. Since that time the passenger traffic has much increased and attained 91,537,000 in 1900. The rolling-stock on the Russian railways (9964 locomotives in 1899) still remains insufficient. It is estimated, however, that about 400 engines and 15,000 carriages can be built every year within Russia itself. The State railways in Finland represent a network comprising 1585 miles of line, and advance as far north as Uleåborg (continued to Torneå), Kuopio, and Ioensun.

Posts and Telegraphs.—The number of letters, books, periodicals, and parcels carried by the Russian post office internally has rapidly increased, from 344,320,000 in 1890 to 668,859,800 in 1899, while in the same time the foreign pieces of mail carried increased from 44,320,000 to 79,700,000. The length of telegraph lines in 1899 in the Russian empire was 98,590 miles (18,719,460 messages, exclusive of railway telegrams), and of telephone lines 45,977 miles.

AUTHORITIES.—The *Russkiy Encyclopedicheskiy Slovar*, edited by BROCKHAUS and EFRON, was begun in 1890, with the idea of giving a Russian version of Brockhaus's *Conversations Lexikon*, but from the very first volumes it became a monumental encyclopædia, to which all the best Russian men of science contributed; it is, indeed, an inexhaustible source of information on everything Russian.—A general popular description of Russia entitled *Rossiya*, containing excellent geographical, geological, and other descriptions of separate regions, and very well chosen illustrations, was begun in 1899 by a number of young Russian geographers and naturalists, under the editorship of V. P. SEMENOFF and the general supervision of P. P. SEMENOFF and V. I. LAMANSKIY. Two volumes of this excellent publication had been issued up to 1901.—Besides the official publications mentioned in the ninth edition and in this article, several volumes of statistics have been published, in English and French, in connexion with the Exhibitions of Chicago and Paris, of which *La Russie à la fin du xixᵉ siècle*, under the editorship of M. W. KOVALEVSKY, is especially worthy of notice. See also NORMAN. *All the Russias.* 1902. (P. A. K.)

RECENT HISTORY.

In the history of Russia the period extending from 1882 to 1902 was much less eventful than the thirty years immediately preceding. The reign of Alexander II. (1855–81) had been a time of important administrative reforms and of great economic, social, and intellectual changes in the life of the nation. Serfage had been abolished, the emancipated peasantry had been made communal proprietors of the soil, a democratic system of rural and municipal self-government for local affairs had been introduced, the tribunals of all degrees had been radically reorganized, means had been taken for developing more energetically the vast natural resources of the country, public instruction had received an unprecedented impetus, a considerable amount of liberty had been accorded to the press, a Liberal spirit had been suddenly evoked and had spread rapidly among all sections of the educated classes, a new imaginative and critical literature dealing largely with economic, philosophical, and social questions had sprung into existence, and for a time the young generation fondly imagined that Russia, awakening from her traditional lethargy, was about to overtake, and soon to surpass, on the path of national progress, the more advanced nations of western Europe. These sanguine expectations were not fully realized. The economic and moral condition of the peasantry was not much improved, and in many districts there were signs of positive impoverishment and demoralization. Local self-government, after a short period of feverish and not always well-directed activity, showed symptoms of organic exhaustion. The reformed tribunals, though incomparably better than their predecessors, did not give universal satisfaction. In the imperial administration the corruption and long-established abuses which had momentarily vanished began to reappear. Industrial enterprises did not always succeed. Education produced many unforeseen and undesirable practical results. The liberty of the press not unfrequently degenerated into licence. The Liberal spirit, which had at first confined itself to demanding feasible reforms, soon soared into the region of Socialistic dreaming and revolutionary projects. In short, it became only too evident that there was no royal road to national prosperity, and that Russia, like other nations, must be content to advance slowly and laboriously along the rough path of painful experience. In these circumstances sanguine enthusiasm naturally gave way to despondency, and the reforming zeal of the Government was replaced by tendencies of a decidedly reactionary kind. Already in the last years of the reign of Alexander II. these tendencies had found expression in ukases and ministerial circulars, and zealous Liberalism was more and more discountenanced in the official world. Partly from a feeling of despondency, and partly from a conviction that the country required rest in order to judge the practical results of the reforms already accomplished, the Tsar refrained from initiating any new legislation of an important kind, and the Government gave it to be understood that the period of radical reforms was closed.

Results of changes during reign of Alexander II.

In the younger ranks of the educated classes this state of things produced much dissatisfaction, which soon found expression in revolutionary agitation. At first the agitation was of an academic character, and was dealt with by the press Censure, but it gradually took the form of secret association, and the police had to interfere. There were no great, well-organized secret societies, but there were

many small groups, composed chiefly of male and female students of the universities and technical schools, which worked independently for a common purpose. That purpose was the overthrow of the existing régime and the reorganization of society on Collectivist principles. Finding that the walls of Autocracy could not be overturned by blasts of revolutionary trumpets, the young enthusiasts determined to seek the support of the masses, or, as they termed it, "to go in among the people" (*idti v narod*). Under the disguise of doctors, midwives, teachers, governesses, factory hands, or common labourers, they sought to make proselytes among the peasantry and the workmen in the industrial centres by revolutionary pamphlets and oral explanations. For a time the propaganda had very little success, because the uneducated peasants and factory workers could not easily understand the phraseology and principles of scientific Socialism; but when the propagandists descended to a lower platform and spread rumours that the Tsar had given all the land to the peasants, and that the proprietors were preventing his benevolent intentions from being carried into effect, there was a serious danger of agrarian disturbances, and energetic measures were adopted by the authorities. Wholesale arrests were made by the police, and many of the accused were imprisoned or exiled to distant provinces, some by the regular judicial procedure, and others by so-called "administrative procedure," without trial. The activity of the police and the sufferings of the victims naturally produced intense excitement and bitterness among those who escaped, and a secret body calling itself the Executive Committee announced in its clandestinely printed organs that those who distinguished themselves by endeavouring to suppress the propaganda would be removed. A number of officials were condemned to death by this secret terrorist tribunal, and in some cases its sentences were carried out. General Mezentsof, the head of the gendarmerie which fulfilled the functions of political police, was assassinated in open daylight in one of the principal streets of St Petersburg, and in the provinces a good many officials of various degrees shared the same fate. As these terrorist measures had quite the opposite of the desired effect, repeated attempts were made on the life of the Emperor. In April 1879 a man called Solovieff fired six shots from a revolver at his Majesty at close quarters. In the following December an attempt was made to blow up the imperial train near Moscow, and in February 1880 a number of conspirators caused an explosion of dynamite under the dining-room of the Winter Palace, by which ten persons were killed and thirty-four wounded, and the imperial family narrowly escaped by not having sat down to dinner punctually. At last, on 13th March 1881, the carefully-laid plans of the conspirators were successful. When driving home from a military parade, near the Winter Palace, Alexander II. was terribly wounded by the explosion of several small bombs, and died shortly afterwards.

Revolutionary movements.

Death of Alexander II.

Finding repressive police measures insufficient to suppress the revolutionary movement, Alexander II. had entertained the idea of giving a certain satisfaction to moderate Liberal opinion without restricting his autocratic power. With this object in view he had appointed General Loris-Melikoff, who was credited with Liberal views, minister of the interior, and on the morning of his death he had signed a ukase creating several commissions, composed of high official personages and eminent private individuals, who should prepare reforms in various branches of the administration. His son and successor Alexander III. (1881–94), who had never shown much sympathy with Liberalism in any form, entered frankly on a reactionary policy, which was pursued consistently during the whole of his reign. He could not, of course, undo the great reforms of his predecessor, but he amended them in such a way as to counteract what he considered the exaggerations of Liberalism. Local self-government in the village communes, the rural districts, and the towns was carefully restricted, and placed to a greater extent under the control of the regular officials. The reformers of the previous reign had endeavoured to make the emancipated peasantry administratively and economically independent of the landed proprietors; the Conservatives of this later era, proceeding on the assumption that the peasants did not know how to make a proper use of the liberty prematurely conferred upon them, endeavoured to re-establish the influence of the landed proprietors by appointing from amongst them "land-chiefs," who were to exercise over the peasants of their district a certain amount of patriarchal jurisdiction. The reformers of the previous reign had sought to make the new local administration (*zemstvo*) a system of genuine rural self-government and a basis for future parliamentary institutions; these later Conservatives transformed it into a mere branch of the ordinary State administration, and took precautions against its ever assuming a political character. Even municipal institutions, which had never shown much vitality, were subjected to similar restrictions. In short, the various forms of local self-government, which were intended to raise the nation gradually to the higher political level of western Europe, were condemned as unsuited to the national character and traditions, and as productive of disorder and demoralization. They were accordingly replaced in great measure by the old autocratic methods of administration, and much of the administrative corruption which had been cured, or at least repressed, by the reform enthusiasm again flourished luxuriantly.

Reaction under Alexander III.

In a small but influential section of the educated classes there was a conviction that the revolutionary tendencies, which culminated in Nihilism and Anarchism, proceeded from the adoption of cosmopolitan rather than national principles in all spheres of educational and administrative activity, and that the best remedy for the evils from which the country was suffering was to be found in a return to the three great principles of Nationality, Orthodoxy, and Autocracy. This doctrine, which had been invented by the Slavophils of a previous generation, was early instilled into the mind of Alexander III. by M. Pobiedonostsef (*q.v.*), who was one of his teachers, and later his most trusted adviser, and its influence can be traced in all the more important acts of the Government during that monarch's reign. His determination to maintain autocracy was officially proclaimed a few days after his accession. Nationality and Eastern Orthodoxy, which are so closely connected as to be almost blended together in the Russian mind, received not less attention. Even in European Russia the regions near the frontier contain a great variety of nationalities, languages, and religions. In Finland the population is composed of Finnish-speaking and Swedish-speaking Protestants; the Baltic provinces are inhabited by German-speaking, Lett-speaking, and Esth-speaking Lutherans; the inhabitants of the south-western provinces are chiefly Polish-speaking Roman Catholics and Yiddish-speaking Jews; in the Crimea and on the Middle Volga there are a considerable number of Tatar-speaking Mahommedans; and in the Caucasus there is a conglomeration of races and languages such as is to be found on no other portion of the earth's surface. Until recent times these various nationalities were allowed to retain unmolested the language, religion,

and peculiar local administration of their ancestors, but when the new nationality doctrine came into fashion attempts were made to spread among them the language, religion, and administrative institutions of the dominant race. In the reigns of Nicholas I. and Alexander II. these attempts were merely occasional and intermittent; under Alexander III. they were made systematically and with very little consideration for the feelings, wishes, and interests of the people concerned. The local institutions were assimilated to those of the purely Russian provinces; the use of the Russian language was made obligatory in the administration, in the tribunals, and to some extent in the schools; the spread of Eastern Orthodoxy was encouraged by the authorities, whilst the other confessions were placed under severe restrictions; foreigners were prohibited from possessing landed property, and in some provinces administrative measures were taken for making the land pass into the hands of Orthodox Russians. In this process some of the local officials displayed probably an amount of zeal beyond the intentions of the Government, but any attempt to oppose the movement was rigorously punished. Of all the various races the Jews were the most severely treated. The great majority of them had long been confined to the western and south-western provinces. In the rest of the country they had not been allowed to reside in the villages, because their habits of keeping vodka-shops and lending money at usurious interest were found to demoralize the peasantry, and even in the towns their number and occupations had been restricted by the authorities. But, partly from the usual laxity of the administration and partly from the readiness of the Jews to conciliate the needy officials, the rules had been by no means strictly applied. As soon as this fact became known to Alexander III. he ordered the rules to be strictly carried out, without considering what an enormous amount of hardship and suffering such an order entailed. He also caused new rules to be enacted by which his Jewish subjects were heavily handicapped in education and professional advancement. In short, complete Russification of all non-Russian populations and institutions was the chief aim of the Government in home affairs.

In the foreign policy of the empire Alexander III. likewise introduced considerable changes. During his father's reign its main objects were: in the West, the maintenance of the alliance with Germany; in South-Eastern Europe, the recovery of what had been lost by the Crimean war, the gradual weakening of the Sultan's authority, and the increase of Russian influence among the minor Slav nationalities; in Asia, the gradual but cautious expansion of Russian domination. In the reign of Alexander III. the first of these objects was abandoned. Already, before his accession, the bonds of friendship which united Russia to Germany had been weakened by the action of Bismarck in giving to the cabinet of St Petersburg at the Berlin Congress less diplomatic support than was expected, and by the Austro-German treaty of alliance (October 1879), concluded avowedly for the purpose of opposing Russian aggression; but the old relations were partly re-established by secret negotiations in 1880, by a meeting of the young Tsar and the old Emperor at Danzig in 1881, and by the meeting of the three Emperors at Skiernevice in 1884, by which the Three Emperors' League was reconstituted for a term of three years (see EUROPE: *Recent History*). Gradually, however, a great change took place in the Tsar's views with regard to the German alliance. He suspected Bismarck of harbouring hostile designs against Russia, and he came to recognize that the permanent weakening of France was not in accordance with Russian political interests. He determined, therefore, to oppose any further disturbance of the balance of power in favour of Germany, and when the treaty of Skiernevice expired in 1887, he declined to renew it. From that time Russia gravitated slowly towards an alliance with France, and sought to create a counterpoise against the Triple Alliance of Germany, Austria, and Italy. The Tsar was reluctant to bind himself by a formal treaty, because the French Government did not offer the requisite guarantees of stability, and because he feared that it might be induced, by the prospect of Russian support, to assume an aggressive attitude towards Germany. He recognized, however, that in the event of a great European war the two nations would in all probability be found fighting on the same side, and that if they made no preparations for concerted military action they would be placed at a grave disadvantage in comparison with their opponents of the Triple Alliance, who were believed to have already worked out an elaborate plan of campaign. In view of this contingency the Russian and French military authorities studied the military questions in common, and the result of their labours was the preparation of a military convention, which was finally ratified in 1894. During this period the relations between the two Governments and the two countries became much more cordial. In the summer of 1891 the visit to Kronstadt of a French squadron under Admiral Gervais was made the occasion for an enthusiastic demonstration in favour of a Franco-Russian alliance; and two years later (October 1893) a still more enthusiastic reception was given to the Russian Admiral Avelan and his officers when they visited Toulon and Paris. But it was not till after the death of Alexander III. that the word "alliance" was used publicly by official personages. In 1895 the term was first publicly employed by M. Ribot, then president of the council, in the Chamber of Deputies, but the expressions he used were so vague that they did not entirely remove the prevailing doubts as to the existence of a formal treaty. Two years later (August 1897), during the official visit of M. Félix Faure to St Petersburg, a little more light was thrown on the subject. In the complimentary speeches delivered by the President of the French Republic and the Tsar, France and Russia were referred to as allies, and the term "nations alliées" was afterwards repeatedly used on occasions of a similar kind.

Foreign policy.

In south-eastern Europe Alexander III. adopted an attitude of reserve and expectancy. He greatly increased and strengthened his Black Sea fleet, so as to be ready for any emergency that might arise, and in June 1886, contrary to the declaration made in the Treaty of Berlin (Art. 59), he ordered Batum to be transformed into a fortified naval port, but in the Balkan Peninsula he persistently refrained, under a good deal of provocation, from any intervention that might lead to a European war. The Bulgarian Government, first under Prince Alexander and afterwards under the direction of M. Stambolof, pursued systematically an anti-Russian policy, but the cabinet of St Petersburg confined itself officially to breaking off diplomatic relations and making diplomatic protests, and unofficially to giving tacit encouragement to revolutionary agitation.

In Asia, during the reign of Alexander III. the expansion of Russian domination made considerable progress. A few weeks after his accession he sanctioned the annexation of the territory of the Tekke Turkomans, which had been conquered by General Skobelef, and in 1884 he formally annexed the Merv oasis without military operations. He then allowed the military authorities to push forward in the direction of Afghanistan, until in March 1885 an engagement took place between Russian

and Afghan forces at Penjdeh. Thereupon the British Government, which had been for some time carrying on negotiations with the cabinet of St Petersburg for a delimitation of the Russo-Afghan frontier, intervened energetically and prepared for war; but a compromise was effected, and after more than two years of negotiation a delimitation convention was signed at St Petersburg on 20th July 1887. The forward movement of Russia was thus stopped in the direction of Herat, but it continued with great activity farther east in the region of the Pamirs, until another Anglo-Russian convention was signed in 1895. During the whole reign of Alexander III. the increase of territory in Central Asia is calculated by Russian authorities at 429,895 square kilometres.

Death of Alexander III.; accession of Nicholas II.

On 1st November 1894 Alexander III. died, and was succeeded by his son, Nicholas II., who, partly from similarity of character and partly from veneration for his father's memory, continued the existing lines of policy in home and foreign affairs. The expectation entertained in many quarters that great legislative changes would at once be made in a Liberal sense was not realized. When an influential deputation from the province of Tver, which had long enjoyed a reputation for Liberalism, ventured to hint in a loyal address that the time had come for changes in the existing autocratic régime, they received a reply which showed that the Emperor had no intention of making any such changes. Private suggestions in the same sense, offered directly and respectfully, were no better received, and no important changes were made in the legislation of the preceding reign. But a great alteration took place noiselessly in the manner of carrying out the laws and ministerial circulars. Though resembling his father in the main points of his character, the young Tsar was of a more humane disposition, and he was much less of a doctrinaire. With his father's aspiration of making Holy Russia a homogeneous empire he thoroughly sympathized in principle, but he disliked the systematic persecution of Jews, heretics, and schismatics to which it gave rise, and he let it be understood, without any formal order or proclamation, that the severe measures hitherto employed would not meet with his approval. The officials were not slow to take the hint, and their undue zeal at once disappeared. Nicholas II. showed, however, that his father's policy of Russification was neither to be reversed nor to be abandoned. When an influential deputation was sent from Finland to St Petersburg to represent to him respectfully that the officials were infringing the local rights and privileges solemnly accorded at the time of the annexation, it was refused an audience, and the leaders of the movement were informed indirectly that local interests must be subordinated to the general welfare of the empire. In accordance with this declaration, the policy of Russification in Finland was steadily maintained, and caused much disappointment, not only to the Finlanders, but also to the other nationalities who desired the preservation of their ancient rights.

In foreign affairs Nicholas II. likewise continued the policy of his predecessor, with certain modifications suggested by the change of circumstances. He strengthened the cordial understanding with France by a formal agreement, the terms of which were not divulged, but he never encouraged the French Government in any aggressive designs, and he maintained friendly relations with Germany. In the Balkan Peninsula a slight change of attitude took place. Alexander III., indignant at what he considered the ingratitude of the Slav nationalities, remained coldly aloof, as far as possible, from all intervention in their affairs. About three months after his death, M. de Giers, who thoroughly approved of this attitude, died (26th January 1895), and his successor, Prince Lobanof, minister of foreign affairs from 19th March 1895 to 30th August 1896, endeavoured to recover what he considered Russia's legitimate influence in the Slav world. For this purpose Russian diplomacy became more active in south-eastern Europe. The result was perceived first in Montenegro and Servia, and then in Bulgaria. Prince Ferdinand of Bulgaria had long been anxious to legalize his position by a reconciliation, and as soon as he got rid of M. Stambolof he made advances to the Russian Government. They were well received, and a reconciliation was effected on certain conditions, the first of which was that Prince Ferdinand's eldest son and heir should become a member of the Eastern Orthodox Church. As another means of opposing Western influence in south-eastern Europe, Prince Lobanof inclined to the policy of protecting rather than weakening the Ottoman empire. When the British Government seemed disposed to use coercive measures for the protection of the Armenians, he gave it clearly to be understood that any such proceeding would be opposed by Russia. After Prince Lobanof's death and the appointment of Count Muravieff as his successor in January 1897, this tendency of Russian policy became less marked. In April 1897, it is true, when the Greeks provoked a war with Turkey, they received no support from St Petersburg, but at the close of the war the Tsar showed himself more friendly to them; and afterwards, when it proved extremely difficult to find a suitable person as governor-general of Crete (see CRETE), he recommended the appointment of his cousin, Prince George of Greece—a selection which was pretty sure to accelerate the union of the island with the Hellenic kingdom. How far the recommendation was due to personal feeling, as opposed to political considerations, it is impossible to say.

In Asia, after the accession of Nicholas II. the expansion of Russia, following the line of least resistance and stimulated by the construction of the Siberian Railway, was effected at the expense of China. That she had already in 1895 marked out Manchuria as within her sphere of influence was proved by the fact that, at the close of the Chino-Japanese war of that year, she objected to all annexations by Japan in that quarter, and insisted on having the treaty of Shimonoseki modified accordingly. Subsequently, by means of railway construction, annexation of Port Arthur and the Liaotung peninsula, financial operations, and various conventions with the Chinese Government, she greatly tightened her hold on that portion of the Chinese empire (see CHINA and SIBERIA).

As a necessary basis for a strong foreign policy the army was systematically strengthened (see ARMIES: *Russia*). At one moment the schemes for military reorganization involved such an enormous expenditure that the Tsar conceived the idea of an agreement among the Great Powers to arrest the increase of national armaments. The idea was communicated to the Powers somewhat abruptly by Count Muravieff, Prince Lobanof's successor in the direction of foreign affairs, and an international conference was held at The Hague to discuss the subject; but it had very little practical result, and certainly did not attain the primary object in view (see PEACE CONFERENCE).

A sketch of the recent history of Russia, however brief, would be incomplete without some mention of the remarkable industrial progress made during the period under consideration. Protected by high tariffs and fostered by the introduction of foreign capital, Russian manufacturing

industry made enormous strides. By way of illustration a few figures may be cited. In the space of ten years (1887–97) the number of workers employed in the various branches of industrial enterprise rose from 1,318,048 to 2,098,262 (see under INDUSTRY). The consumption of cotton for spinning purposes, which was only 117 million kilograms in 1886, was 257 millions in 1898, and the number of spindles, according to the weekly journal *Russia* of 2nd August 1902, was estimated at that date at 6,970,000. Thanks chiefly to this growth of the cotton industry, the town of Łódz, which was little more than a big village in 1875, has now a population of over 300,000. The iron, steel, and petroleum industries have likewise made enormous progress. Between 1892 and 1900 the estimated value of metallic articles manufactured in the country rose from 142 millions to 276 millions of roubles. As is generally the case in such circumstances, protection led to temporary over-production, which brought about a financial and economic crisis; but if we may accept certain figures given by Mr Henry Norman in his *All the Russias* (London, 1902), the crisis could not have been very severe, for he states that "no fewer than 580 companies declared a dividend during the first nine months of 1901, their total nominal capital being £105,000,000, and the average dividend no less than 10·1 per cent." Much of this progress is due to the intelligence and energy of M. Witte, minister of finance. (D. M. W.)

Industrial progress.

RECENT LITERATURE.

The death of Nekrasoff in 1877 deprived Russia of her most eminent poet since the days of Pushkin and Lermontoff. During the last generation of the 19th century the Titans of her literature departed, and cannot be said to have left successors of equal merit. Dostoievski, Pisemsky, Tourguenieff, Goncharoff, Ostrovski, and Saltikoff followed each other to the grave in rapid succession. In 1895 Apukhtin, author of many graceful lyrics, died; in 1897 Apollon Maikoff, also a lyric poet of considerable power; and soon afterwards Polonski. These men were well known throughout Russia. A new school of poets has sprung up, consisting for the most part of the so-called decadents and symbolists. Among them may be mentioned A. Korinfski; Ivan Bunin, who shows much feeling for nature, and has published an excellent translation of Longfellow's *Hiawatha;* and Constantine Balmont. The last of these has given to the public several volumes of lyrics, many of which exhibit a graceful imagination and a capacity for skilfully reproducing various poetic moods. His command of all rhythms is astonishing, and owing to this gift, he has been a successful translator. Thus we may point to his excellent version of Shelley, besides translations from Edgar Allen Poe, Ibsen, and Calderon. We must also find room for the names of V. Briusoff and K. Sluchevski. Two female poets may be mentioned here, Mme Gippius-Merszhkovskaya and Mme Lokhvitskaya. It will be seen that the modern tendency in Russia is wholly to lyric poetry. These productions are often pervaded by an air of melancholy and *Weltschmerz.* The drama is not in a flourishing condition. Very little of merit has been produced since the great trilogy of Alexis Tolstoy dealing with the reign of Ivan the Terrible—full of picturesque horrors for the dramatist—and the *bourgeois* comedies of Ostrovski.

If we turn to history, in which the Russians have always shown considerable talent, we can cite some really good work. Of course we cannot here find room to discuss the publications of the various historical societies in the country, nor the valuable memoirs and other documents which are constantly appearing in the *Russian Antiquary* (*Russkaya Starina*); the *Historical Messenger* (*Istoricheski Viestnik*), and other journals, the name of which is legion. In 1897 Professor Bestuzheff-Riumin, of the University of St Petersburg, died. He had held his chair of history since 1865. His valuable *History of Russia* must now remain a torso only, the first volume and the first half of the second having alone appeared. Solovieff and Kostomaroff are dead. The famous school of Russian historians is thus almost extinct. But some excellent writers in this department have come to the front. Professor Miliukoff has published the first volume of his *Sketches of the History of Russian Culture* (*Ocherki po istorii russkoi kulturi*), which has been much read. Professor Bilbasoff is continuing his *History of Catherine II.* Some parts of this work appear to have been extensively mutilated by the censor. D. Evarnitski has added a third volume to his interesting work on the Zaporozhian Cossacks. The Russians have always enjoyed a considerable reputation as memoir-writers, and the *Recollections of Mme Smirnoff,* which first appeared in the *Northern Messenger* (*Sievernii Viestnik*) proved very interesting owing to her familiarity with court life and her intimacy with the leading men of the time who frequented her *salon.* Pushkin appears before us in the most minute details of his everyday life. The centenary of his birth (1899) was signalized by the publication of many interesting monographs on his strange career. The details furnished by his nephew, L. Pavlistcheff, were especially noteworthy. The second volume appeared of the classical *History of the Russian Church,* by E. Golubinski. A valuable contribution to early Russian history was furnished by the *Legal Antiquities* (*Youridicheskia Drevrosti*) of V. Serguievich, by which quite a new light has been thrown upon the Russian *sobor.* The well-known savant, Maxime Kovalevski, published the second volume of his *Economic Development of Europe to the Rise of Capitalism.* N. Rozhkoff wrote an important work entitled *Village Economy in Muscovy in the Sixteenth Century.* This book analyses the conditions under which economic production was developed in Old Russia. S. Platonoff published a *History of the Insurrections in Russia in the Sixteenth and Seventeenth Centuries.* He holds entirely new views on the *oprichina,* the famous bodyguard of Ivan the Terrible. Professor B. Kliuchevski, of the University of Moscow, published in 1883 a valuable book on the Russian Duma, as the Privy Council of the emperors was called, and in 1899 he issued his *Aids to Lectures on Russian History.* The study of the early institutions of their own country has always been actively pursued by Russian writers. They have less often devoted themselves to the political and social conditions of other countries, but an exception must be made in the case of the book by Professor Vinogradoff of Moscow, entitled *Investigations into the Social History of England in the Middle Ages* (1887). The learned author also prepared an edition of this work for the English public.

As yet no worthy successors have appeared of the great Russian novelists, Gogol, Tourguenieff, Dostoievski, and Tolstoy. We can hardly hope for such a constellation to appear again. Tolstoy, however, although advanced in years, and having almost deserted artistic production, shows no falling off in his latest work, *Resurrection,* a monument of his vigorous and deeply pathetic realism. In the region of fiction A. Chekhov of the younger school is especially remarkable. He is still in the prime of life, and has already shown great power in his short stories. Some of the tales of Gorki, Ertel, and Yasinski are also of great merit. The brilliant Garshin died insane in 1888.

(W. R. M.)

Rustchuk, or Rouchchouk, capital of a department in the principality of Bulgaria. It is situated on the south bank of the Danube, opposite the Rumanian town of Giurgevo, 139 miles north-west of Varna, on the railway line to Varna, and at the terminus of a line joining the central Sofia–Varna Railway near Tirnovo. Though no longer of strategic value, the town has acquired new importance owing to a great revival of commercial prosperity. The principal buildings are the custom-house, the municipal buildings, the theatre, the arsenal, and the barracks. The town possesses tobacco and cigarette factories, soap works, breweries, aerated water factories, dye-works, tanneries, saw-mills, brick and tile works, and a celebrated pottery. In 1897 the exports amounted to 20,225 tons, valued at £110,968, and in 1900 to 18,827 tons, valued at £110,470—the imports in the same years being 44,223 tons, valued at £616,573, and 20,285 tons, valued at only £240,844. Population (1900), 32,661.

Rustenburg. See Transvaal.

Rutherglen, a royal and parliamentary burgh (Kilmarnock group) of Lanarkshire, Scotland, on the Clyde, 2 miles south-east of Glasgow by rail. Dye-works, chemical works, cotton-weaving factories, chair, tube, and rope and twine works are among the industrial features. Population of royal burgh (1891), 13,361; (1901), 18,280.

Ruthin, a municipal borough and market-town, Denbighshire, North Wales, 21 miles west by south of Chester by rail, on the river Clwyd. It belongs to the Denbigh district of boroughs, which returns one member to Parliament. It is governed by a mayor, 4 aldermen, and 12 councillors. The grammar school has produced many distinguished men, and new buildings, in grounds 8 acres in extent, were opened in 1893, near the town. Scholarships connecting it to the universities have been established. Population of the municipal borough (1891), 2760; (1901), 2641.

Rutland, a north midland county of England, bounded on the N. by Leicester and Lincoln, on the S.E. by Northampton, and on the W. by Leicester.

Area and Population.—In 1891 the area of the ancient (geographical) county, with which that of the administrative county coincides, was 97,273 acres, and the population 20,659, of whom 10,323 were males and 10,336 females; and in 1901, 19,708. Thus there was a decrease of 951 between 1891 and 1901, or at the rate of 4·6 per cent., as compared with a decrease of 3·6 per cent. between 1881 and 1891, and of 2·9 per cent. between 1871 and 1881. In 1901 there were 0·20 persons to an acre, and 4·94 acres to a person. In the same year the area of the registration county was 108,700 acres, and the population 20,742.

The subjoined table gives particulars of the birth-rate, death-rate, and illegitimacy-rate, and the number of persons married per thousand inhabitants:—

	1871–80.	1881–90.	1889–98.	1899.
Birth-rate	30·7	27·6	24·0	22·9
Death-rate	18·5	16·3	14·9	14·2
Illegitimate-rate	53	52	49	49
Marriage-rate	12·9	11·2	13·3	12·3

In 1891 the county contained 113 persons of Scottish birth, 71 of Irish birth, and 71 foreigners. At the same date there were 22 blind persons, 6 deaf and dumb, and 21 insane.

Administration, &c.—The ancient county returns one member to the House of Commons, and contains neither municipal borough nor petty sessional division, but has one court of quarter sessions. The administrative county contains 58 entire civil parishes. The ancient county contains 41 entire ecclesiastical parishes and districts, and part of one other. It is entirely included within the diocese of Peterborough.

Education.—The number of elementary schools in the county on 31st August 1900 was 38, namely, 2 board schools and 36 voluntary schools, the latter including 35 National Church of England schools and 1 Roman Catholic school. The average attendance during the year amounted to 2803 out of 3349 on the register.

Agriculture.—Since 1885 there has been a decrease in the areas of the corn crops, and in fallow land, and an increase in the permanent pasture and meadow land. In 1900 a total of 78,188 acres were farmed by tenants and 8263 acres by the owners; the corresponding figures in 1889 were 74,811 and 12,113 acres, and in 1895, 74,159 and 13,165 acres respectively.

The following table shows the areas under the different kinds of crops at the periods named:—

Year.	Area in Cultivation.	Area under Corn Crops.	Area under Green Crops.	Area of Bare Fallow.	Area under Permanent Grass.
1885	86,477	22,820	7,520	1,768	47,816
1890	86,966	21,945	7,107	1,815	49,438
1895	87,324	20,541	7,612	1,422	51,850
1900	86,451	20,672	7,403	1,132	50,946

The next table shows the numbers of the live stock at the same periods:—

Year.	Cows and Heifers.	Other Cattle.	Total Cattle.	Horses.	Sheep.	Pigs.
1885	4,251	15,559	19,810	3,062	81,328	3,054
1890	4,026	15,815	19,841	3,097	86,382	2,989
1895	3,420	14,092	17,512	3,151	82,809	3,234
1900	3,455	15,663	19,118	3,232	84,794	2,277

Rutland produces a little limestone and sandstone (8030 tons in all in 1900).

See C. Wordsworth. *Rutland Words* (English Dialect Society). London, 1891.

Rutland, a city of Vermont, U.S.A., the capital of Rutland county. It is situated in 43° 37′ N., 72° 57′ W., in the valley of Otter Creek, and on the Bennington and Rutland, the Delaware and Hudson, and the Rutland railways, south-west of the centre of the state, at an altitude of 562 feet. It is divided into eleven wards, and has an excellent water-supply from East Creek by gravity. Rutland is best known for the quarries of fine marble in its vicinity. It contains large and varied manufactures, producing, among other things, machinery of various sorts and lumber products. Population (1890), 11,760; (1900), 11,499; showing a slight diminution in the preceding ten years. Of the population in 1900, 1533 were foreign-born.

Rutland, John James Robert Manners, 7th Duke of (1818–——), English statesman, was born at Belvoir Castle on 13th December 1818, being the younger son of the 5th duke of Rutland by Lady Elizabeth Howard, daughter of Byron's guardian, the 5th earl of Carlisle. Lord John Manners, as he then was, was educated at Eton and Trinity College, Cambridge. In 1841 he was returned for Newark in the Tory interest, along with W. E. Gladstone, and sat for that borough until 1847. Subsequently he sat for Colchester, 1850–57; for North Leicestershire, 1857–85; and for East Leicestershire from 1885 until in 1888 he took his seat in the House of Lords upon succeeding to the dukedom. Melbourne's Whig Government had been doomed for some time before it went out in June 1841. The Tories came in with a large majority under Peel, and among Manners's friends who were successful in the constituencies, besides Gladstone, were Smythe (afterwards 7th Viscount Strangford) at Canterbury, Baillie-Cochrane (afterwards 1st Lord Lamington) at Bridport, and Disraeli at Shrewsbury. Cherishing many of the ideas of the Cavaliers of the 17th century, and full of political and literary ardour, he was soon prominent in the social group which revolved round Lady Blessington. He seems to have inherited the poetical ambition of his maternal grandfather, and in 1841 he committed some of his Loyalist and other fancies to a volume called *England's Trust, and other Poems*, which he dedicated to his friend Smythe, in which occurred the familiar line about "laws and learning" and "our old nobility." Before the end of

this year Manners had definitely associated himself with the "Young England" party, under the leadership of Disraeli. The Young England party sought to extinguish the predominance of the middle-class bourgeoisie, and to recreate the political prestige of the aristocracy by resolutely proving its capacity to ameliorate the social, intellectual, and material condition of the peasantry and the labouring classes. At the same time they looked for a regeneration of the Church, and the rescue of both the Church and Ireland from the trammels inherited from the Whig predominance during the 18th century. Outside as well as inside Parliament Manners strenuously advocated these principles. He made an extensive tour of inspection in the industrial parts of northern England, in the course of which he and his friend Smythe expounded their views with a brilliancy which frequently extorted compliments from the leaders of the Manchester school. In 1843 he supported Lord Grey's motion for an inquiry into the condition of England, the serious disaffection of the working classes of the north being a subject to which he was constantly drawing the attention of Parliament. Among other measures that he urged were the disestablishment of the Irish Church, the modification of the Mortmain Acts, and the resumption of regular diplomatic relations with the Vatican. In the same year he issued in pamphlet form a strong *Plea for National Holydays*. In 1844 he vigorously supported the Ten-hours Bill, which, though strongly opposed by Bright, Cobden, and other members of the Manchester school, was ultimately passed in May 1847. In October during this year he took part in and spoke at the brilliant *soirée* held at the Manchester Athenæum under the presidency of Disraeli. A few days later he and his friends attended a festival at Bingley, in Yorkshire, to celebrate the allotment of land for gardens to working men, a step which, through the agency of his father, he had done a great deal to further. About the same time Smythe dedicated to him his *Historic Fancies* as to "the Sir Philip Sidney of our generation." Manners figured as Lord Henry Sydney in Disraeli's *Coningsby*, and not a few of his ideas are represented as those of Egremont in *Sybil* and Waldershare in *Endymion*. But the disruption of the Young England party was already impending. Lord John's support of Peel's decision to increase the Maynooth grant in 1845 led to a difference with Disraeli. Divergences of opinion with regard to Newman's secession from the English Church produced further defections in the ranks, and the rupture was completed by Smythe acquiescing in Peel's conversion to Free Trade. Lord John produced another volume of verse, known as *English Ballads*, chiefly patriotic and historical, in 1850. In the same year, as the fruit of a cruise in Scottish waters, he wrote the letterpress for a sumptuous atlas of coloured views by J. C. Schetky; and he published several pamphlets, one on the *Church of England in the Colonies* in 1851. During the three short administrations of Lord Derby (1851, 1858, and 1866) he sat in the cabinet as first commissioner of the Office of Works. On the return of the Conservatives to power in 1874 he became postmaster-general in Disraeli's administration, and was made G.C.B. on his retirement in 1880. He was again postmaster-general, in Lord Salisbury's administration 1885–86, and was head of the department when sixpenny telegrams were introduced. Finally, in the Conservative Government of 1886–92 he was chancellor of the duchy of Lancaster. He succeeded to the dukedom in March 1888, upon the death of his elder brother, Charles Cecil John Manners (the Marquis of Beaumanoir of *Coningsby*), 6th duke of Rutland, an unflinching Protectionist and supporter of Lord George Bentinck. He was made K.G. in 1891.

Ruvo, a town and episcopal see of Italy, Apulia, province of Bari, 21 miles west of Bari, with a cathedral, technical school, and a collection of antique vases (others at Naples) found in the place. It has olive-oil presses. Population (1900), about 17,000.

Ruwenzori, or Runsoro, a great mountain range in Central Africa, lying between the equator and 1° N., and intersected at about its centre by 30° E. It possesses probably the most extensive snow-fields which exist in the whole of Africa, but being still imperfectly known, its greatest height cannot be estimated with any accuracy. The range forms a great volcanic mass, of which the core seems to be composed of coarse-grained granite rocks, flanked by schists, &c., tilted at a high angle. Its formation was evidently connected with that of the great central rift valley, towards which it falls steeply on the west, while at its southern end it is abruptly terminated by the widening of the valley where occupied by the Albert Edward Lake. Eastward it falls somewhat less steeply to the high plateau of western Uganda, while to the north it appears to sink gradually to the plateau forming the eastern wall of the Albert Nyanza. The general axis runs from south-south-west to north-north-east, the highest summits lying near the western edge, while the eastern half seems to consist of parallel ridges of less elevation, giving a breadth to the range where widest of some 22 miles. The sides of the range are deeply furrowed by the valleys of streams, some of which descend from the glaciers of the upper region. The highest peaks, many of which rise above the line of perpetual snow, occur between 0° 25′ N. and 0° 35′, mostly near the meridian of 30° E. They seem to form three or more groups, separated by deep clefts which admit of a passage across the range at an altitude of some 12,000 feet. Of the central group, the principal peak appears to be that known as Ngomwimbi (0° 21′ N.), from the neighbourhood of which several large glaciers descend to the east. A little to the north is the peak of Kanyangugwe, while other snow peaks extend as far north as 0° 32′ N., where is the lofty Saddle Mountain. The altitude assigned to these peaks varies between 16,000 and 20,000 feet. The lower estimates have generally been made by travellers in the immediate neighbourhood of the peaks, where the highest summits may have been hidden from view, while the higher figures have been deduced from a general view at a distance, which shows the great extent of the snow-fields.

The upper parts of the range are almost constantly veiled in cloud, which, however, gradually rises during the day, sometimes leaving the summits clear at about 5.30 P.M. As a result, perpetual moisture prevails above 7000 feet, and there is a very heavy rainfall, especially in the districts on the east, a number of rushing streams descending to Lake Ruisamba (an arm of the Albert Edward Lake) on the east and the Semliki valley on the west, thus playing an important part in filling the source-reservoirs of the Nile. As on other high mountains of equatorial Africa, there is a regular succession of zones of vegetation, the belts being defined by Mr Scott-Elliot as follows:—

- 3850–5350 feet: Bananas and tall grasses.
- 6700 feet: limit of settlements, with Colocasia and beans.
- Up to 8530 feet: forests of deciduous trees, with Erica and bamboo.
- Up to 11,800 feet: Erica forests, bogs, and Vaccineum.
- Up to snow-line (about 13,000 feet): bushes, tree ferns, grass, mosses, lichens.

First seen from the Albert Lake by Gessi and Mason,

the true character and extent of the range were first brought to light by Stanley in 1888–89, when Lieutenant Stairs ascended (in 0° 30′ N.) to a height of 10,677 feet. The northern and eastern slopes were first traversed by Lugard in 1891, while ascents to the snows, or near them, were afterwards made by Stuhlmann (1891), Scott-Elliot (1894; 12,640 feet), Moore (1900), Johnston (1900), and Wylde (1901), the last-named having possibly reached a higher point (15,000 feet by aneroid) than had been before attained.

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Ryazan, a government of Middle Russia, lying to the south-east of the government of Moscow, with an area of 16,255 square miles. Its geology has now been carefully explored, and the physical description given in the ninth edition may now be supplemented by the statement that the province is widely covered with the so-called Volga deposits, intermediate between Jurassic and Chalk, and by Chalk in the north-east. Quaternary deposits, represented by the Glacial boulder clay, also cover extensive areas. The domiciled population numbered 1,713,581 in 1882 and 1,827,539 in 1897, when there were 962,085 women in the province and the total urban population was only 166,122. More than half of the land (52 per cent.) is owned by the village communities, 40 per cent. by private owners, 5 per cent. by the Crown, and 2 per cent. by various institutions. During the last thirty years of the 19th century the nobles sold 36 per cent. (1,261,000 acres) of their lands, mainly to merchants and peasants; the latter cultivate two-thirds of the total cultivated area. In 1900 there were 3,045,300 acres under cereal crops, and the average yield per annum in 1895–99 was: wheat 77,000 cwt., rye 10,044,000, oats 4,971,000—all cereal crops 17,037,000 cwt.; potatoes also yielded 11,484,000 cwt. But the crops are still insufficient for the needs of the inhabitants. Tobacco, hops, vegetables and fruit, however, are grown for export. The live stock included in 1896, 303,583 horses, 323,600 horned cattle, and 806,800 sheep, thus showing a considerable increase on the number of head in the province in 1882. Bee-keeping is also developing and manufactures increasing, there being in 1897, 4008 factories, which gave occupation to nearly 25,000 workers and showed a yearly output of £2,212,000. These factories are chiefly cotton mills, flour mills, machine works, tanneries, soap works, boot factories, match factories, and chemical works. Coal is extracted to the amount of about 77,000 tons per annum. The province is divided into twelve districts, the chief towns of which are Ryazan (see below), Dankov (9097), Egorievsk (19,241), Kasimoff (13,545), Mikhailoff (9149), Pronsk (7827), Ranenburg (15,347), Ryazhsk (12,993), Sapozhok (8544), Skopin (14,737), Spassk (4760), and Zaraisk (8078). Small industries are carried on in the villages, especially in the northern part of the government, which belongs, properly speaking, to the Vladimir industrial region. Domestic trades, such as lace-making (supported by two schools) and embroidering on leather, give occupation to 40,000 women. Trade, especially in corn and manufactured goods, is brisk, and has been stimulated by the opening of coal mines, of which the Chulkovo mine, in the district of Skopin, is one of the largest. A number of secondary railways have been built in the government, and steamers now ply on the Oka river from Nijni-Novgorod to Ryazan. Considerable efforts have been made by the local governing bodies to increase the number of schools, of which there were 964 in 1897. Most interesting archæological finds have been made in the government, which have been placed in the new museum at Ryazan.

Ryazan, the capital of the above government, 119 miles by rail south-east of Moscow, 1 mile above the junction of the Trubezh with the Oka. Owing to its situation on the great railway connecting Moscow with South-East Russia, and on a navigable river, Ryazan occupies a very advantageous position both as a centre of trade and of railway traffic. Its twenty factories (works for the manufacture of machinery and wax candles, and distilleries) give occupation to only a few hundred workers; but its trade in grain and live stock is growing, as also is its population, which was 30,325 in 1883 and 44,552 in 1897. In 1896 there were 31 schools, with 3860 pupils; and there is a good historical museum and library, with an archæological section, and various philanthropic institutions.

Ryazhsk, a district town of Russia, in the government and 70 miles south of the town of Ryazan. It is one of the chief railway junctions of Russia, where meet the lines from Moscow to South Russia and the Caucasus, and the railway from Poland to Samara and Siberia. Consequently it has become a very important centre of trade for all the grain-growing regions of Russia, and is a wealthy place. Its population in 1897 was 12,993.

Rybinsk, a district town of Russia, in the government of Yaroslavl. It stands on the Volga, 186 miles by rail east of Bologoye, a junction on the St Petersburg–Moscow Railway. It is one of the most important towns of Central Russia, and has an exchange, a theatre, gymnasia for boys and girls, technical and navigation schools, and a great number of primary schools; also numerous flour-mills and breweries. It derives its importance mainly from being a centre for navigation on the upper Volga, and for trade in corn. Every year from 3800 to 4500 vessels enter (of which 1823 were steamers in 1898), while as many as 6300 clear. The aggregate tonnage of goods passing through the port annually is 1,327,310 entered and 1,124,200 cleared—one-third by rail and two-thirds by the way of the canals connecting the Volga with St Petersburg. From 300,000 to 400,000 tons of wheat and rye and from 290,000 to 340,000 tons of oats pass through the port every year. The permanent population, which was 18,900 in 1883 and 25,223 in 1897, is increased in the summer by nearly 100,000 workers from different parts of Russia. Throughout the summer, indeed, Rybinsk might almost be said to be one huge fair for trade in agricultural produce.

Rydberg, Abraham Viktor (1828–1895), Swedish author and publicist, was born in Jönköping on 18th December 1828. He showed an inclination to literature from his early boyhood. He was educated at the high school of Växiö, and passed on to the University of Lund in 1851. While at school he was publishing verse and prose in the periodicals; some of these early miscellanies he collected in 1894, in the volumes called *Varia.* As a student he turned to more precise labours, and devoted himself to science. He had almost determined to adopt the profession of an engineer, when he was offered in 1855 a post on the staff of one of the largest Swedish newspapers. This caused his thoughts to return to imaginative literature, and it was in

the feuilleton of this journal (the *Göteborgs Handels-och sjöfartstidning*) that Viktor Rydberg's romances successively appeared; he was editorially connected with it until 1876. *The Freebooter on the Baltic* (1857) and *The Last of the Athenians* (1859) gave Rydberg a place in the front rank of contemporary novelists. It was a surprise to his admirers to see him presently turn to theology, but with *The Bible's Teaching about Christ* (1862), in which the aspects of modern Biblical criticism were first placed before Swedish readers, he enjoyed a vast success. He followed this up by a number of contributions to the popular philosophy of religion, all inspired by the same reverent and yet searching spirit of inquiry. The modernity of his views led to his being opposed by the orthodox clergy, but by the wider public he was greatly esteemed. Nevertheless, it is said that it was his religious criticism which so long excluded him from the Swedish Academy, since he was not elected until 1877, when he had long been the first living author of Sweden. A very engaging work of Rydberg's is his *Roman Days*, a series of archæological essays on Italy (1876). He collected his carefully polished poems in 1882; his admirable version of *Faust* dates from 1876. In 1884 he was appointed professor of ecclesiastical history at Stockholm. He died, after a short illness, on 1st September 1895. In Viktor Rydberg Sweden possessed a writer of the first order, who carried on the tradition of Boström and Geijer in philosophy and history, and possessed in addition a glow of imagination and a marvellous charm of style. He was an idealist of the old romantic type which Sweden had known for three-quarters of a century; he was the last of that race, and perhaps, as a mere writer, the greatest. In personal character Rydberg was extremely like his writings—stately, ardent, and ceremonious, with a fund of amiability which made him universally beloved. It may make him more intelligible to the English reader to say that both in temperament and in the character of his writings Rydberg possessed a curious similarity to Charles Kingsley. His premature death was the subject of national mourning, and had even a historical significance, for with him the old romantic influence in Swedish literature ceased to be paramount. (E. G.)

Ryde, a municipal borough and watering-place, Hampshire, England, in the Isle of Wight, 5 miles south by west of Portsmouth and 12 miles by rail from Cowes. The pier has been entirely reconstructed by a combination of railway companies, so that passengers may step direct from train to boat. This involved a pier half a mile long by the side of the original pier, and also a tunnel under part of the town. Population of municipal borough (1891), 10,952; (1901), 11,042.

Rye, a municipal borough, cinque port, and market town, Sussex, England, in the Rye parliamentary division of the county, on the river Rother, 63 miles south-south-east of London by rail. A steam tram-line from Rye to Camber, which has golf-links, was opened in 1895. Almshouses in honour of Queen Victoria's Diamond Jubilee were erected on the green by public subscription in 1897. Population of municipal borough (1891), 3871; (1901), 3900.

Ryezhitsa, a district town of Russia, in the government and 199 miles by rail north-west of the town of Vitebsk, on the railway from St Petersburg to Warsaw. It is an old town, founded in 1285, and temporarily annexed to Poland in 1561, but retaken by the Russians in 1577, and finally annexed to Russia in 1773. It has a very picturesque old castle. In 1897 its population was 10,681.

Rylsk, a district town of Russia, in the government and 83 miles west-south-west of the town of Kursk. It is connected by a branch line with the Kursk-to-Kiev Railway. In the way of industrial establishments it has only oil works, but its merchants carry on an active trade in corn, hemp, and scythes imported from Austria. It has gymnasia for both boys and girls. In 1897 its population was 11,415. It is a very ancient town, founded in the 9th century, and is frequently mentioned in the annals from 1152 onwards. It derived importance from being an important post on the Russian frontier down to the 18th century; its cathedral was built in the 15th century.

Rzeszów, the chief town of a government district of the same name in Galicia, Austria. It is situated on the Wislok, a tributary of the San, and is a station on the Cracow–Lemberg Railway. It is the headquarters of an infantry and a cavalry brigade, has the most important horse fairs of Galicia, and manufactures cloth and linen goods, goldsmiths' work, and tobacco pipes. It contains an old château of the princely family of Lubomirski, a Polish gymnasium, and a training college. Population (1890), 11,953; (1900), 14,714 (including garrison of 2296 men), almost exclusively Polish-speaking.

Saale, a river of Germany, originating between Bayreuth and Hof in the north-east of Bavaria, springing out of the Fichtelgebirge at an altitude of 2390 feet. It pursues a winding course in a northerly direction, flowing past Hof, Saalfeld, Rudolstadt, Jena, Naumburg, Weissenfels, Merseburg, Halle, Bernburg, and Kalbe, and joins the Elbe (from the left) just above Barby, after traversing a distance of 226 miles. It is navigable from Naumburg, 100 miles, with the help of sluices, and is connected with the Elster near Leipzig by canal. The soil of the lower part of its valley is of exceptional fertility, and produces, amongst other crops, large supplies of sugar beetroot. Among its affluents are the Elster, Regnitz, and Orla (right bank), and the Ilm, Unstrut, Salza, Wipper, and Bode (left). Its upper course is rapid. Its valley (down to Merseburg) is picturesque, and even romantic, because of the many castles which crown the enclosing heights. It is sometimes called the Thuringian or Saxon Saale, to distinguish it from another Saale (70 miles), a right-hand tributary of the Main, in the Bavarian district of Lower Franconia.

Saar, a river of Alsace-Lorraine and Rhenish Prussia, rising on the north-east shoulder of the Vosges Mountains, under the foot of Mount Donon. It flows northwards past Saarburg, Saar Union, Saargemünd, Saarbrücken, then north-north-westwards past Saarlouis, and joins the Mosel (Moselle) from the right a few miles above Treves. Its total length is 153 miles, of which 75 (namely, from Saargemünd) are navigable. Its valley is broad and shallow. By means of the Saar canal (40 miles long), made by the French Government in 1862, it is connected with the Rhine–Marne canal.

Saarbrücken, or SANKT JOHANN-SAARBRÜCKEN, a town of Prussia, in the Rhine province, 49 miles by rail east-north-east of Metz, on the left bank of the Saar, the

sister town of Sankt Johann being immediately opposite. The Saar coal-fields are estimated to yield 9 to 10 million tons annually, and give employment to nearly 42,000 men. The two towns together possess important iron and glass works, and manufactures of machinery, chemicals, tobacco, &c., and a large trade in coal. In Saarbrucken there are a mining academy and a monument to Bismarck (1899). The town-hall has been adorned with paintings by Anton von Werner, illustrating the battles of the neighbouring Spicheren Heights in 1870. Population of Saarbrucken (1885), 10,453; (1900), 23,242; of Sankt Johann (1885), 13,598; (1900), 21,257.

Saarburg, a town of Germany, Alsace-Lorraine, district Lorraine, on the Saar, 44 miles west-north-west of Strasburg. It is still surrounded with walls. Its manufactures include watch-springs, gloves, lace, and beer. It is identified with the *Pons Saravi* of the Romans. Population (1900), 9178.

Saarlouis, a fortified town of Prussia, in Rhine province, 40 miles by rail south of Treves, on the left bank of the Saar. Its fortifications were laid out by Vauban in 1680–85. There are coal-mines, and considerable manufacture of porcelain, glass, and leather. It was the birthplace of Marshal Ney (1769–1815). Population (1900), 7864.

Saaz (Czech, *Žatec*), a manufacturing and commercial town in the north of Bohemia, on the river Eger, 30 miles east by north of Carlsbad. Population (1890), 13,234; (1900), 16,168, mainly German and Catholic. Together with the important export of hops—of which business it is the chief centre—there is a trade in vegetables, machinery, brewing and corn-milling, &c. The town was provided with a new water-supply in 1894. It has latterly become prominent for its strong German-Nationalist sentiment and its efforts to exclude the Czech element, which forms, however, only about 5 per cent. of the population.

Sabadell, a town of Spain, province of Barcelona, on the river Ripoll, with a station on the Barcelona–Saragossa Railway. Population (1887), 19,645; (1897), 23,044. The industries comprise cloths and linen, which give employment to 11,000 workmen in a hundred factories, producing goods valued at half a million sterling annually. There are also manufactures of alcohol, paper, and flour, besides foundries and saw-mills. The town has handsome modern public buildings, including the town-hall, schools for primary and higher education, hospitals, and casinos. The churches are not interesting. Sabadell is said to be the Roman *Sebendunum*, but in Spanish annals it is not noticed until the 13th century.

Sables d'Olonne, Les, chief town of arrondissement, department of Vendée, France, 21 miles west-south-west of Roche-sur-Yon by rail. There are a municipal school of maritime fisheries and a maritime laboratory. In 1900, 372 boats manned by 1788 men were engaged in the fisheries, the total annual value of which is estimated at about £95,000, the average annual product of the sardine fishery alone amounting to over 160,000 cwts., while the tunny fishery is also important. More than 7 million oysters are annually exported. The port is now accessible for vessels of 800 to 2000 tons. The total movement of shipping, including coasting trade, amounted in 1900 to 164,392 tons. Foreign exports are unimportant; the principal imports are coal, wood, petroleum, and phosphates. Population (1891), 9905; (1901), 11,870.

Sachs, Julius von (1832–1897), German botanist, was born at Breslau on 2nd October 1832. At an early age he showed a taste for natural history, and on leaving school he became, in 1851, private assistant to the physiologist Purkinje at Prague. In 1856 he graduated as doctor of philosophy, and then adopted a botanical career, establishing himself as *privat-docent* for plant physiology in the University of Prague. In 1859 he was appointed physiological assistant to the Agricultural Academy of Tharandt in Saxony; and in 1861 he was called to be director of the Polytechnic at Chemnitz, but was almost immediately transferred to the Agricultural Academy at Poppelsdorf, near Bonn, where he remained until 1867, when he was nominated professor of botany in the University of Freiburg-im-Breisgau. In 1868 he accepted the chair of botany in the University of Würzburg, which he continued to occupy (in spite of calls to all the important German universities) until his death on 29th May 1897.

Sachs achieved distinction as an investigator, a writer, and a teacher; his name will ever be especially associated with the great development of plant physiology which marked the latter half of the 19th century, though there is scarcely a branch of botany to which he has not materially contributed. His earlier papers, scattered through the volumes of botanical journals and of the publications of learned societies (a collected edition was published in 1892–93), are of great and varied interest. Prominent among them is the series of "Keimungsgeschichten," which laid the foundation of our knowledge of micro-chemical methods, as also of the morphological and physiological details of germination. Then there is his resuscitation of the method of "water-culture," and the application of it to the investigation of the problems of nutrition; and further, his discovery that the starch-grains to be found in chloroplastids are the first visible product of their assimilatory activity. His later papers were almost exclusively published in the three volumes of the *Arbeiten des botanischen Instituts in Würzburg*, 1871–88. Among these are his investigation of the periodicity of growth in length, in connexion with which he devised the self-registering auxanometer, by which he established the retarding influence of the highly refrangible rays of the spectrum on the rate of growth; his researches on heliotropism and geotropism, in which he introduced the "clinostat"; his work on the structure and the arrangement of cells in growing-points; the elaborate experimental evidence upon which he based his "imbibition-theory" of the transpiration-current; his exhaustive study of the assimilatory activity of the green leaf; and other papers of interest. Sachs' first published volume was the *Handbuch der Experimental-Physiologie der Pflanzen*, 1865 (French edition, 1868), which gives an admirable account of the state of knowledge in certain departments of the subject, and includes a great deal of original information. This was followed in 1868 by the first edition of his famous *Lehrbuch der Botanik*, by far the best book of its kind. It is a comprehensive work, giving an able summary of the botanical science of the period, enriched with the results of many original investigations. The fourth and last German edition was published in 1874, and two English editions were issued by the Oxford Press in 1875 and 1882 respectively. The *Lehrbuch* was eventually superseded by the *Vorlesungen über Pflanzen-physiologie* (1st ed., 1882; 2nd ed., 1887; Eng. ed., Oxford, 1887), a work more limited in scope, but yet covering more ground than its title would imply: though it is a remarkable book, it has not gained the general recognition accorded to the *Lehrbuch*. Finally, there is the *Geschichte der Botanik* (1875), a brilliant and learned account of the development of the various branches of botanical science from the middle of the 16th century up to 1860, of which an English edition was published in 1890 by the

Oxford Press. As a teacher Sachs exerted great influence, for his vigorous personality and his ready and lucid utterance enabled him not only to instruct, but to fire his students with something of his own enthusiasm.

A full account of Sachs' life and work has been given by Prof. Goebel, formerly his assistant, in *Flora*, 1897, of which an English translation appeared in *Science Progress* for 1898. There is also an obituary notice of him in the *Proc. Roy. Soc.* vol. lxii.

(S. H. V*.)

Saco, a city of York county, Maine, U.S.A., on the left bank of the Saco river, just above its mouth, opposite Biddeford, and on two lines of the Boston and Maine Railroad, in the south-western part of the state. It has fine water-power derived from a fall of 40 feet in the river, which is utilized in the manufacture of cotton goods, machinery, boots and shoes, &c. Near the city is Old Orchard Beach, a popular seaside resort. Population (1890), 6075; (1900), 6122, of whom 903 were foreign-born.

Sacramentary of Serapion, The, contained in a collection of Egyptian documents in an 11th-century MS. at the Laura on Mount Athos, was published by A. Dmitrijewskij in 1894, but attracted little attention until independently discovered and published by G. Wobbermin in 1899. It is a celebrant's book, containing thirty prayers belonging to the mass (19–30, 1–6), baptism (7–11, 15, 16), ordination (12–14), benediction of oil, bread, and water (17), and burial (18), omitting the fixed structural formulæ of the rites, the parts of the other ministers, and almost all rubrication, except what is implied in the titles of the prayers. The name of Serapion, bishop of Thmuis, St Athanasius's friend, is prefixed to the anaphora of the mass (1) and to the group 15–18: but whether this indicates authorship is doubtful; for whereas the whole collection is bound together by certain marks of vocabulary, style, and thought, 15–18 have characteristics of their own not shared by the anaphora, while no part of the collection shows special affinities with the current works of Serapion. But his name is at least a symbol of probable date and provenance: the theology, which is orthodox so far as it goes, but "conservative," and perhaps glancing at Arianism, shows no sign that the Macedonian question has arisen; the doxologies, of a type abandoned by the orthodox, and by *c.* 370 treated by St Didymus Al. as heretical; the apparent presupposition that the population is mainly pagan (1, 20); the exclusive appropriation of the mass to Sunday (19; cp. Ath. *ap. c. Ar.* 11), whereas the liturgical observance of Saturday prevailed in Egypt by *c.* 380; the terms in which monasticism is referred to—together point to *c.* 350: the occurrence of official interpreters (25) points to a bilingual Church, *i.e.*, Syria or Egypt; and certain theological phrases (*ἀγένητος, ἐπιδημία, μόνη καθολικὴ ἐκκλησία*) characteristic of the old Egyptian creed, and the liturgical characteristics, indicate Egypt; while the petition for rains (23), without reference to the Nile-rising, points to the Delta as distinguished from Upper Egypt. The book is important, therefore, as the earliest liturgical collection on so large a scale, and as belonging to Egypt, where evidence for 4th-century ritual is scanty as compared with Syria.

The rites form a link between those of the *Egyptian Church Order* (a 3rd- or early 4th-century development of the Hippolytean Canons, which are perhaps Egyptian of *c.* 260) and later Egyptian rites—marking the stage of development reached in Egypt by *c.* 350, while exhibiting characteristics of their own. I. The Mass has the Egyptian notes—a prayer before the lections, elsewhere unknown in the East; an exceptionally weighty body of intercessions after the catechumens' dismissal, followed by a penitential act, probably identical with the *ἐξομολόγησις* of *Can. Hippol.* 2, which disappeared in later rites; a setting of the Sanctus found in several Egyptian anaphoras; the close connexion of the commemorations of the offerers and of the dead; and the form of the conclusion of the anaphora. The structure of the communion—with a prayer before and prayers of thanksgiving and blessing after—shows that Egypt had already developed the common type, otherwise first evidenced in Syria, *c.* 375 (*Ap. Const.* viii. 13). Among the special characteristics of Serapion are the simplicity of the Sanctus, and of the Institution, which lacks the dramatic additions already found in *Ap. Const.*; the interpolation of a passage containing a quotation from *Didache* 9 between the institutions of the bread and of the chalice; the form of the *ἀνάμνησις*; and the invocation of the Word, not of the Holy Ghost, to effect consecration. That the Lord's Prayer before communion is not referred to may be only because it is a fixed formula belonging to the structure of the rite. II. The Order of Baptism has a form for the consecration of the water, and a preliminary prayer for the candidates, perhaps alluding to their exorcism; a prayer for steadfastness following the renunciation and the confession of faith; the form of anointing with oil; appropriate prayers preceding and following the act of baptism; and the prayer of confirmation with imposition of the hand, chrism, and crossing. All this corresponds to and fills up the outline of the *Church Order* and allusions in 4th-century writers, and is in line with later Egyptian rites. III. Forms of Ordination are provided only for deacons, presbyters, and bishops, the orders of divine institution (12). They are concise, but of the normal type. That for deacons (12) commemorates St Stephen, invokes the Holy Ghost, and prays for the gifts qualifying for the diaconate. That for presbyters (13) recalls the Mosaic LXX, invokes the Holy Ghost, and asks for the gifts qualifying for administration, teaching, and the ministry of reconciliation. That for bishops (14) appeals to the mission of our Lord, the election of the apostles, and the apostolic succession, and asks for the "Divine Spirit" conferred on prophets and patriarchs, that the subject may "feed the flock" "unblameably and without offence continue in" his office. The minor orders, interpreters, readers, and subdeacons (25) are evidently, as elsewhere in the middle of the 4th century, appointed without sacramental ordination. IV. The use of exorcised or blessed oil, water, and bread is fully illustrated by the lives of the fathers of the desert (cp. the Gnostic use, Clem. Al. *Excerpta* 82). Serapion has a form of benediction of oil and water (5) offered in the mass (like *Can. Hippol.* and *Ch. Ord.* for oil), probably for the use of individual offerers. A longer form for all three matters (17) perhaps has in view the general needs of the Church in the visitation of the sick. The occurrence in both prayers of "the Name" and the commemoration of the Passion, Resurrection, &c., corresponds with early allusions, in Origen and elsewhere, to the usual form of exorcism. V. For burial of the dead Serapion gives a prayer for the departed and the survivors (18). But the funeral procession is alluded to (*ἐκκομιζομένου*), and in the mass (1) the particular commemoration of departed persons is provided for. Hence we have the elements of the 4th-century funeral, as we know it in Egypt and elsewhere: a preliminary office (of readings and psalms) to which the prayer belongs, the procession (with psalmody) to the cemetery, the burial, and the mass *pro domitione*.

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Sacramento, a city of California, U.S.A., capital of the state and of Sacramento county, on the river Sacramento, at the mouth of the river American, on the eastern side of Sacramento valley, at an altitude of 30 feet. It has a level site and its street plan is regular, with broad streets, few of which are paved. The north and south streets are numbered, the east and west designated by letters. Its water-supply is derived from the river. Besides the state Capitol, the notable buildings are the Roman Catholic cathedral, agricultural hall, the court house, the city hall, and the Croker art gallery. The city is practically at the head of navigation on the river, and has daily steamer connexion with San Francisco. It is on the direct line east of the Southern Pacific Railroad, the starting-point of the line to Portland, Oregon, and the terminus of several smaller branches, all of which give it a large trade. In 1900 it contained 279 manufacturing establishments, with a total invested capital of $7,492,313; they employed 4393 hands, and the product was valued at $11,785,621. The principal product was flour, with a value of $1,128,536. In 1898 the assessed valuation of real and personal property was $15,654,625; the net debt of the city was but $164,000; and the rate of taxation was $35·40 per $1000. Population (1890), 26,386; (1900), 29,282, of whom 6723 were foreign-born and 1806 were coloured (negroes, Chinese, &c.).

Sado, an island belonging to Japan, lying 32 miles westward of Niigata, on 38° N. and a little to the east of 138° E. It has a circumference of 130 miles, an area of 336 square miles, and a population of 112,738. The port is Ebisu-minato, on the west coast; and at a distance of 16½ miles, near the east coast, is the town of Aikawa, having in its vicinity gold and silver mines, for which Sado is famous, and which have been worked from very early times. The loftiest peak is that of Kimpokusan (3815 feet), to the north of Aikawa.

Sadowa (Czech, *Sádová*), a village in north-east Bohemia, Austria, near Königgrätz. Sadowa, with the small adjoining wood, was one of the principal and most hotly-contested Prussian positions in the decisive battle of 3rd July 1866, which is still frequently spoken of as the battle of Sadowa. In 1890 it had 205, and in 1900 183 Czech inhabitants, chiefly engaged in agriculture, sugar-refining, and brewing.

Safes and Vaults.—From the earliest times strong receptacles for valuables have been constructed, and as the ingenuity of robbers successively overcame them, improvements have followed. As the name indicates, the earliest vaults were of masonry; the thickness of the walls was relied upon for security, and the entrance was closed by a heavy wooden door, secured by some form of lock. In the ancient days the bolts were of wood, and the locking mechanism of the Egyptian pin type. Later the doors were made of metal, and the iron bolts were often secured by padlocks, the lock protection probably being quite as strong as the door it fastened. The modern safe is doubtless an evolution from the old strong box, and to-day many so-called burglar-proof safes are nothing more than iron chests secured by key locks, and offering no defence whatever against the attacks of burglars. At the present time safes are divided into two distinct classes: fire-proof safes and burglar-proof safes, although occasionally the two constructions are combined. In each case the term is of relative meaning, no safe being either fire- or burglar-proof if unlimited time be given. What is aimed at is to provide protection which shall be efficient during the duration of any probable conflagration, and to prevent forcible entry within the limited period in which the safe is left unguarded.

Fire-proof safes.

The usual method of fire-proofing a safe is to make the walls of sufficient thickness to contain a filling of some material which shall be at the same time a good non-conductor of heat and also contain a large proportion of combined water. Such fillings are found in plaster of Paris, alum, &c. The chests themselves, being made of sheet iron or steel, offer some resistance to ordinary tools, but may readily be penetrated by drills or cold chisels used by experienced hands; but when properly fitted, such safes will resist the action of the temperatures to which they are exposed in ordinary conflagrations, and will effectively protect books, papers, and valuables against fire. Such safes are often fitted with dial locks, the construction of which will be referred to later. Burglar-proof safes are ordinarily not intended to resist fire, but are supposed to be placed either in fire-proof buildings or in masonry vaults where they will be sufficiently protected against heat in case of fire, to prevent danger of injury to the contents from this cause. Since the attacks of burglars may be upon the body of the safe, upon the door, or upon the locking mechanism, these all require consideration.

Burglar-proof safes.

The most acceptable construction for the body of a burglar-proof safe is generally conceded to be that of laminated plates, the walls being built up of layers of steel of different thicknesses, riveted through adjacent plates—none of the rivets passing through the whole series of plates, but being offset, so that drilling through a rivet would terminate after the thickness of two plates had been pierced. The plates are made of different thicknesses, and are usually alternately hard and soft, the outer plate being heavier than the others, and very hard. The change from hard to soft, or *vice versâ*, is almost certain to break any drill which may be employed, and thus greatly prolongs the time required for penetration. The latest improvements in the manufacture of steel have been utilized in providing material for this work, both chrome steel and manganese steel having been employed for the hard plates, the latter material with especial success.

The door of a safe may be attacked in various ways. Drilling is resisted by the use of a similar construction to that used for the walls of the safe. The door itself is accurately fitted to its seat by a series of offset bearings, in order to prevent the introduction of wedges; and the bolts shoot in all four directions, in order to hold the door in place independently of the hinges, which are only used to carry the open door. In order to prevent the use of liquid explosives, as described below, one or more tongue-and-groove joints are provided, an elastic packing being fitted in the grooves, and the door forced up to its seat by a powerful cam or lever device. The hinge in such construction is of the so-called "crane" type, enabling the door to be brought round squarely in front of its seat and pushed directly up to its bearings. In many modern safes the door is round instead of being rectangular; this form enables it to be ground to a bearing very effectively after hardening. When a door is thus made and fitted, it is found that the joint offers no less resistance to attack than the walls of the safe. The bolts by which the door is secured are usually thrown by a special handle attached to a spindle passing through the door, the bolt-work being locked in position by a separate locking mechanism,

controlled by one or more combination dial locks with separate spindles. These spindles must be very closely fitted and packed, otherwise they become points of weakness, at which liquid explosives may be admitted. If it is intended to prevent this weakness of a perforated door, an automatic bolt-work is employed, the bolts being thrown by springs upon the closing of the door, and retracted by another set of springs after the lapse of a determinate period of time controlled by a time lock.

Modern vault construction is practically burglar-proof safe-work on a far larger scale. The walls are best made of laminated steel plates, alternately hard and soft, fitted and riveted in the most solid manner, and of such thickness that the time required for drilling materially exceeds, even in the most favourable circumstances, the time available for attack. There are usually two doors, a heavy outer door, carrying the main locking mechanism, and ranging from 8 to 11 inches in thickness; and an inner door, with dial locks, adapted for quick and secure closing in case of sudden alarm. The interior of such vaults is fitted with tiers of drawers and boxes; the partitions being of sheet steel, and each drawer having its own lock. These compartments are of various sizes, and may either be used solely for the purposes of the institution owning the vault, or, more frequently, may be rented for safe-deposit purposes to customers. The compartments are generally furnished with key locks, the usual form having two keyholes and requiring the use of two keys, one of which is in the possession of the renter and the other in the hands of the vault attendant. The combination operated by the attendant's key is identical in all the locks, and this key must be turned before the renter's key can be operated; this arrangement requires the identification of the renter by the attendant, but at the same time gives the latter no access to the compartment.

The main points of difference in various vaults lie in the mechanism by which the door is secured. While reference must be made to Lord Grimthorpe's article on Lock (*Ency. Brit.* vol. xiv.), for the state of the art down to the date at which he wrote, some later features may here be added. Key locks are now only suitable for use on inner compartments of safes or vaults, the most secure of this type being the improved forms of Yale lock. The main improvement consists in the deep corrugation of the keyway, forming what is termed the "paracentric" construction, an arrangement which effectively prevents the vertical motion of any picking tool which might be inserted with the intention of lifting the pins and picking the lock by the so-called "tentative" method. Dial locks, or, as they are sometimes termed, combination locks, are generally employed for fire-proof safes; and when carefully constructed with packed spindles and balanced fence, are also suitable for burglar-proof work. The dial lock is fitted with two, three, or four circular discs or tumblers on one spindle, each tumbler having a gating or square notch at one point in its periphery. When all the gatings coincide with each other and are at the proper point with regard to the "fence" or releasing member of the locking mechanism, the bolts may be thrown back. As each tumbler is free upon the spindle, and is turned only by a projection upon the adjacent tumbler, the correct unlocking position can only be given to all the tumblers by the proper rotations of the knob upon the dial outside the safe. The numbers on the dial indicate the positions of the tumblers within to the person familiar with the combination to which the lock has been set; to all others it is a "puzzle" with such a vast number of permutations as to render the method of "trial and error" out of the question. Taking a lock with 100 divisions, the number of changes with one tumbler would be 100; with two tumblers, $100^2 = 10{,}000$; with three tumblers, $100^3 = 1{,}000{,}000$; and with four tumblers, $100^4 = 100{,}000{,}000$. Additional security is obtained by the use of two independent dial locks, each operating the same bolt mechanism. This arrangement may be employed in various ways, the most usual being with two locks set to the same combination, either lock releasing the bolt-work, or with two locks set to different combinations, and both requiring to be correctly set before the bolts can be thrown, the secrets of the combinations being in the possession of two different persons. This latter method is intended to prevent the dishonest access to the vault by either custodian, the presence of both being required.

Dial locks.

Time locks.

A number of years ago there occurred in the United States many masked burglaries. The thieves entered the residence of the cashier or other custodian at night, and under threat of death or torture compelled him to go with them to the vault and unlock the combination of the vault. They then looted the place at their leisure, and left the custodian bound. The result of this form of attack was the introduction of the time lock. The original form of the time lock was merely that of a simple clock movement, similar in mechanism to that of an ordinary alarm clock, except that instead of releasing an alarm at a predetermined time, an obstruction was introduced to the movement of the bolt-work which effectually prevented the retraction of the bolts, even when the combination lock was correctly set. At the proper time the clockwork lifted the obstruction, and the bolts could be withdrawn. It will be seen that this addition did not change the security given by the combination lock, but added to it the mechanical limitation of operation to certain hours, and made it impossible for compulsion to be employed at other times. The time lock in this form practically put an end to masked burglaries, but introduced a new difficulty, namely, the "lock-out." Any failure of the time lock to perform its work rendered it impossible for the proper persons to operate the lock; and at first it was feared that this defect might be a serious objection. The next improvement was the introduction of the double time lock, in which there were two independent movements, either of which operated the mechanism; and this was followed by the triple and the quadruple time locks, this reduplication of movements giving practically complete immunity from danger of lock-out from stoppage of the clockwork.

Automatic bolts.

With the perfection of modern high explosives a new form of attack was developed. It was found that nitroglycerine could be so diluted as to become so exceedingly limpid that it could readily penetrate joints hitherto supposed to be liquid-tight. Thus if a gutter of clay be formed along the top joint of a safe or vault door and filled with the liquid, in a short time it will be found to have passed in through the crack. In like manner a cup of clay, formed round the knob of a dial lock, or about the T-handle by which the bolts were operated, could be filled with the liquid explosive, which in a few minutes would penetrate through the space about the spindle, no matter how carefully fitted. The concussion of an exploding primer, attached to the outside of the door, would then explode the charge within and blow the door off. Although this form of attack has been provided against by packing the door joints and spindles, to prevent the access of liquid explosives, a more effective defence is that of employing automatic bolt mechanism, which requires the use of no holes whatever through the door. In automatic bolt devices powerful spring mechanism is employed to shoot and retract the bolts, there being two sets of springs, one to lock the door and the other to

unlock it. These springs require to be compressed by hand, a powerful lever mechanism being used, and each set is caught when compressed, and held by a suitable trigger. The trigger of the locking springs is released when the door is tightly closed, and the bolts are shot. When the predetermined time has elapsed, the unlocking springs are released by the time lock, and the bolts are retracted and the door may be pulled open. It will be seen that this mechanism introduces anew the danger of lock-outs by reason of its possible failure to act, and the difficulty has been met in the same manner as in the time lock, *i.e.*, by the duplication of the parts.

The direction in which modern bank locks and locking appliances have advanced may be described generally as inaccessibility from the exterior of the door. The difficulty with all key locks, however complicated, was that they were accessible through the keyhole, so that explosives could be introduced; and also that the loss of the key itself, or its illicit possession, would enable any one readily to open the lock. In the first forms of combination locks the construction was such that by the manipulation of the dial a skilful operator could form an accurate judgment of the positions of the tumblers, and was thus enabled to pick the locks. Modern combination locks are so constructed that by means of independent bearings, which are operated through the revolution of the spindle, and by use of a balanced fence arbour (that is, the connecting piece between the spindle and the tumblers), it is impossible for any one manipulating the spindle or the dial to form any idea of the position of the tumblers on the inside, because the moment the spindle is revolved, the fence arbour is lifted away from the tumblers, and there is no possibility of feeling their motion. The only way, therefore, of opening the modern combination lock is by knowledge of the combination, or by forcing the one who has the combination to open the lock, either by torture or by threats of death.

Recent devices.

The next step was to add to the combination lock a time lock which had no connexion with the exterior of the door, and which, when set to remain locked for a certain period, could not be opened by any one. This was followed by the attack by liquid explosives, as discussed above, and the new attack was opposed by the new defence of the automatic bolt-throwing devices. The modern time lock is protected against unlocking by jarring, whether from explosives or otherwise, by having all its time-movements and locking mechanism mounted upon a movement block, which is cushioned on springs at its back and front, so that all the operative mechanism is, as it were, floating. The mechanism is operated generally by three, sometimes by four, time-movements, each of which is entirely independent and fully able of itself to operate the mechanism, even if all the other movements should stop. Automatic bolt-operating devices are so designed that the effect of jarring will simply be to lock the locking levers tighter. The unlocking mechanism of the best of these is double, so that in case of any accident to part of the mechanism, the reserve mechanism will operate the bolt.

In all the advances which have been made in burglar-proof protection, it will be observed that the burglars are the experts, and as soon as they succeed in penetrating a defence, a new and stronger one is devised. Plans have been suggested by which the locks may be operated electrically from a distance, but that simply removes the point of attack to a new place, and does not constitute any greater protection. At the present time the existing defences, as described above, have held good, and the best modern devices have not yet been successfully attacked. (H. H. S*.)

Saffi, or Asfi, a seaport on the west coast of Morocco, 106 miles west-north-west of Morocco. Although the principal wool and grain port of central Morocco, it is sadly hampered by bad landing in certain weathers. There are several important European business houses, a Scottish mission, and the usual consular officials. Exports: 1896, £92,716; 1900, £143,438. Imports: 1896, £81,730; 1900, £83,073. Shipping: 1896, 68,286 tons; 1900, 84,682 tons. Population, about 15,000.

Saffron Walden, a municipal borough, market town, and railway station in the Saffron Walden parliamentary division of Essex, England, 24 miles north-north-west of Chelmsford. A British and Foreign School Society's training college for mistresses has been opened, and the library of the literary institution reconstructed. Area, 7502 acres. Population (1891), 6104; (1901), 5896.

Sagaing, a division and district in Upper Burma, lying to the south and west of Mandalay. The Sagaing division includes the districts of Upper and Lower Chindwin, Shwebo, and Sagaing, and covers an area of 30,039 square miles, with a population of 821,769 in 1891, and 999,168 in 1901, of whom 463,966 were males and 535,202 females. In 1898–99 it had 3666 villages, paying a revenue of Rs.20,86,158. The Sagaing district has an area of 1862 square miles; population (1891), 246,141, living in 593 villages and paying Rs.6,80,827 in 1898–99. In 1901 the population was 282,691, of whom 132,028 were males and 150,663 females. The inhabitants are almost wholly Buddhists and Jains. Except for a ridge of hills along the Irrawaddy the greater part of the district is flat. Paddy is the chief crop. The total acreage is 1,191,469. Of this, 266,754 acres were cultivated in 1898–99, 253,088 acres were current fallow, 49,562 acres were available for cultivation, and 622,065 acres were not cultivable. The total rainfall in 1898–99 was 31·37 inches, taken at Sagaing. In the hot weather the maximum shade temperature rises to a little over 100° F. The lowest readings in the cold weather average about 56° F. Sagaing, the headquarters town, opposite Ava, a few miles below Mandalay, had a population in 1891 of 9934. The hills above are studded with pagodas, and the town itself is well shaded by large tamarind trees. It was formerly a capital of Burma. It is connected by railway with Myitkyina. A steam ferry connects with the Rangoon–Mandalay line, and the steamers of the Irrawaddy Flotilla Company call daily.

Saganeiti. See Eritrea.

Sagasta, Praxedes Mateo (1827–——), Spanish statesman, was born on 21st July 1827, at Torrecilla de Cameros, in the province of Logroño. He began life as an engineer, and from his college days he displayed very advanced Liberal inclinations. He entered the Cortes in 1854 as a Progressist deputy for Zamora. After the *coup d'état* of O'Donnell in 1856, Sagasta had to go into exile in France, and promptly returned, to become the manager of the Progressist paper *La Iberia*, and to sit in the Cortes from 1859 to 1863. He seconded the Progressist and revolutionary campaign of Prim and the Progressists against the throne of Queen Isabella, conspiring and going into exile with them. He returned, *viâ* Gibraltar, with Prim, Serrano, and others, to take part in the rising at Cadiz, which culminated in the revolution of September 1868, that made Sagasta in succession a minister several times under Serrano and then under King Amadeo of Savoy, 1868–1872. Sagasta ultimately headed the most Conservative groups of the

revolutionary politicians against Ruiz Zorrilla and the Radicals, and against the Federal Republic in 1873. He took office under Marshal Serrano during 1874, after the *pronunciamiento* of General Pavia had done away with the Cortes and the Federal Republic. He vainly attempted to crush the Carlists in 1874, and to check the Alphonsist military conspiracy that overthrew the Government of Marshal Serrano at the end of December 1874. Barely eight months after the restoration of the Bourbons in the autumn of 1875, Sagasta accepted the new state of things, and organized the Liberal dynastic party that confronted Canovas and the Conservatives for five years in the Cortes, until the Liberal leader used the influence of his military allies, Jovellar, Campos, and others, to induce the king to ask him to form a Cabinet in 1881. The Liberals only retained the confidence of the king by postponing the realization of almost all their democratic and reforming programme, and limiting their efforts to financial reorganization and treaties of commerce. A military and republican rising hastened Sagasta's fall, and he was not readmitted into the councils of Alphonso XII. On the death of that king in 1885, Sagasta became premier under the regency of Queen Christina, and remained in office until 1890, long enough to carry out all his reform programme, including universal suffrage. A coalition of generals and Conservatives turned Sagasta out in July 1890, and he only returned to the councils of the regency in December 1892, when the Conservative party split into two groups under Canovas and Silvela. In his tenure of office from 1892 to March 1895 Sagasta did not do much, and he had to cope with many difficulties, including a serious conflict with Morocco, in which he averted a war and secured a heavy indemnity for the aggression of the Riff tribes on Melilla. He was still in office when the final rising of the Cubans began in February 1895, and he had to resign in March of the same year because he could not find generals or superior officers in the army willing to help him to put down the turbulent and disgraceful demonstrations of the subalterns of Madrid garrison against newspapers which had given offence to the military. Sagasta kept quiet until nearly the end of the struggle with the colonies, when the queen-regent had to dismiss the Conservative party, much shorn of its prestige by the failure of its efforts to pacify the colonies, and by the death of its chief, Canovas del Castillo. Sagasta gallantly undertook the hopeless task of conciliating both the Cubans and the United States by a tardy offer of colonial home rule, the recall of General Weyler, and other concessions that did not avert either the disastrous war with the United States or the loss of Cuba, Porto Rico, and the Philippine Islands. The Liberal party and Sagasta paid the penalty of their lack of success, and directly the Cortes met after the peace treaty of 12th December 1898 with the United States, they met with a parliamentary defeat in the Senate that sent them into the cold shade of opposition. Sagasta did not obstruct too much the Conservative Cabinet that undertook to reorganize Spain after the loss of her colonies. He ever pursued his policy of playing into the hands of the sovereign whilst keeping up the appearances of a Liberal, almost democratic, leader, skilful in debate, a trimmer *par excellence*, and abler in opposition than in office.

Sagastyr, an island of Russian Siberia, at the mouth of the Lena, situated in 73° 22′ 48″ N. and 126° 35′ E. It was during the years 1882–83 the seat of an International polar station. The average temperature throughout the year, from two years' observations, appears to be 1° F.

Saginaw, a city of Michigan, U.S.A., capital of Saginaw county, on both banks of the Saginaw river, at an altitude of 589 feet. The city has a level site, a regular street plan, is divided into fifteen wards, has good water-supply and sewerage systems, and is well paved, mainly with wood. The river is navigable for large vessels from Lake Huron to this point, making it practically a lake port and giving it a share of the lake commerce. It has four railways, the Grand Trunk, the Pere Marquette, the Michigan Central, and the Saginaw, Tuscola and Huron, which afford ample means for inland trade. Saginaw is situated in a farming, lumber, and salt region, and its manufactures are related to these industries. In 1900 it had 480 manufacturing establishments, with a total capital of $7,558,806. They employed 4866 hands, and the product was valued at $10,034,499. The most important of these products was lumber, the value of which was $2,647,461. The product of foundries and machine shops was valued at $1,256,183. Flour was manufactured to the value of $412,962. The assessed valuation of real and personal property was, in 1900, $18,998,090; the net debt of the city was $1,314,326; and the tax rate $19.80 in the east district and $21.96 in the west district per $1000. The city was formed on 1st April 1890 by the consolidation of the former city of Saginaw with East Saginaw. Population (1890), 46,322; (1900), 42,345, of whom 11,435 were foreign-born and 348 negroes.

Sahara, the great desert of northern Africa, with an area, according to Dr Bludau's calculation of the areas of African river basins, of 3,459,500 square miles, which is made up as follows:—

Drainage or slope to Atlantic	131,000	square miles.
,, Mediterranean	502,000	,,
,, inland	2,602,500	,,
Slope to Niger basin	224,000	,,
Total	3,459,500	,,

This includes Tripoli and Fezzan, which practically belong to the desert zone, but does not include arid portions of the basins of the Nile and Niger, in which the drainage is at most intermittent, and which might with reason be included in the Sahara. The area would thus be brought up to at least $3\frac{1}{2}$ million square miles.

Although some additions to our knowledge of the Sahara by exploration were made within the last dozen years of the 19th century, the most valuable results have been obtained by the study of material already available, which has thrown considerable light on the physical history of the region.[1] An admirable investigation of this, and summary of our knowledge of Saharan geography in all its aspects, was published in 1893 by M. Henri Schirmer, whose conclusions may be briefly summarized here. M. Schirmer contests the idea that the desert nature of the Sahara has been acquired within comparatively modern times, showing that it is due to forces which have been at work for ages in the region in question, although, as in all deserts, the dryness is probably progressively increasing. The primary cause is to be sought in the existing distribution of land and sea, the great land mass of North Africa causing an outflow of air in all directions (and consequent absence of rain) in winter, and an indraught in summer, when the surface is intensely heated and the relative humidity of the atmosphere becomes so small that condensation is all

[1] M. de Lapparent has called attention to a marine fossil of Cretaceous age brought home by Monteil from the central Sahara, as indicating that in Cretaceous times that region was covered by the sea, and so modifying current views as to its geological history (see *La Géogr.*, 1901).

but impossible. To this must be added that the vicinity of the comparatively cool Mediterranean in the north accentuates the force of the winds from that direction, which, blowing as they do towards a lower latitude, are in their very nature dry winds. The influence of mountain ranges, such as the Atlas, round the border of the desert, is thus but a subordinate cause of the latter's dryness, which would probably be little diminished did the Atlas not exist. This dryness reacts again on the temperature conditions of the Sahara, accentuating both the daily and annual variation. The intense heat of the days is compensated by the cold of the nights, so that the mean annual temperature is not excessive. The difference between the mean temperature of the hottest and coldest month has been found to be as high as 45° F., and the extreme range at least 90° F., maxima of 112° and over having been frequently observed. As a result of the extreme dryness of the air, evaporation is excessive, and, being greater than the precipitation, involves a progressive desiccation of the Sahara. This being the case, it is plain that any attempt to improve the climatic conditions of the Sahara as a whole, which some have considered possible, can hardly meet with real success. Much may, however, be done to modify local conditions, and fairly satisfactory results have been obtained within recent years, in the direction of fixing the dunes and covering them with a growth of vegetation. Experiments carried out at Ain Sefra, on the northern border of the desert, have shown that by protecting the sand from the action of the wind by a litter of alfa grass, time is given for the establishment of suitable trees, which include the tamarisk, acacia, eucalyptus, prickly pear, peach, and aspen poplar, the last-named having proved the most capable of all of resisting the desert conditions. Such planting operations can only be carried out in favourable localities, such as valleys in which a certain amount of water is available. Wide areas like the arid stony plateaux (Hammada) must be abandoned as hopeless, so that a change for the better in the general atmospheric conditions of the Sahara is certainly not to be looked for.

Our knowledge of the history and mutual relations of the races who inhabit the Sahara is still very imperfect, but the facts have been well summarized by M. Schirmer. The attempts made by many explorers and writers to trace in certain of the existing inhabitants the remnants of an aboriginal race of negro affinities, which inhabited the Sahara before the arrival of the Berbers and Arabs, is, he shows, not justified by the facts at our disposal. That negro influence is to be seen in various parts is undeniable, but it can be shown to date from a much more recent period than has been supposed. The connexion between many of the place-names in Fezzan and the language of Bornu is attributable, *e.g.*, to the northward extension of the influence of the Bornu-Kanem empire between the 11th and 14th centuries of our era. The allusions by classical writers to Æthiopians as inhabitants of the Sahara prove little, in view of the very vague and general meaning attached to the word by many ancient authorities. The physical characters, and especially the dark colour, of many of the Saharan populations is apparently a stronger argument, but even this is capable of another explanation. Caravans of negro slaves have from time immemorial passed northwards along the main desert routes, and it is just in the oases on these that the dark element in the population is chiefly found. It may therefore be attributed to the intermarriage of the original lighter inhabitants of the oases with such slaves. The Tebu or Teda, once thought to be almost pure negro, who inhabit the east-central portion of the desert, proved, when examined by Nachtigal in Tibesti, where they are found in greatest purity, to be a superior race with well-formed features and figures, of a light or dark bronze rather than black. Their language is related to that of the Kanur in Bornu, but it appears that these have derived theirs from the Tebu, not the Tebu from the Kanur. Physically, the Tebu appear to resemble somewhat the Tuareg, their western neighbours, but their true affinities have so far remained unsolved.

The chief centres of population in the Sahara are, firstly, the oases, which occupy positions where the underground water makes its way to the surface or is readily reached by boring; and, secondly, certain mountainous districts where the atmospheric moisture is condensed, and a moderate rainfall is the result. Except in the south of Algeria, where cultivation has been extended by means of artesian wells, the condition of the Sahara oases is far from prosperous. A feeling of insecurity has been engendered by the marauding habits of the nomad tribes; cultivation has become more restricted; and the decline of the caravan trade has brought ruin to certain centres, such as Murzuk. The most important are the oases of the Tuat region, especially Insalah; those of Rhat and Ghadames, on the route from Tripoli to Zinder; and of Kufra, in eastern Sahara. The various confederations of the Tuareg, in central Sahara, are grouped round hilly districts, which serve them as refuges from their enemies. The most important are the Awellimiden, on the left bank of the Middle Niger; and the Kel-Ui, grouped around the mountainous districts of Air or Azben; the two northern confederations, those of the Ahaggar and Azjer, being less powerful. The chief centre of the former seems to be the mountainous district of Aderar or Adghag (not to be confounded with Adrar in western Sahara), which lies north of the Middle Niger, but has not yet been visited by any European. Much information respecting the present state of the confederation was, however, obtained during the voyage down the Niger, in 1896, of Lieutenant Hourst, who was much struck with its powerful organization under the chief Madidu. The Kel-Ui of Air have not maintained the purity of their race to the same extent as other divisions of the Tuareg, showing some signs of mixture with a negroid race, which is still to be found in the country as the result of former relations with Hausa and Songhai stocks. The residence of the sultan is at Agades, which has some importance as a halting-place of caravans, though less than formerly. When visited by M. Foureau in 1899, more than half of its area, which is considerable, was found to be occupied by ruined houses. Those still intact are built of mud, some having an upper storey. A few houses of a better style belong to merchants of Tuat or Tripoli. The sultan's residence, however, has architectural merit, being a massive two-storeyed structure pierced with small windows. The mosque, with its minaret in the form of a truncated pyramid, still remains as in Barth's time. The country receives a fair amount of rain during the summer, and the valleys are green and dotted over with trees of the mimosa class. Little of the land is, however, cultivated.

Other mountainous districts in which a certain amount of rain falls regularly, and which contain a population above the average for the Sahara, are Tibesti and Borku, in the east centre, and Adrar, in the west. Tibesti, which, as already stated, is peopled by the Tebu race, lies on the line of elevation, with a core of crystalline and volcanic rocks, which traverses central Sahara from south-east to north-west. In the mountain group of Tarso it rises to an average height of some 7000 feet, the volcanic cone of Tussido probably approaching 8000 feet. The slopes are bare and rocky, the summer rains running off quickly by the beds of watercourses which traverse the valleys. The occupation of the inhabitants is mainly pastoral. Borku lies to the south-east, in part on the same line of heights, and is also inhabited by the Tebu, but the extent of inhabited country is smaller. Adrar is still imperfectly known, the attempts made by travellers to reach it having met with little success. In 1900 the oasis of Atar, on the western borders of the country, was reached by M. Blanchet. It has a permanent population of 2000, but is described as a wretched spot. The other centres are Shingeti, Wadan, and Ujeft, Shingeti being the chief commercial centre, whence caravans take to St Louis gold-dust, ostrich feathers, and dates. A considerable trade is also done in salt from the sebkha of Ijil, in the north-west. Adrar occupies the most elevated part of a plateau which ends westwards in a steep escarpment and falls to the east in a succession of steps.

During the last two decades of the 19th century considerable changes have come over the commercial and political relations of the Saharan populations, even apart from the attempted extension of European influence over that region, to which reference will shortly be made. The most important fact is without doubt the great impetus which the Senussi movement has received during that period, especially in eastern Sahara. The chief centre of this powerful and fanatical sect is now at Kufra, on

the northern border of the Libyan desert, while the old focus of Senussism Jarabub now serves as a kind of university for its adherents. One of the main doctrines of the sect is that of emigration from infidel countries, under the influence of which new centres are coming into prominence and new routes being opened, while the quasi-masonic brotherhood of the members facilitates intercourse between widely-distant districts. This movement has been one out of several causes which have brought into prominence the desert routes between Wadai in the south and Jalo and Benghazi in the north, which has to some extent superseded some of the older caravan routes across the Sahara. Other causes have tended to reduce the importance of these. The long established route from Darfur to the Kharjah and Dakhilah oases has fallen into entire disuse since the closing of eastern Sudan by the Mahdist troubles, though with the cessation of these it may possibly again acquire importance. Again, the route from Kuka in Bornu to Tripoli, by Murzuk, which had been for some time sinking in importance, has now practically fallen into disuse, largely in consequence of the political troubles in Bornu since its conquest by the adventurer Rabah. The next in order towards the west of the great trade routes—that leading from Tripoli *viâ* Ghadames and Rhat, to Zinder, Kano, and other great centres of the Hausa States—has up to the present maintained its importance, but with the opening of trade from the side of the Niger may be expected in time to decline. This has already been the fate to some extent of the routes across western Sahara to Timbuktu, owing to the opening up of a route from Medina on the Senegal *viâ* Nioro to the Upper Niger, by which European goods now make their way to western Sudan. The old route will, however, retain some of its importance on account of the salt trade from the Sahara, which still centres at Timbuktu.

The extension of French influence over central and western Sahara, so long a desideratum on the part of that nation, has of late years made a decided advance. The work of French pioneers to the south of Algeria was recognized in 1890 by the Anglo-French agreement, which assigned to France the whole central Sahara from Algeria to a line from Say on the Niger to Lake Chad; and this was soon followed (1892) by Monteil's great journey from Senegal to Lake Chad and across the desert to Tripoli. The southern limit of the territory was, however, not strictly defined until 1898, when a new agreement gave to France a rectangular block south of the line mentioned, including the important frontier town of Zinder. To the north-east and east the boundary of the French sphere was defined, by the supplementary declaration of 1899, as running south-east, from the intersection of the Tropic of Cancer with 16° E., until it meets the meridian of 24° E., following this south to the frontier of Darfur. French Sahara is thus connected with French Sudan in the south-west, and with the Congo–Shari territories on the south-east. On the west, where Spain claimed the Sahara coast between Capes Blanco and Bojador, the interior frontier was defined by the Franco-Spanish agreement of 1900, being so drawn as to leave to France the whole of the country of Adrar, the boundary north of the tropic being the 12th meridian east of Greenwich. French authority has been established over a small part only of the vast area included within the above boundaries. South of Algeria military posts have been gradually pushed into the desert, El Golea being until 1900 the farthest point which acknowledged French rule. The great desideratum was the opening up of a route to the Sudan which might in time divert the trade from Tripoli to Algeria, but all attempts long proved fruitless, owing to the dangerous character of the tribes by which the way was infested. In 1886 Lieutenant Palat was murdered a little south of Gurara, and in 1889 the same fate befell Camille Douls in Tidikelt (Tuat) in his attempt to reach Timbuktu from the north. In 1890 F. Foureau—who in 1883 had undertaken a first journey of exploration south of Wargla—reached the Tademayt plateau in 28° N., and in 1892–93 came the first of his long series of expeditions undertaken with a view of penetrating the country of the Azjer Tuareg, the powerful confederacy which lay on the route to Air and Lake Chad, never traversed in its entirety by a European. The borders of their country were reached in the same year by M. Méry, and in 1894 by D'Attanoux, while in 1895–96 M. Foureau did valuable work in the Erg region south of Tunis, between Tuggurt and Ghadames. But all efforts to obtain a passage were unavailing until in 1898–99 this indefatigable traveller, accompanied by an escort of troops under Major Lamy, at last attained his object, finally reaching Zinder, the important trade centre on the borders of the Sudan, on 2nd November 1899.

The important section of M. Foureau's route began at Ain El-Hajaj, in about 26½° N., immediately beyond which the frowning *massif* of Tindesset had to be crossed by a most difficult route among a chaos of rocks and ravines, the geological formation being principally sandstone. After descending the southern escarpment of the "Tassili," the expedition crossed a mountainous region named Anahef, composed of quartz and granite, through which the line of partition between the basins of the Mediterranean and Atlantic was found to run. Beyond this the route lay across the wide plain of quartz gravel, strewn with blocks of granite, known to the Tuareg as Tiniri, to the well of In-Azaua, beyond which a march of eleven days, with a water-supply at one point only, led to the first village of Air, where the Tuareg proved hostile. Agades, the capital of Air, was reached by a march through difficult mountains, with valleys which gradually opened into a wide plain. From Agades to Zinder the route lay, first, through the bare and arid district of Azauak; next, through the bush-covered Tagama, a district abounding in game; and, lastly, through the cultivated country of Damerghu. Zinder had only once before been reached by way of Air—by Barth's expedition in 1850. It was now occupied by a French garrison, established by the expedition from the Niger under Lieutenant Joalland, who had thus retrieved the disasters of the two previous expeditions by this route, the first under Cazemajou, the second under Voulet and Chanoine. M. Foureau's farther route round Lake Chad and south to the Congo does not come within the scope of the present article.

M. Foureau's achievement was quickly followed by increased political activity of the French in the Sahara south of Algeria, where, in addition to the work of explorers already mentioned, surveys had been carried by French officers (especially Captains Germain and Laperrine in 1898) as far as the important centre of Insalah, the position of which had, as a result, been shifted some twenty-five miles east of its former position on our maps, being found to lie in 2° 16′ E., 20° 17′ 30″ N. Early in 1900 M. Flamand, who had been entrusted with a scientific mission to the Tuat oases, came into collision with the natives, and Insalah was occupied by the military escort which accompanied him. This was quickly followed by the occupation of Tuat, and, later, by that of Igli, a position of some importance, as securing the communications with Tuat and the region to the south. As, however, it lies west of the southward continuation of the frontier of Algeria with Morocco, its occupation did not pass without protests on the part of the Moorish authorities, but these are little likely to stem the tide of French expansion in this region. Simultaneously with these events, an attempt was made to pave the way for the establishment of French influence in western Sahara by the expedition of M. Blanchet to Adrar, which had not been visited since the middle of the 19th century. It returned in September 1900, only partially successful, M. Blanchet and his companions having been detained for some time as virtual prisoners on the borders of Adrar. The leader almost immediately succumbed to fever.

The hope of an eventual commercial exploitation of the Sahara rests mainly on the possible existence of mineral wealth, of which nothing is yet known. For the supply of easy communication between Algeria and the Sudan the construction of a railway across the desert has found many advocates, though others have considered the idea impracticable and useless, pointing out that such a route could not hope to compete with the shorter and more natural outlets from the Sudan to the south and west. Two principal routes have been suggested, the one, recommended especially by M. Leroy-Beaulieu, taking an easterly line from Biskra through Wargla to Air (Agades) and Zinder—generally, the route followed by Foureau; the other, of which M. Laferrière is an advocate, starting from the terminus of one of the more westerly railways already existing—preferably that opened early in 1900 to Jenien-bu-Rezg—and reaching Timbuktu *viâ* Igli and the Tuat oases. A third suggested route is one from Igli to the Senegal, still farther west. Pending the possible adoption of any such scheme, it has been suggested that a telegraph line by one of these routes would do good service, while the establishment of a regular caravan service is also advocated.

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Saharanpur, a city and district of British India, in the Meerut division of the North-Western Provinces. The city is situated on a stream called the Damaula Nadi, 907 feet above the sea, and 1041 miles north-west from Calcutta by rail. Population (1891), 63,194; (1901), 63,850, of whom more than half are Mahommedans. The municipal income in 1897–98 was Rs.57,253, mostly

derived from octroi, and the incidence of taxation was R.0.12.8 per head. The death-rate in 1897 was 35 per thousand. It is an important junction of the North-Western with the Oudh and Rohilkhand Railway, and point of departure by road for Mussoorie. The Government botanical gardens were established in 1817. There are two high schools, and seven printing-presses, issuing one vernacular newspaper. The district of SAHARANPUR has an area of 2242 square miles. Population (1881), 979,544; (1891), 1,001,280; (1901), 1,046,412, showing an increase of 2 per cent. in the earlier and 4 per cent. in the later decade.

The land revenue and rates are Rs.18,69,282, the incidence of assessment being R.1.8.4 per acre; cultivated area (1897–98) 739,651 acres, of which 188,983 were irrigated, including 122,642 from Government canals; number of police, 2650; vernacular schools, 151, with 4665 pupils; registered death-rate (1897), 35·6 per thousand. The principal crops are wheat, rice, pulse, maize, sugar-cane, and cotton.

Saidapet, a town of British India, administrative headquarters of the Chingleput district of Madras; station on the South Indian Railway, 5 miles south-west of Madras city by rail, from which it is separated by a line of tanks. Population (1881), 4917; (1891), 5702. There is a Government college of agriculture, with museum, chemical laboratory, and veterinary hospital. The model farm, established in 1865, is now attached to the college. The Government teachers' college, with 46 students in 1898, has a hostel or boarding-house for Brahmans, opened in 1897. The high school, used as a practising school, had 303 pupils in 1898.

Saigon, capital of French Indo-China, on the right bank of the river Saigon, about 8 miles from its junction with the Donnai, 34 miles from the sea. Before the French conquest, Saigon, then known as *Gia-dinh-thanh*, was the capital of Lower Cochin-China, which consisted of the "six southern provinces," and constituted a vice-royalty under the government of a *kinh-luoc*. The population, which at the time of the French occupation did not exceed 5000 or 6000 inhabitants, rose in 1882 to 13,348, and in 1896 to 44,764 of whom 3258 were Europeans or *assimilés*, namely, nationalized persons, and 41,506 Asiatics. Of these latter, 25,411 were Annamese, 13,801 Chinese, and the remainder Asiatic foreigners. The town covers an area of 1730 acres. It is enclosed in an irregular trapezium, formed by the river Saigon on the east, the Chinese Arroyo on the south, and the canal on the west. The streets are wide and straight, running in parallel lines or united at right angles. Double rows of trees give shade in all the streets and boulevards. All public offices are situated in the upper part of the town. The floating-dock, sunk several years ago, is furnished with a repairing-dock in which vessels of the largest size can be accommodated. The movement of the port in 1898 was as follows: 598 arrivals, 579 departures, representing 731,368 tons entering and 729,781 clearing. In the same year French vessels made 444 entries and departures, carrying 609,008 tons; British vessels, 310, carrying 426,040 tons (an increase on 1897 of 61 entries and departures and 65,555 tons); German vessels, 279, carrying 314,939 tons (a decrease on 1897 of 32 entries and departures and 45,545 tons); Japanese vessels 42 entries and departures, with 67,580 tons. The arsenal of Saigon occupies an area of 55 acres. The town is lighted by gas and electricity. Its water-supply is secured by a filtering-basin, which yields 16,000 cubic metres daily. Three great banks are established in Saigon: the Bank of Indo-China, the Hong Kong and Shanghai Banking Corporation, and the Chartered Bank of India, Australia, and China. The Messageries Maritimes and the Messageries Fluviales have their headquarters at Saigon. The channels of the river Saigon between the town and the sea have been dredged, widened, and rendered available at all times. At a distance of 3½ miles from Saigon, to which it is united by a railway, lies Cholon, or Cholen, "the great market," the largest commercial town of Cochin-China. Its population is almost entirely Asiatic, and has more than trebled since 1885. In that year it had only 40,000 inhabitants; in 1901 it numbered about 127,000, among whom were a smaller proportion of Chinese than formerly. There are 41,500 Chinese in Cholon, 80,061 Annamese, 135 French, and 15 nationalized; the remainder consists of Cambodians and Asiatic foreigners. During the rice season the town is visited by a floating population of more than 20,000 persons. Cholon is traversed by two railways. The Chinese Arroyo is frequented by innumerable boats. Cholon is administered by a municipal council, composed of French, Annamese, and Chinese traders. An administrator of native business, nominated by the governor, fills the office of mayor. The rice trade is the leading industry. The rice is treated in seven immense steam mills (the husks being used as fuel), which daily treat 96,400 piculs of paddy (the mill picul weighs 68 kilogrammes), yielding 44,000 piculs of rice cargo and 24,200 piculs of white rice. There are also, in Saigon, copper foundries, potteries, and marqueterie works.

(J. M. A. DE L.)

St Albans, a city, municipal borough, and market town in the St Albans parliamentary division of Hertfordshire, England, 20 miles north-west of London by rail. The renovation of the cathedral by Sir Gilbert Scott was completed by Lord Grimthorpe in 1894. Modern erections are a technical school, a hospital, and a hospital for infectious diseases. A public park of 24 acres was opened in 1894, and a recreation ground in 1898. The industries include brush-making and letterpress and chromo-lithographic printing. Area, 997 acres. Population (1891), 12,898; (1901), 16,019.

St Albans, a town of Vermont, U.S.A., capital of Franklin county. It is in the north-western part of the state, 3 miles from Lake Champlain, and on lines of the Central Vermont Railway, at an altitude of 390 feet. The surrounding country is largely devoted to dairy farming, and the town has considerable trade in its products. It is the headquarters of the Central Vermont Railway, and contains its car shops, &c. Population (1890), 7771; (1900), 6239, of whom 1201 were foreign-born.

St Andrews, a city, royal and parliamentary burgh (St Andrews group), and university town of Fife, Scotland, on a bay of the German Ocean, 11 miles south-south-east of Dundee by rail. The increasing interest in golf, and the educational enterprise manifested by the university, have furthered the prosperity of the city. The golf links were acquired by the town in 1894, and an additional course was opened in 1895. For the Roman Catholics an iron church was erected by the Marquis of Bute in 1885. The University College of Dundee was in 1890 affiliated to, and made to form part of, the university of St Andrews. This arrangement was set aside by the House of Lords in 1895, but a reaffiliation took place in 1897. In 1887–88 a common dining-hall for the students was established; in 1892 provision was made within the university for the instruction of women; and for the board and residence of lady students a permanent building was opened in 1896. In 1889–90 a large addition was made to the university library building, and to the south of the library new medical buildings, erected in the English Renaissance style, by the munificence of the Marquis of

Bute, were opened for classes in October 1899. The annual number of matriculated students is over 400, including about 120 at University College, Dundee. The endowments of the university have been greatly increased through private bequests, the annual value of bursaries, scholarships, and prizes open for competition being about £3000. Dr Donaldson became Principal in 1886 in succession to Tulloch, and Lord Balfour of Burleigh was installed as Chancellor in 1901. In addition to the town-hall there is a large volunteer hall, and a recreation hall with tennis courts. A new marine laboratory, erected by Dr C. H. Gatty, was opened in 1896, and a boys' brigade hall was completed in 1900. Population of the royal and police burgh (1891), 6853; (1901), 7621.

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St Austell, a parish and market-town, Cornwall, England, in the St Austell parliamentary division of the county, 14 miles north-east of Truro by rail. Public rooms were erected in 1895 at a cost of £5000. Other public buildings are Liberal club (1890), Bible Christian chapel (1890), Y.M.C. Institution (1894), Baptist chapel (1900), masonic hall (1900), and Exchange (1900). St Austell is the centre of the China clay (kaolin) district. About 400,000 tons are annually despatched to the Potteries and Lancashire. The tin and copper mines of the district have added to the prosperity of the town. An extensive steam brewery was built in 1893. Population (1891), 11,377; (1901), 11,761.

St Bees, a township and railway station in the Egremont parliamentary division of Cumberland, England, on the coast, 4 miles south of Whitehaven. The nunnery of St Bega, founded about 650, was succeeded in 1120 by a Benedictine priory, to which belonged the present parish church, restored in 1855–58. St Bees College, founded in 1816 for the theological education of Church of England students, was closed in 1897. The free grammar school, founded 1583, is liberally endowed, and has many scholarships and exhibitions. Area, 1814 acres. Population (1881), 1142; (1901), 1236. The ancient parish includes Whitehaven.

Saint-Bon, Simone Arturo (1823–1892), Italian admiral, was born at Chambéry on 20th March 1823. Leaving the Naval Academy in 1847, he attained the rank of commander in 1860, and that of vice-admiral in 1867. He took part in the Crimean war, distinguished himself in 1860 at the siege of Ancona, and was decorated for valour at the siege of Gaeta. At the battle of Lissa, in 1866, his vessel, the *Formidabile,* forced the entrance of the port of San Giorgio and silenced the Austrian batteries, for which exploit he received a gold medal. In 1873 he was elected deputy, and appointed by Minghetti to be minister of marine, in which position he revolutionized the Italian navy. Insisting upon the need for large battleships with high powers of attack and defence, and capable of fighting as single units, he introduced the colossal types of which the *Duilio* and the *Dandolo* were the earliest examples. Falling from power with the Right in 1876, he resumed active service, but in 1891 was again appointed minister of marine. His death on 26th November 1892, while still in office, precluded the accomplishment of his naval programme, but his name is still revered in Italy as that of the originator of the modern Italian fleet.

St Brieuc, chief town of department Côtes du Nord, France, 278 miles west-south-west of Paris, on the railway from Paris to Brest. There are important iron and steel works, and wool-spinning and dyeing are flourishing industries. Its port is Le Légué, at the mouth of the Gouet. Including coasting trade, the total movement in 1900 was 84,517 tons. Nearly all the foreign trade is with England, from which the chief imports are metals and coal. Population (1881), 12,029; (1901), 22,198.

St Catharines, a city of Ontario, Canada, on the Welland canal and the Grand Trunk and St Catharines and Niagara Central railways, 30 miles north-west of Buffalo. The principal industrial establishments are the electric-car works, bicycle, saw, axe, and canning factories, and flour-mills. It is in the midst of the finest fruit-growing district of Canada. It has electric tramways. Imports (1900–01), $1,537,084. Population (1891), 9170; (1901), 9946.

St Chamond, town, arrondissement of St Étienne, department of Loire, France, 8 miles east-north-east of St Étienne by rail. The manufacture of laces of every variety has grown by rapid strides throughout the district of which St Chamond is the centre. The annual value of the manufactured products exceeds £900,000. There are noted dye-works, and metallurgical manufactures are very extensive. The naval and railway workshops employ a considerable number of hands. Population (1881), 13,713; (1901) (comm.), 15,469.

St Charles, a city of Missouri, U.S.A., capital of St Charles county. It is on the north bank of the river Missouri, 23 miles north-west of St Louis, and on the Missouri, Kansas and Texas and the Wabash railways, in the eastern part of the state, at an altitude of 614 feet. The business portion is built in the bottom lands, stretching along the river, while the residential portion is on the face and summit of the cliffs. The city has flour-mills and elevators, tobacco factories, breweries, and car works. Population (1890), 6161; (1900), 7982, of whom 966 were foreign-born and 719 negroes.

St Claude, chief town of arrondissement, department of Jura, France, 27 miles in direct line south-east of Lons-le-Saunier, with terminal station on the branch line from La Cluse, on the railway from Bourg to Geneva. The town is situated at an altitude of over 1300 feet, at the confluence of the Bienne and the Tacon; the former crossed by a stone bridge, the latter by a suspension bridge. The cathedral of St Pierre, 13th to 15th centuries, contains fine 15th-century stalls and a reredos of the same period. St Claude has been noted, since the close of the Middle Ages, for its fancy articles in horn, tortoise-shell, hard-wood, ivory, &c., and many establishments are specially engaged in the manufacture of briar-root pipes. Diamond-cutting and lapidary work, introduced in 1870, is a prosperous and expanding industry. The town derives its name from a penitent bishop of Besançon who died in the 12th century in the monastery founded here in the 5th century. The monks subsequently acquired enormous and almost independent judicial authority, and held their retainers in a state of serfdom till the Revolution, refusing to relinquish their claims even when St Claude was constituted a bishopric in 1762. Voltaire pleaded the cause of the serfs, though unsuccessfully, before the Parliament of Besançon, and in memory of his services a

statue was erected to him in 1887. Population (1881), 7129; (1901), 10,449.

St Cloud, a city of Minnesota, U.S.A., capital of Stearns county. It lies on both banks of the river Mississippi, and on the Northern Pacific and the Great Northern railways, in the central part of the state, at an altitude of 1037 feet. Situated in a lumber region, it derives power for its mills from the river. It has many lumber and flour mills and other manufactures of varied character. Population (1890), 7686; (1900), 8663, of whom 1907 were foreign-born.

St Croix, West Indies. See St Thomas.

St Cunegonde, an incorporated city of Hochelaga county, Quebec, Canada, on the north bank of the Lachine canal, adjoining the city limits of Montreal. It contains a college, convent, two schools, rolling mills, a sewing-machine factory, and brass foundry. Population (1891), 9291; (1901), 10,912.

St Denis, chief town of arrondissement, department of Seine, France, 5 miles north of Paris (Nôtre Dame), an important junction on the Northern Railway. Although at the head of an arrondissement, it is only a titular sub-prefecture, separate administration having been suppressed in the department in 1886. Modern erections are an orphanage, founded and endowed in 1886, the monument commemorative of the Revolution, added to the public statues in 1888, and the railway station, 1897. The ancient Hôtel-Dieu was in 1888 converted into a hospital for aged men. Population (1891), 49,275; (1901), 60,808.

St Dizier, a town and railway station, arrondissement of Vassy, department of Haute-Marne, France, 37 miles, in direct line, west-north-west of Chaumont, on the Marne and the Marne and Saône canal. There is a public library and museum. The town is a very important centre of the iron trade, with foundries of iron, steel, copper, and bronze, engineering works, &c. Population (1881), 8582; (1900), 14,601.

St Étienne, chief town of department of Loire, 310 miles from Paris by rail. In respect of population it is the seventh town of France. It owes its importance to its rich coal basin and to the attendant industries. Ribbon weaving occupies 80,000 workpeople (men and women) in St Étienne and its environs, and goods are annually made to the value of £4,000,000, and even of £4,800,000 if the laces (boot and shoe, &c.), for which St Chamond is the centre of production, be included. The work is mainly done in small factories, electricity supplying the necessary motive power—659 weaving factories being thus operated. The manufacture of heavy iron goods occupies 16,000 workmen, the production at St Étienne, St Chamond, and Rive de Gier being valued at £3,200,000. Powerful steam hammers forge the enormous quantities of steel needed for cannon, armour-plating, great locomotive wheels, &c. Some 4000 workmen are occupied in making nails, bolts, locks, wire, and agricultural implements. Goods of this class are valued at £800,000 a year. Mines occupy 15,000 men in the extraction of 4,000,000 tons of coal, worth £2,000,000 annually. Exclusive of the national manufacture of arms, private factories make to the yearly value of £400,000. The glass industry in Rive de Gier, St Étienne, &c., amounts to £400,000 per annum. The Company of the Loire for the supply of electricity distributes it for lighting or motive power to 23 communes in the neighbourhood of St Étienne. Population (1886), 103,229; (1890), 120,300; (1901), 139,350.

St Gall, a Swiss canton. It ranks officially and politically as the 14th canton, but in area it is the 6th; the total area being 779·3 square miles, of which 661·4 are reckoned as "productive"—forests cover 149 square miles, vineyards 2·1, and arable or pasture land the remaining 510·3. In 1880 the population was 209,719, and in 1888 228,174, while in 1900 it was 250,285. The canton is practically only German-speaking. In 1900 the canton had 321 inhabitants per square mile. In 1900 the following towns in the canton besides the city of St Gall had populations exceeding 5000:—Tablat (12,590), Altstätten (8724), Straubenzell (8090), Rorschach (9140), Gossau (6051), and Kirchberg (5025). The canton is divided into 15 administrative districts. In 1896 the number of "alps" or mountain pastures in the canton amounted to 304, capable of supporting 21,744 cows, and of an estimated capital value of 13,986,700 francs. The cantonal constitution dates from 1890. The legislature is elected by the "communes," each "commune" of 1500 inhabitants or less having the right to one member, and as many more as the divisor 1500 (or a fraction of 750 at the least) justifies. For the election of the 7 members of the Executive all the "communes" form but a single electoral circle. Proportional representation was rejected by a popular vote in 1893. The right of "facultative referendum" and "initiative" as to legislative projects can be exercised if 4000 vote for it, but 10,000 voices are necessary for a demand for the revision of the cantonal constitution. In 1897 the State revenue of the canton was 4,217,913 francs (a rise of nearly 70 per cent. since 1885), and the State expenditure 4,018,457 francs (a rise of over 70½ per cent. since 1885), while in 1898 there was a surplus of 132,013 francs. In 1897 the public debt was 22,400,000 francs.

St Gall, the capital of the above canton, 2208 feet above sea-level, 12½ miles by rail from its port, Rorschach, on the Lake of Constance, and 49¾ miles from Zürich. Its population was 21,204 in 1880 and 33,116 in 1900. Practically German is the only language spoken, and the inhabitants, so far as creed is concerned, are about equally divided between the Protestant and Roman Catholic Churches, though there are a few Jews. The archives of the convents of St Gall and Pfäffers are in the Government offices (part of the old monastery), while the town library is rich in works relating to the Reformation.

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(W. A. B. C.)

St Helena, an island possession of Great Britain, situated in the South Atlantic Ocean, in 15° 55′ S. and 5° 42′ W. It is a Crown colony, administered by a governor and executive council consisting of three members. The climate is exceptionally healthy, being kept cool by the south-east trade wind and by the cold waters of the South Atlantic current. Farm and garden produce constitute the whole wealth of the colony, and there is no trade except that connected with supplying provisions to the garrison and to passing ships. The prosperity of St Helena was destroyed by the Suez Canal and the disuse of sailing vessels. The annual revenue is now not more than about one-third of its former amount. Custom duties are the chief item, and in 1898 amounted to less than £5000, against an average of £16,000 in the three years preceding the opening of the Suez Canal. In 1900 they amounted to nearly £10,500 owing to the

presence of the Boer prisoners of war and of British troops and sailors. There is practically no export trade, though a certain amount of specie is annually exported. The resident population in 1891 showed a decrease of 14 per cent. from that of 1881, which in turn had been less by 23 per cent. than the figures of 1871. The civil population was in 1891, 3877, of whom 2000 lived in Jamestown. The estimated population in 1900 was 5316, inclusive of troops. There is telegraphic communication between St Helena and Europe and South Africa.

For history under the East India Company see *Extracts from the St Helena Records from 1673 to 1835*, Jamestown, 1885; *Historical Geography of the British Colonies*, vol. iii., *West Africa*, 2nd ed., Oxford, 1900; and M. DANVERS' *Report on the Records of the India Office*, London, 1887. See also *Report on the Present Position and Prospects of the Agricultural Resources of the Island of St Helena*, by D. MORRIS (printed for the Colonial Office), 1884, and *Colonial Reports*—Annual.

St Helens, a municipal, county (1888), parliamentary borough, and market-town of Lancashire, England, 193 miles north-west of London by rail. A canal communicates with the Mersey. The borough was in 1893 extended, and the enlarged borough constituted the township of St Helens. Modern erections are two Established churches, the Cowley schools, seven voluntary schools, public baths, and the Gamble Institute, erected and presented by Sir David Gamble, Bart., for a technical school and library, costing about £30,000, and educating some 2000 students. Victoria Park (36 acres) was opened in 1887, Thatto Heath Park (17 acres) in 1890, Taylor Park (48 acres) in 1893, and three further recreation grounds, comprising in all 44 acres, in 1901. Besides St Helens hospital (1873) and Rainhill county lunatic asylum, enlarged in 1886, there are a Roman Catholic hospital (1884) and two isolation hospitals, one of which was extended in 1893, 1896, and 1898. Works for the disposal of the sewage, costing about £50,000, date from 1890. In 1891 there were 4845 males and 573 females engaged in the manufacture of glass, 1748 persons in that of alkali, 4320 in coal-mining, and 538 in the manufacture of iron and steel. The municipal and county borough, as extended, has an area of 7254 acres. Population (1891), 72,413; (1901), 84,410. Previous to extension the municipal borough was coextensive with the parliamentary borough, which had an area of 6558 acres.

St Helier. See CHANNEL ISLANDS.

St Henri, incorporated city of Hochelaga county, Quebec, Canada, 2½ miles south-west of the centre of Montreal, on the north bank of the Lachine canal and on the Grand Trunk Railway. It contains municipal buildings, a college, and convent. The principal industrial establishments are sewing-machine, calico, shirt and collar, leather, confectionery, and rock-drill manufactories, rolling mill, tanneries, foundries, and one of the largest cotton mills in Canada. Population (1891), 13,413; (1901), 21,192.

St Hyacinthe, a city and port of entry of Quebec, Canada, and capital of St Hyacinthe county, 29 miles east-north-east of Montreal, on the left bank of the river Yamaska and on the Grand Trunk, Canadian Pacific, Intercolonial, and Quebec Southern railways. It is the seat of a Roman Catholic bishop, and contains a classical college, dairy school, a number of educational and charitable institutions, and two monasteries. It has manufactories of organs, leather, woollens, and agricultural implements. Population (1891), 7016; (1901), 9210.

St Ingbert, a town of Bavaria, Germany, in the Palatinate, 14 miles by rail west of Zweibrücken. It has coal-mines, iron-works, and manufacture of glass and machinery. Population (1885), 10,321; (1900), 14,048.

St Ives, a municipal borough and market-town in the St Ives parliamentary division of Cornwall, England, on St Ives Bay, 8 miles north-east of Penzance by rail. The works and property of St Ives harbour were in 1886 vested in the corporation. Modern buildings are a pier and a free library. The old stone pier has been repaired and lengthened. Area, 1019 acres. Population (1891), 6094; (1901), 6697.

St Johann, a town of Prussia, in the Rhine province. See SAARBRÜCKEN.

St John, the capital of St John county, New Brunswick, the largest city in the province, 275 miles from Halifax by the Intercolonial Railway, and 481 miles from Montreal by the Canadian Pacific Railway, of which it is the Atlantic terminus. In 1889 the cities of St John and Portland were united under one government. Through its direct connexion with Montreal and the West, St John has rapidly come into prominence as the winter port of Canada. The city expended about $750,000 in providing terminal facilities, in the shape of wharves, elevator, &c., on the west side of the harbour. The winter port trade opened in 1895–96, and has since steadily increased. Another large grain elevator has been constructed at the deep-water terminus of the Intercolonial Railway, where extensive wharf accommodation has also been provided by the Dominion Government, the two costing over $1,000,000. A large tract of forest land, including a beautiful sheet of water called Lily Lake, just north of the city, has been secured for a public park, the natural beauties of which are being constantly improved. It has the nucleus of a zoological garden. Through the munificence of one of its late citizens, St John has a home for incurables, $100,000 having been bequeathed for that purpose. The most important modern buildings are the Intercolonial Railway station, opera house, quarantine station, the market building, and high school, and a site has been selected for a Carnegie library. The geology and natural history of the province are well represented in the museum of the Natural History Society of New Brunswick, situated in the market building. This collection includes the specimens formerly in the mechanics' institute.

The city is governed by a mayor and fifteen aldermen, thirteen of whom represent separate wards and two the city at large, but each alderman is elected by the whole city. St John city and county return two members to the House of Commons, instead of three, as formerly. The following figures show the condition of the coasting trade in 1901:—Steamers and sailing vessels, arrived, 2620, tonnage 408,055, men 18,890; departed, 2790, tonnage 562,778, men 22,431. The number of steamers and sailing vessels entering from British and foreign ports was 1663 (668,227 tons); cleared, 1465 (478,613 tons). On the 31st December 1900 there were 399 sailing ships and steamers (net tonnage 61,072) on the registry books; of these, 68 were steamers, gross tonnage 7564. In 1900, 12 new vessels (410 tons) were built. In 1902 there were 153 schools, attended by 6947 pupils, 40 churches, 1 bank and 6 branch banks, and a good electric street railway. The city is lighted by gas and electric light. In 1880 the exports amounted to $3,249,718 and the imports to $3,197,568. In 1890, exports $3,595,877, imports $4,352,018; in 1901, exports $11,094,903, imports $4,623,134. Population (1881, including Portland), 41,353; (1901), 40,711.

St John, West Indies. See ST THOMAS.

St Johns, the capital of Newfoundland, situated on the east coast of the island, in 47° 33′ 54″ N. and 52° 40′ 18″ W., the seat of government and the chief seaport and place of trade in the colony. From all records St Johns may fairly claim the distinction of being the earliest English settlement in America. The

old city, built entirely of wood, was twice completely destroyed by the French, and twice (1816–17 and 1846) by fire. Half of the capital was again burnt down in 1892. From all these disasters and, worse than all, the bank crash of 1894, St Johns arose, better built and more prosperous than ever. The town is well drained and its sanitary arrangements are fairly good. The main street is admirably paved, and there is an electric railway of the most modern construction. The railway across the island to Port aux Basques has one terminus in the east end of the town; another in the western quarter, has a fine station, whence a branch line connects with the main line, about 7 miles west. The English cathedral, an admirable specimen of Gothic architecture, is not yet complete. Unfortunately part of the nave was burned, and the central tower is unfinished. The hotel accommodation is quite inadequate to the needs of the city. There are several good public halls. Education is purely denominational. The colleges for the higher education are modern buildings; and the council of higher education, formed of all the denominations, has worked well. St Johns is not an incorporated town. A municipal council was abolished after having increased the city debt to a million and a half dollars. The town is now governed by three commissioners appointed by the governor in council.

St Johns, with its narrow entrance and surrounding hills, is a great natural fortress, the Gibraltar of North America. As a naval base it would control the trade of the North Atlantic, which all passes within a short radius of Cape Race. Both in the war of the Revolution and in that of 1812 St Johns was the headquarters of the British fleet, and at one time the western end of the harbour was filled up with American prizes. The forts are all dismantled and in decay; but a very elaborate survey of St Johns and the surrounding country has been made by the naval officers on the station, with a view to the fortification and defence of the port. Steamship lines run to Liverpool, New York, Halifax, N.S., the north and west coasts of the island, and Labrador. Local steamers in connexion with the railway also run on Placentia, Trinity, Bonavista, and Notre Dame Bays. Out of 399,852 tons of British steam shipping entered in Newfoundland in the year ending 30th June 1900, St Johns represented 243,367 tons. The total tonnage of sailing vessels entering and clearing from the port was in the same year 88,731 tons. Ninety per cent. of all duties collected are paid in the capital. Up to the bank crash of 1894, there were only local banks; three Canadian banks have now established branches, and the financial condition of the city is to-day thoroughly sound. At the census of 1891 St Johns electoral district had 36,027, and the city 29,007 inhabitants. By the census of 1901 the electoral district contained 39,994 inhabitants, divided as regards religion as follows:—Church of England, 9566; Roman Catholic, 21,575; Methodists, 6737; Presbyterians, 1062; Congregationalists, 412; Salvation Army, 520; other denominations, 122. The population of the municipality was 30,486.

St Johns, a town and port of entry of Quebec, Canada, and capital of St Johns county, 19 miles south-east of Montreal by rail, on the bank of the river Richelieu and at the head of the Chambly canal. There are county buildings, head office of the St Johns Bank, silk works, drain-pipe and chinaware factories, potteries, &c. A large export trade in lumber, grain, and farm produce is carried on. Three railways, the Grand Trunk, Canadian Pacific, and Central Vermont, enter St Johns. Imports for the year 1900–01, $2,477,942, and exports, $2,709,172. Population (1891), 4722; (1901), 4030.

St Johnsbury, a town of Vermont, U.S.A., capital of Caledonia county. It is on the river Passumpsic, and on the St Johnsbury and Lake Champlain and the Boston and Maine railways, in the north-eastern part of the state, at an altitude of 572 feet. The principal village bears the same name as the town, and has some prominence as a manufacturing place. Population (1890) of the town, 6567; of the village, 3857; (1900) of the town, 7010; of the village, 5666, of whom 1309 were foreign-born.

St Joseph, a city of Michigan, U.S.A., capital of Berrien county. It is on Lake Michigan, at the mouth of the river St Joseph, and on the Vandalia and the Pere Marquette railways. Population (1890), 3733; (1900), 5155, of whom 1183 were foreign-born and 103 negroes.

St Joseph, a city of Missouri, U.S.A., capital of Buchanan county. It is situated in 39° 45′ N., 94° 53′ W., on the east bank of the river Missouri, in the north-western part of the state, at an altitude of 825 feet. The city is divided into nine wards, is supplied with water by pumping from the Missouri, is sewered, and its streets are paved with brick or macadamized. It is one of the most important railway points of the interior, since six railways enter the city, the Atchison, Topeka and Santa Fé, the Chicago, Burlington and Quincy, the Chicago Great Western, the Chicago, Rock Island and Pacific, the Missouri Pacific, and the St Joseph and Grand Island. These make it a commercial centre of the first importance, and to its immense traffic by rail is to be added that by the river. Its manufactures, though not of so great relative importance, are considerable. In 1900 there were 440 manufacturing establishments, with a total capital of $11,068,825; they employed 7429 hands, and their output was valued at $31,690,736. The chief items of production were slaughtering and meat-packing, valued at $19,009,332; clothing, $1,782,395; and bakery products, $1,327,470. In 1901 the assessed valuation of real and personal property was $23,588,380, the net debt of the city was $1,655,140, and the rate of taxation was $28·50 per $1000. Population (1890), 52,324; (1900), 102,979; showing an extremely rapid growth. Of the population in 1900, 8424 were foreign-born and 6260 negroes.

St Junien, a town, arrondissement of Rochechouart, department of Haute-Vienne, France, 18 miles in direct line west by north of Limoges, on the railway from Limoges to Angoulême, and on the right bank of the Vienne. The 12th-century church, a fine example of the Roman Limousin style, contains a richly sculptured tomb of St Junien, the 6th-century hermit, from whom the town takes its name; and adjacent to the church is a canonical refectory of the 13th century. Another interesting edifice is the Gothic chapel of Notre Dame, with three naves, rebuilt by Louis XI., standing close to an ancient bridge over the Vienne. The town, which ranks second in the department in population and industry, is noted for leather-dressing and the manufacture of gloves and straw paper; other considerable establishments are felt and clog works, and there are spinning, flour, and saw mills. Near the forest of Brigueil, 4 miles north-east of the town, are large porcelain works, one of the most important in the Limousin region. Population (1881), 5499; (1901), 11,432.

St Kitts, or St Christopher, forming, with Nevis and Anguilla, one of the presidencies of the colony of the Leeward Islands (British West Indies). The island is well watered, healthy, and fertile. The temperature varies from 67° to 89°. The rainfall for 1900 was 38·00 inches. The roads are good. Population (1881), 29,137; (1901), 29,782. Basseterre, the capital, has a population of about 10,000. Sugar-growing is the sole staple industry. Revenue of the presidency (1900), £39,904; expenditure, £43,964; public debt, £73,950. Primary education is by law compulsory. Most of the inhabitants are Protestants. The local legislative council of St Kitts-Nevis comprises ten official and ten unofficial members, all of whom are nominated by the representative of the Crown.

St Lawrence.—The river St Lawrence, in North America, with the five fresh-water inland seas—Lakes Ontario, Erie, Huron, Michigan, and Superior—that are linked to it, is one of the great river systems of the world. Its length, from the source of the river St Louis (which rises near the source of the river Mississippi and falls into the head of Lake Superior) to Cape Gaspé, where it empties into the Gulf of St Lawrence, is 2100 miles. From the head of Lake Superior the lakes are navigable to Buffalo, at the foot of Lake Erie, a distance of 1023 miles, for vessels having a draught of from 17 to 20 feet; from Buffalo to Montreal, 348 miles, the draught is limited by the capacity of the canals to 14 feet; from Montreal to Quebec, 160 miles, the ship channel accommodates vessels with a draught of $27\frac{1}{2}$ feet, rapidly being increased to 30 feet; below Quebec the river is navigable to vessels of any draught. The lakes, and the river to the point where it crosses the 45th parallel of north latitude in its north-easterly course, form the boundary-line between the Dominion of Canada on the north and the United States of America on the south; thence to the sea the river is wholly within Canadian territory.

The population of the states and provinces bordering on the St Lawrence system was estimated in 1899 to be 35,000,000. In Pennsylvania and Ohio, south of Lake Erie, there are large coal-fields. Surrounding Lake Michigan, and west of Lake Superior, are vast grain-growing plains, and the prairies of the Canadian North-West are rapidly increasing the area and quantity of wheat grown; while both north and south of Lake Superior are the most extensive iron mines in the world, from which $18\frac{1}{2}$ million tons of ore were shipped in 1899. The natural highway for the shipment of all these products is the Great Lakes, and over them coal is distributed westwards and grain and iron ore are concentrated eastwards. The great quantity of coarse freights, that could only be profitably carried long distances by water, has revolutionized the type of vessel used for its transportation, making large steamers imperative, driving out sailing and small steam vessels, consolidating interests, and cheapening methods. With every increase in available draught, larger ships have been built to take advantage of it, and now the bulk of the trade is done in steel steamers of large tonnage, many of which tow barges, also of large size. It is usual for the vessels in the grain trade and in the iron-ore trade to make their up trips empty; but in consequence of the admirable facilities provided at terminal points, they make very fast time, and carry freight very cheaply. The cost of freight per ton-mile fell from $\frac{23}{100}$ cent in 1887 to $\frac{8}{100}$ cent in 1898; in 1899 the rate rose again, because there were not sufficient vessels to handle the freight offered. The large shipping trade is assisted by both the United States and Canadian Governments by a system of aids to navigation that very carefully mark every channel and danger. In 1901 there were on the Great Lakes 437 United States and 191 Canadian lighthouses; and on the river and gulf, 184 Canadian lights, including 11 lightships; besides steam fog-alarms, gas and bell buoys, and buoys and beacons in great numbers. There are also life-saving stations at all dangerous points.

Duluth, at the head of Lake Superior, has rapidly developed into a harbour of great shipping capacity. Other large iron-ore shipping ports on Lake Superior are Ashland, Two Harbours, Marquette, Superior. Fort William, at the mouth of the river Kaministiquia, Thunder Bay, is important as the most westerly point at which the Canadian Pacific Railway strikes the St Lawrence system, and is the outlet for much of the wheat of the Canadian North-West. There are large elevators at this point, and a line of fine Tyne-built passenger steamers runs to Owen Sound. These, and a line of passenger steamers running between Buffalo and Duluth, are equal in accommodation to transatlantic liners.

The river St Mary, 55 miles long, is the only outlet of Lake Superior. From Point Iroquois, which may be considered the foot of the lake to Sault Ste Marie, St Mary's Falls, or St Mary's Rapids, as it is variously called, a distance of 14 miles, there is a single channel, which has been dredged by the United States Government to give a minimum width of 800 feet, and a depth of 23 feet at mean stage water. Below the Sault, the river, on its course to Lake Huron, expands into several lakes, and is divided by islands into numerous contracted passages. There are two navigated channels; the older one, following the international boundary-line by way of Lake George, has a width of 150 to 300 feet and depth of 17 feet; the other, some 12 miles shorter, an artificial channel dredged by the United States Government in their own territory, has a minimum width of 300 feet and depth of 20 feet.

Between Lake Superior and Lake Huron there is a fall of about 20 feet, of which the Sault, in a distance of half a mile, absorbs from 18 to $19\frac{1}{2}$ feet, the height varying as the lakes change in level. The enormous growth of inter-lake freight traffic has justified the construction of three separate locks, each overcoming the rapids by a single lift—two side by side on the United States, and one on the Canadian, side of the river. These locks, the largest in the world, are all open to Canadian and United States vessels alike, and are operated free from all taxes or tolls on shipping. The Canadian ship canal, opened to traffic on the 9th September 1895, was constructed through St Mary's island, on the north side of the rapids, by the Canadian Government, at a cost of $3,684,227, to facilitate traffic and to secure to Canadian vessels an entrance to Lake Superior without entering United States territory. The canal is 5967 feet long between the extremities of the entrance piers, has one lock 900 feet long, and 60 feet wide, with a depth on the sills at lowest known water-level of $20\frac{1}{4}$ feet. The approaches to the canal are dredged to 18 feet deep, and are well buoyed and lighted.[1]

On the United States side of the river the length of the canal is $1\frac{5}{8}$ miles, the channel outside the locks having a varying width of 108 to 600 feet, and depth of 25 feet. The locks of 1855 were closed in 1886, to give place to the Poe lock. The Weitzel lock, opened to navigation 1st September 1881, was built south of the old locks, the approach being through the old canal. Its chamber is 515 feet long between lock-gates, and 80 feet wide, narrowing to 60 feet at the gates. The length of masonry walls is 717 feet, height $39\frac{1}{2}$ feet, with 17 feet over mitre sills at mean stage of water.

The Poe lock, built because the Weitzel lock, large and fully equipped as it is, was insufficient for the rapidly-growing traffic, was opened on the 3rd August 1896; length between gates, 800 feet; width, 100 feet; length of masonry walls, 1100 feet; height, $43\frac{1}{2}$ to 45 feet, with 22 feet on mitre sills at mean stage of water.

The canals are closed every winter, the average date of opening up to 1893 being 1st May, and of closing 1st December. The pressure of business since that time, aided possibly by some slight climatic modification, has extended the season, so that the average date of opening is now ten days earlier, and of closing twelve days later. The earliest opening was in 1898, on 11th April, and the latest closing in 1899, on the 20th December. The following table gives the average yearly commerce for every five years since 1880, and serves to show the rapid increase in freight growth:—

*Statement of the Commerce through the several Sault Ste. Marie Canals, averaged for every Five Years.**

Years.	Passages.	Registered Tonnage.	Passengers.	Coal. Net Tons.	Flour. Barrels.	Wheat. Bushels.	Other Grains. Bushels.	General Merchandise. Net Tons.	Salt. Barrels.	Iron Ore. Net Tons.	Lumber. M. feet B.M.	Total Freight. Net Tons.
1880–84 .	4,457	2,267,166	34,607	463,431	681,726	5,435,601	936,346	81,966	107,225	867,999	79,144	2,184,731
1885–89 .	7,908	4,901,105	29,434	1,398,441	1,838,325	18,438,085	1,213,815	74,447	175,725	2,497,403	197,605	5,441,297
1890–94 .	11,965	9,912,589	24,609	2,678,805	5,764,766	34,875,971	1,738,706	87,540	231,178	4,939,909	510,482	10,627,349
1895–99 .	18,352	18,451,447	40,289	3,270,842	8,319,699	57,227,269	23,349,134	164,426	282,156	10,728,075	832,968	19,354,974
1901 alone	20,041	24,626,974	59,663	4,593,136	7,634,350	52,812,636	24,760,547	558,041	443,774	18,090,618	1,072,124	28,403,065

* Statistical Report of Lake Commerce passing through Canals, published annually by the U.S. Engineer officer in charge.

The outlet of Lake Michigan, which is the only lake lying wholly in United States territory, is near the point where the river St Mary reaches Lake Huron. The level of Chicago, above Lake Michigan, is so slight that much difficulty arose in draining it. A drainage canal has consequently been constructed, 34 miles long, to divert the river Chicago, a small stream which flowed into the lake, into the river Joliet, which flows into the Mississippi. Water was let into the drain in December 1899. The estimated flow through it is 10,000 cubic feet per second. It is proposed to utilize this drainage canal as a ship canal, to give the lakes a freight outlet into the Gulf of Mexico.

Lake Huron empties into Lake Erie through the river St Clair,

[1] Report of Department of Railways and Canals, 1899, pp. 10 and 31.

Lake St Clair, and the river Detroit. On these connecting waters are several important manufacturing and shipping towns, and through this chain passes nearly all the traffic of the lakes, both that to and from Lake Michigan ports, and also that of Lake Superior. It is estimated that the tonnage of a single short season of navigation exceeds in the aggregate 40,000,000 tons. Extensive dredging and embankment works have been carried on by the United States Government in Lake St Clair and the river Detroit, and a 20-feet channel now exists, which is being constantly improved.

The Grand Trunk Railway opened in 1891 a single-track tunnel under the river St Clair, from Sarnia to Port Huron, the only tunnel under the river St Lawrence. It is 6026 feet long, a cylinder 20 feet in diameter, lined with cast iron in flanged sections.

From Buffalo, at the foot of Lake Erie, the river Niagara runs northwards 36 miles into Lake Ontario. Niagara Falls are 23 miles below Buffalo. The river is spanned by five important railway and tramway bridges.

To overcome the difference of 327 feet in level between Lakes Erie and Ontario, the Welland canal, accommodating vessels of 255 feet in length, with a draught of 14 feet, was built, and is maintained, by Canada.

The Murray canal, opened for traffic on 14th April 1890, extends from Presqu'ile Bay, on the north shore of Lake Ontario, a distance of 6½ miles, to the headwaters of the Bay of Quinte, and enables vessels to avoid the open lake navigation. It is 11 feet deep below the lowest lake level, and has no locks.

Trent canal is a term applied to a series of water stretches in the interior of Ontario which are ultimately designed to connect Lake Huron with Lake Ontario. At Peterboro a hydraulic balance-lock, with a lift of 65 feet, 140 feet in length and 33 feet clear in width, allowing a draught of 8 feet, has been constructed. The ordinary locks are 134 by 33 feet, with a draught of 6 feet. When the whole route of 200 miles is completed, there will not be more than 15 miles of actual canal, the remaining portion of the waterway being through lakes and rivers.

The name St Lawrence is first applied to the river where it leaves Lake Ontario at Kingston. The canals on the St Lawrence have been enlarged to the capacity of the Welland and Lachine canals, the system having been opened to commerce in the autumn of 1899. Instead of enlarging the Beauharnois canal, on the south side of the river, a canal, the "Soulanges," was built from Coteau Landing to Cascades Point, on the north side, the Beauharnois canal still being utilized for small barges. The locks of all these canals are 45 feet wide, with an available depth of 14 feet and a minimum length of 270 feet. The following table shows the canalized stretches in this portion of the river:—

Name.	From	To	Length in Miles.	Number of Locks.	Rise in Feet.
Galops .	Head of Galops Rapids	Iroquois	7⅓	3	15½
River .	...	...	4	...	...
Rapide Plat	Head of Ogden Island	Morrisburg	3⅔	2	11½
River .	...	...	10½	...	...
Farrans Point	Head of Croils Island	Farrans Point	1	1	3½
River .	...	...	5	...	...
Cornwall Canal	Dickinsons Landing	Cornwall	11	6	48
Lake St Francis	...	...	30½	...	...
Soulanges	Coteau Landing	Cascades Point	14	4	82½
Lake St Louis	...	...	14	...	...
Lachine .	Lachine	Montreal	8½	5	45
			109½	21	206

The river St Lawrence is spanned by the following railway bridges:—1. A truss bridge, built near Cornwall in 1900 by the New York and Ottawa Railroad. 2. A truss bridge with a swing, built in 1890 by the Canada Atlantic Railway at Coteau Landing. 3. A cantilever bridge, built in 1887 by the Canadian Pacific Railway at Caughnawaga. 4. The Victoria Jubilee bridge, built as a tubular bridge by the Grand Trunk Railway in 1860, and transformed into a truss bridge in 1897–98. The new bridge rests on the piers of the old one, enlarged to receive it, is 6592 feet long by 67 feet wide, with 25 spans, has double tracks, trolley tracks, driveways, and sidewalks, and was erected without interruption of traffic. Between Quebec and Montreal the ship channel, begun by the Montreal Harbour Commissioners, has been assumed by the Government as a national work.

The river St Lawrence is the shortest freight route from the Great Lakes to Europe. From Buffalo to Liverpool *viâ* New York involves rail or 7-foot canal transport of 496 miles and an ocean voyage of 3034 nautical miles. *Viâ* Montreal, there is 14-foot canal transport of 348 miles and river and ocean voyage in transatlantic ships of 2772 nautical miles. From Quebec to Liverpool by Cape Race is 2801 nautical miles, while the route by Belle Isle, more nearly a great circle course, usually taken between July and October, is only 2633 nautical miles. The St Lawrence route suffers in competition with more southerly routes in consequence of not being open throughout the year. The Great Lakes never freeze over completely, but the harbours, and often the connecting rivers, are closed by ice. The navigable season at the Sault is about 7½ months; on Lake Erie it is somewhat longer. The average time between the arrival of the first vessel at Montreal from sea and the departure of the last ocean vessel is seven months. From Kingston to Quebec the river freezes over every winter, except at points where the current is rapid. Below Quebec, although there is heavy border ice, the river never freezes over. For a few winters, while the bridge accommodation at Montreal was restricted to the old single track Victoria bridge, railway freight trains were run across the ice bridge on temporary winter tracks.

Efforts have been made to lengthen the season of navigation by using specially constructed steamers to break ice; and it is claimed that the season of navigation could be materially lengthened, and winter floods prevented, by keeping the river open up to Montreal. Car ferries run through the winter across Lake Michigan and the strait of Mackinac, across the rivers St Clair and Detroit, and across the middle of Lake Erie. The largest of these steamers is 350 feet long by 56 feet wide, draught 14 feet, horse-power 3500, speed 13 knots. She carries on four tracks 30 freight cars, with 1350 tons of freight.[1] Winter ferries are maintained at Quebec, between Prince Edward Island and Nova Scotia, and between Newfoundland and Sydney, Cape Breton. In the winter of 1898–99 an attempt was made to run a winter steamer from Paspebiac to England, but was not successful, principally because an unsuitable vessel was used. To pass through the field ice that is always present in the gulf, in greater or lesser quantity, specially strengthened vessels are required.

The river St Lawrence above tide water is not subject to excessive flooding, the maximum rise in the spring and early summer months, chiefly from northern tributaries from the Ottawa eastwards, being 10 feet. The Great Lakes serve as impounding reservoirs for the gradual distribution of all overflows in the west. At Montreal, soon after the river freezes over each winter, there is a local rise of about 10 feet in the level of the water in the harbour, caused by restriction of the channel by anchor ice; and in the spring of the year, when the volume of water is augmented, this obstruction leads to a farther rise, in 1886 reaching a height of 27 feet above ordinary low water. To prevent flooding of the lower parts of the city a dyke was in 1887 built along the river front, which prevented a serious flood in 1899.

The level of the lakes varies very gradually, and is affected by the general character of the season, and not by individual rainfalls. The variations of level of the several lakes do not necessarily synchronize. There is an annual fluctuation of about 1 foot in the upper lakes, and in some seasons over 2 feet in the lower lakes; the lowest point being at the end of winter and the highest in midsummer. In Lake Michigan the level has ranged from a maximum in the years 1859, 1876, and 1886, to a minimum, nearly 5 feet lower, in 1896.[2] In Lake Ontario there is a range of 5½ feet between the maximum of May 1870 and the minimum of November 1895. In consequence of the shallowness of Lake Erie, its level is seriously disturbed by a persistent storm; a westerly gale lowers the water at its upper end exceptionally as much as 7 feet, seriously interfering with the navigation of the river Detroit, while an easterly blow produces a similar effect at Buffalo. There is geological evidence to show that the whole basin of the lakes has in recent geological times gradually changed in level, rising to the north and subsiding southwards; and it is claimed that the movement is still in gradual progress, the rate assigned being ·42 foot per 100 miles per century.[3]

The maintenance of the levels of the Great Lakes is a matter of vital importance to the large freight boats, which always load to the limit of depth, at critical points in the dredged channels or in the harbours. Fears have been entertained that the water-power canals at Sault Ste Marie, the drainage canal at Chicago, and the dredged channel in the river Detroit will permanently lower the levels respectively of Lake Superior and of the Michigan–Huron–Erie group. An international deep-waterway commission considered this question, and army engineers appointed by the United States

[1] *Trans. Royal Soc. Canada, 1898–99*, vol. iv. sec. iii. T. C. KEEFER on *Ice Floods and Winter Navigation of the St Lawrence.*

[2] Appendices CCC and DDD to the Annual Report of the Chief of Engineers U.S. Army, 1897.

[3] Eighteenth Annual Report U.S. Geological Survey, 1896–97.

Government worked on the problem.[1] Wing dams in the rivers St Mary and Niagara, to retard the discharges, were proposed as remedial measures.

The Great Lakes are practically tideless, though some observers claim to find true tidal pulsations, said to amount to 3½ inches at spring tide at Chicago. Secondary undulations of a few minutes in period, ranging from 1 to 4 inches, are well marked. Tides enter the Gulf of St Lawrence from the Atlantic chiefly through Cabot Strait (between Cape Breton and Newfoundland), which has a width of 75 miles and a depth of 250 fathoms. The tide entering through Belle Isle Strait, 10 miles wide and 30 fathoms deep, is comparatively little felt. The tidal undulation, in passing through the gulf, expands so widely as to be almost inappreciable in places, as, for example, at the Magdalen Islands, in the middle of the gulf, where the range amounts to about 3 feet at springs, becoming effaced at neaps. There is also little more tide than this at some points on the north shore of Prince Edward Island. The greatest range is attained locally in Northumberland Strait and in Chaleur Bay, where it amounts to 10 feet. At the entrance to the estuary of the river St Lawrence, at Anticosti, it has again the oceanic range of about 6 feet, and proceeds up the estuary with an ever-increasing range, which attains its maximum of 19 feet at the lower end of Orleans Island, distant 650 miles from the ocean at Cabot Strait. This must be considered as the true head of the estuary. At Quebec, 30 miles farther up, the range is nearly as great; but at 40 miles above Quebec it is largely cut off by the Richelieu Rapids, and finally ceases to be felt at Three Rivers, at the lower end of Lake St Peter, 760 miles from the ocean.

The St Lawrence system is rich in water-powers, which are being increasingly utilized, and promise to add greatly to the resources of both countries. The river at Sault Ste Marie has been diverted into power canals on both sides, and furnishes electric light, traction, and power to both towns, and operates a very large pulp mill. The Niagara at the Falls is led through tunnels on both sides of the gorge, and electricity at a very high voltage is supplied to Buffalo, 22 miles distant, as well as being used locally. The St Lawrence Rapids have long been utilized for milling and factory purposes; a wing dam on the north side of the Lachine Rapids furnishes electricity to Montreal; the Falls of Montmorency light Quebec and run her street cars; and from Lake Superior to the gulf there are numerous water-powers on tributaries to the St Lawrence, only awaiting population and capital for profitable development.

The Great Lakes are well stocked with fish of commercial value. These are largely gathered from the fishermen by steam tenders, and taken fresh or in a frozen condition to railway distributing-points. In Lakes Superior and Huron salmon-trout (*Salvelinus namaycush*, Walb) are commercially most important. They ordinarily range from 10 to 50 ℔ in weight, and are often larger. In Georgian Bay the catches of whitefish (*Coregonus clupeiformis*, Mitchill) are enormous. In Lake Erie whitefish, lesser whitefish, erroneously called lake-herring (*C. artedi*, Le Sueur), and sturgeon (*Acipenser rubicundus*, Le Sueur) are the most common. There is good angling at numerous points on the lakes and their feeders. The river Nepigon, on the north shore of Lake Superior, is famous as a stream abounding in speckled trout (*Salvelinus fontinalis*, Mitchill) of unusual size. Black bass (*Micropterus*) are found from Georgian Bay to Montreal, and the Maskinongé (*Esox nobilior*, Le Sueur), plentiful in the same waters, is a very game fish that often attains a weight of 70 ℔. Nearly all the rivers flowing into the St Lawrence below Quebec are stocked with salmon (*Salmo salar*), and are preserved and leased to anglers by the provincial government. In the salt water of the gulf and lower river, mackerel, cod, herring, smelt, sea-trout, striped bass, and other fish are caught for market. (W. P. A.)

St Leonards, a parish of Sussex, England, on the south coast, included in the municipal borough of Hastings. Population (1881), 7165; (1891), 10,283; (1901), 26,872. (See HASTINGS.)

St Louis, the most important city in the state of Missouri and the 4th in size in the United States, situated on the right, or west, bank of the river Mississippi, about 20 miles below its junction with the Missouri, in 38° 38′ 3–6″ N. and 90° 12′ 17″ W. It has an area of 62½ square miles and a river front of 19 miles. Twenty lines of railway have their terminus in the Union station, which covers 11 acres and was opened in September 1894. The cost of the station, including the site, was $6,500,000. The lines from the east cross the Mississippi by Eads Bridge, which was opened for traffic 4th July 1874, and also by Merchants' Bridge, 3 miles above the former, which was finished in 1890 and is controlled by the Terminal Railway Company. An Act of the legislature, passed in 1899, authorized the consolidation of nearly all the rapid transit lines within the city. A single company owns and controls 361 miles of single track, and runs about 2000 cars. By a system of transfers, passengers can go from almost any point in the city to another upon payment of one fare. The suburban system owns 100 miles of single track, and its equipment includes 200 cars.

Population.—The population in 1890, not including any suburban locality, was 451,770, an increase of 28·89 per cent. over that of 1880. In 1900 it was 575,238, an increase of 27·33 per cent. over that of 1890. In 1900 the foreign-born population numbered 111,356, and the native white population born of foreign parents was 239,170. The total number of negroes, or persons of negro descent, was 35,516. The death-rate by the census of 1890 was 17·4. In 1900 it was 17·9, being nearly 90 per cent. higher among the coloured than among the white population. The birth-rate by the census of 1890 was 26·46 per 1000 for white persons and 26·36 for coloured persons.

Education, Libraries, &c.—The number of public schools in 1901 was 188; the number of teachers, 1751; the number of pupils, 82,712. The total amount expended for school purposes in 1899 was $1,888,670.22, and the estimated value of all public school property, including that held for investment, was $6,803,704. During the year 1899 and the spring of 1900 Washington University, an endowed non-sectarian institution, increased its endowment fund by more than $4,000,000, and began preparations for removal to a new site comprising 150 acres on the outskirts of the city. The land, which cost about $350,000, the fund for the new buildings, amounting to $750,000, and the increased endowment, were the gifts of citizens of St Louis. The St Louis University, belonging to the Roman Catholic order of Jesuits, occupies large and commodious buildings in the city, and is one of the most important institutions of learning controlled by that religious body in the United States.

St Louis has a large number of clubs for social and business purposes, chief among which are the St Louis, the University, the Mercantile, the Noonday, the Union, the Commercial, and the Round Table. The Mercantile library contains upwards of 112,000 volumes. The public library contains 135,000 volumes.

Municipal Affairs, Taxation, &c.—The bonded debt at the end of the fiscal year 1900–1901 amounted to $18,916,278. The annual interest charges on the debt outstanding 10th April 1899 amounted to $802,209, or an average of 4·367 per cent. per annum. The resources of the sinking fund for the fiscal year 1898–99 amounted to $361,783, and this money was used in returning to the treasury the sum advanced during the year 1897–98, and in the redemption of bonds maturing during the year 1898–99. The assessed valuation of property for the taxes of 1901 was $394,722,700, not including the street railway property, the assessment on which is made by the state board of equalization. The rate of taxation on the $100 valuation of property for 1901 for municipal purposes was $1.90. In 1887 the city council authorized the extension of the water-works system, and established a low-service station at the Chain of Rocks, several miles above the former station. This work was put into operation during 1894. Since that time an extension of the high-service pumping plant has been authorized, and plans are on foot for a plant to filter all water before it is delivered. The extended works are able to furnish 100 million gallons of water a day.

Commerce and Manufactures.—Foreign shipments of flour and grain by rail and river on through bills of lading during the year 1901 were: of flour, 2,961,563 barrels; of wheat, 16,922,890 bushels; of corn, 14,942,915 bushels; of oats, 6,219,540 bushels; cotton, 973,837 bales. The total value of the gross receipts of

[1] Report of the Chief of Engineers U.S. Army in Report of War Department U.S., 1898, p. 3776.

cotton for 1901 was about $40,000,000. Among other receipts for 1901 were: lumber and logs, 824,201,000 feet; wool, 25,877,110 ℔; sugar, 253 hhds., 465,246 barrels, 534,576 bags; coal, 4,407,890 tons; butter, 13,476,929 ℔. The total number of tons of freight of all kinds received and shipped was 28,758,664. St Louis produces more than three-fourths of all the manufactures of the state of Missouri. The estimated product of the manufactures of St Louis for 1901 is valued at $340,000,000, of which the following are the chief: tobacco, 80,766,883 ℔; flour, 1,505,234 barrels; furniture of the value of about $33,000,000. Boots and shoes have been sold valued at $43,500,000; bagging, 12,500,000 yards.

Banking.—The number of banks in St Louis has been reduced by consolidation from twenty-five in 1896 to nineteen in 1901; the total capital has, however, been increased. There are eight trust companies. In 1901 the bank deposits increased to $788,801,986, and those in the trust companies increased to $19,016,293. The total capital of the nineteen banks in December 1901 was $30,059,963, and of the trust companies, $29,278,007. The dividends paid by both banks and trust companies in 1901 amounted to $2,604,000, an increase of $619,000 over those of 1900. The clearings for 1901 exceeded those of any previous year by $562,830,722, aggregating $2,270,680,216. The balances for the year 1898 were $182,014,792, and for 1899, $214,166,941.

Political Parties.—The city several years gave a decided majority to the candidates of the Republican party in municipal, state, and Federal elections, although the state of Missouri was Democratic by a large majority for many years. The city, however, gave a majority to the candidates of the Democratic party in 1901. The vote for Presidential electors in 1896 was as follows: for Republican electors, 65,708; for Democratic electors, 50,091; in 1900, for Republican electors, 60,597; for Democratic electors, 59,931. In the election of a state supreme judge in 1898 the vote was as follows: for the Republican candidate, 48,900; for the Democratic candidate, 39,697.

AUTHORITIES.—*Encyclopædia of the History of St Louis*, a compendium of history and biography, in four volumes, published in 1899. A Blue Book is published yearly by the Merchants' Exchange, compiled by its secretary, dealing with the business progress of the year. (M. S. S.)

St Lucia, the largest of the British Windward Islands, West Indies. Population (1891), 42,220; (1901), 49,895. Of these, a small percentage are of European descent, but the majority are negroes, with about 2000 East Indian coolies. The death-rate is about 22·50 per 1000. The dangers from venomous reptiles have been exaggerated. Only one death from snake-bite was recorded in 1898, none in 1900; and snakes are now but rarely met with.

The climate is humid; the rainfall varying from 70 to 120 inches per annum, with a very uniform average temperature of about 80° F. In 1899 the highest temperature was 91° (in May) and the lowest 68° (in December). Great damage was done on 11th September 1898 by a hurricane and the accompanying rains—steep hillsides, surcharged with water, slid away in all directions, carrying with them plantations, houses, roads, and bridges, and leaving rocks and rubbish behind. Castries, the capital (with a population of about 7900), by reason of its harbour, wharfage, and coaling facilities, is the second naval station and one of the most important shipping ports in the British West Indies. It is strongly fortified, and is the chief coaling station of the fleet in the West Indies. It is in telephonic communication with seven small towns or villages. Crown lands occupy about one-half of the island. Amongst the principal products are sugar, cacao, logwood, coffee, nutmegs and mace, kola nuts, and vanilla. Tobacco is grown, but not for export. The imports of 1900 were valued at £403,592, largely owing to increased importation of military stores, the total of 1899 having been only £282,693; the exports at £229,436, of which £55,561 was for sugar. Revenue (1900), £72,107; expenditure, £64,750; public debt in 1901, £176,680. In 1900, at Castries, 1240 steam vessels and 617 sailing vessels entered and cleared, giving a total tonnage of 1,841,593, of which 82 per cent. was British. Of the total trade values in 1900, the United Kingdom sent 55 per cent. of the imports and the United States 31 per cent.; while the former took 26 per cent. of the exports, but the United States 71 per cent.

In 1900 there were 42 state-aided elementary schools under the control of the Roman Catholics, to whom were handed over all the Government schools in 1898. The number of children on the roll in 1900 was 6365, and the amount spent on primary education was £3138. There are also a grammar school for boys and a high school for girls. The military expenditure for 1898 was £54,385. There is a police force numbering 59, with a rural constabulary of 100. Knowledge of the English language is increasing amongst the country people, who formerly spoke a French patois, the result of frequent French occupation of the island.

St Malo, chief town of arrondissement, department Ille-et-Vilaine, France, 43 miles north-north-west of Rennes, with terminal station on the railway from Rennes. Shipbuilding, engineering, and iron and copper founding are the most important industries. The harbour, including the contiguous and connected basins belonging more especially to St Servan, comprises an outer basin, a tidal harbour, two wet docks, and an inner reservoir, affording a total length of quayage of over two miles. The inner harbours have a minimum depth of 18 feet, but in the tidal harbours the depth at low water is *nil*. The number of vessels entered in 1900 was 784, of 208,080 tons; cleared 791, of 217,083 tons. Nearly all the trade is with England. The total port movement, including coasting trade, was 509,051 tons; 37 vessels with 824 men were engaged in the cod fishery. The number of passengers arriving by regular lines of vessels in 1900 was 10,271, and of departures, 9530. Population (1881), 9432; (1901), 11,486. The trade and industries of St Servan are of the same nature as those of St Malo, but are on a much smaller scale. Population (1881), 9583; (1901), 12,597.

St Marys, a village of Auglaize county, Ohio, U.S.A. It is on the Lake Erie and Western Railroad, and on the Miami and Erie canal, in the western part of the state. Population (1890), 3000; (1900), 5359, of whom 246 were foreign-born.

St Michael, Alaska Territory, formerly Redoubt St Michael, a settlement on an island of the same name, founded by Tebenkoff in 1833, is situated at the southern end of Norton Sound in 63° 28′ N. and 162° 05′ W. Since the discovery of gold on the Yukon, this place has been garrisoned by the United States army, and forms the centre of a military reservation with a radius of 100 miles. The island is low, volcanic, and covered with herbage. It derives its importance from the fact that it is the only port for Yukon commerce. This is carried on through a channel called the Uphoon, available for light draught vessels, behind the bar of the main river. It has a population of about 400 Eskimo natives, and a variable number of whites, which at times has amounted to several thousands. Thirty-five river steamers in 1899 were engaged in the river traffic from this place, and the commerce amounted to several millions of dollars. Navigation opens in June and closes in September. The annual mean temperature is 26·6° F. and the rainfall about 12 inches. The discovery of rich gold fields at Cape Nome, on the north shore of the Sound, attracted a temporary population estimated at 5000. The permanent population was reported by the United States census of 1900 as 857; in 1890 it was 101.

St Nazaire, chief town of arrondissement, department of Loire-Inférieure, France, 37 miles west of Nantes by rail. The parish church was completed in 1891. The Institut Verneuil established at La Baule is an

important sanatorium. The shipbuilding yards of the Transatlantic and Loire Companies, where are built large ships for the navy as well as for the mercantile marine, employ about 2500 men. Three dry docks are leased from the French Government. Forges, at a little distance from the town, employ 1600 men, and turn out large quantities of steel rails, sheet and bar iron, &c. There are also several large flour-mills and steam saw-mills. Great improvements have been effected in the port. A channel was dredged at the mouth of the river in 1892–93, sufficient to admit the passage of battleships. The old basin was considerably deepened, and has a depth on sill, high spring tides, of 30½ feet; an entrance with a minimum depth of 16 feet affords direct access from the roads to the old dock. There is regular communication with Newhaven. In 1900, including coasting trade, 807 vessels of 776,059 tons entered, and 832 of 786,403 tons cleared. The total port traffic, including coasting trade, amounted to 1,930,980 tons. The value of the imports was £2,608,000, and of the exports £3,488,000. The principal exports are woollen fabrics, wines and spirits, fruits, vegetables, sardines, silk goods, poultry, &c., and coffee. Foreign trade is chiefly with England, and the import of coal from Great Britain exceeded 1,000,000 tons. There are several stations much visited by the English and Americans for sea-bathing and as health resorts, especially La Baule and St Marguérite. The air in this district is noted as remarkably health-giving. At Fort de Lève are subterranean batteries. Population (1881), 15,843; (1901), 35,813.

St Omer, chief town of arrondissement, department of Pas-de-Calais, France, 42 miles north-west of Arras, on the railway from Paris to Calais. The fortifications have been demolished, making way for important alterations and improvements begun in 1892. Population (1881), 17,404; (1901), 20,867.

Sainton, Prosper Philippe Catherine (1813–1890), French violinist, was the son of a merchant at Toulouse, where he was born 5th June 1813, and educated at the college of his native town. He entered the Paris Conservatoire under Habeneck in 1831, and after gaining various prizes and undertaking a successful tour, became professor of the violin in the Conservatoire of Toulouse. In 1844 he made his first appearance in England, at a Philharmonic concert directed by Mendelssohn, and settled in London in the following year, in the course of which he was appointed professor at the Royal Academy of Music. In the early organizations for chamber music which culminated in the establishment of the Popular concerts, Sainton bore an important part; and when the Royal Italian Opera was started at Covent Garden, he led the orchestra under Costa, with whom he migrated to Her Majesty's Theatre in 1871. From 1848 to 1855 he was leader of the Queen's Band, and in 1862 he conducted the music at the opening of the International Exhibition. Two years before this, in 1860, he had married the famous contralto singer, Miss Charlotte Dolby. He was leader of the principal provincial festivals for many years, and gave a farewell concert at the Albert Hall in 1883, dying on 17th October 1890. His method was sound, his style artistic, and his educational work of great value, the majority of the most successful orchestral violinists having been his pupils. (J. A. F. M.)

Sainton-Dolby, Charlotte Helen (1821–1885), English contralto singer, was born in London 17th May 1821, studied at the Royal Academy of Music from 1832 to 1837, Crivelli being her principal singing-master. In 1837 she was elected to a king's scholarship, and first appeared at a Philharmonic concert in 1841. In October 1845 she sang at the Gewandhaus, Leipzig, through the influence of Mendelssohn, who had been delighted by her singing in *St Paul*. The contralto music in his *Elijah* was written for her voice, but she did not appear in that work till the performance at Exeter Hall on 16th April 1847. She married M. Sainton in 1860, and in 1870 she retired from the career of a public singer, but two years afterwards started a "vocal academy" in London. She made various successful attempts as a composer, and the cantatas "The Legend of St Dorothea" (1876), "The Story of the Faithful Soul" (1879), and "Florimel" (1885), enjoyed considerable success. Her last public appearance was at her husband's farewell concert in June 1883, and she died 18th February 1885. A scholarship in her memory was founded at the Royal Academy of Music. Her voice was of moderate power and of fine quality, but it was her dignified and artistic style that gave her the high place she held for so many years both in oratorio and ballads.

(J. A. F. M.)

St Ouen, town in the department of Seine, France, 1 mile north of the fortifications of Paris. Besides other important industries, it has manufactures of firearms (military and sporting), tinned foods, indiarubber goods, perfumery, soap, blacking, varnish, printers' ink, with glass works, sugar and saw mills, and distilleries. Population (1901), 35,351.

St Paul, one of the "twin" cities of Minnesota, U.S.A., situated in 44° 52′ 46″ N. and 93° 5′ W., on the river Mississippi. With Minneapolis it constitutes the centre of the commercial life of the North-West. The population in 1895 was 140,292; in 1900 it was 163,632, of whom 46,819 were foreign-born, and 2263 were negroes. Out of 51,027 adult males, 1351 were illiterate (unable to write), of whom 1225 were foreign-born. The birth-rate was 14·80 and the death-rate (1900) only 9·7 per thousand. The public school system has 49 buildings and employs 534 teachers. Pupils enrolled in 1899 numbered 24,344. The other educational institutions are enumerated in the article on MINNEAPOLIS. St Paul has 167 churches, a public library of 47,000 volumes, 29 parks aggregating 560 acres, not including New Phalen Park of 600 acres, and many miles of boulevards, and 103 miles of electric and cable street railways. Fifty-six newspapers and periodicals are published. There are 5 national banks, 8 state banks, 4 savings banks, and 13 trust companies. The aggregate capital of these institutions is $5,559,000. St Paul is distinctively a commercial city; its jobbing interests in 1898 did a business amounting to $168,000,000. It possesses the largest boot and shoe and clothing manufactures in the west. According to the United States census of 1900, there were in St Paul 1591 manufacturing concerns. The capital invested amounted to $28,208,389, the number of persons employed was 17,593, and the product $38,541,030. St Paul is the head of navigation on the Mississippi; but the channel will be extended to Minneapolis by dams and locks. The assessed valuation of real and personal property in 1900 was $86,637,646. The tax upon this amount was 22·40 mills on the dollar. A total debt of $8,404,035 rests upon the city, but a considerable part of this amount consists of water bonds issued to build a water-works system. The city government is what is called the board type. The cost of maintenance is about $2,150,000 each year. (F. L. McV.)

St Peter Port. See CHANNEL ISLANDS.

St Petersburg, a government of north-western Russia, at the head of the Gulf of Finland, stretching for

130 miles along its south-east shore and the southern shore of Lake Ladoga, and bordering on Finland, with an area of 20,760 square miles. It is hilly on the Finland border, but flat and marshy elsewhere, with the exception of a small plateau in the south (Duderhof Hills), which rises only from 300 to 550 feet. It has a damp and cold climate, the average temperatures being: at St Petersburg, for the year 39° F., for January 15°, for July 64°; yearly rainfall, 18·7 inches; at Sermaksa (60° 28′ N.), for the year 37°, for January 13°, for July 62°; yearly rainfall, 20·8 inches. The population, which was 635,780 in 1882, numbered 873,043 (census population, domiciled only) in 1897, without the capital and its suburbs. Of this latter number 466,750 were women and 160,499 lived in towns. The average density was 122 per square mile. The population is chiefly composed of Russians, with a small admixture of Finns and Germans, and according to religion it is distributed as follows: Greek Orthodox, 78 per cent.; Nonconformists, 1·6 per cent.; Lutherans, 17 per cent.; Roman Catholics, 2·4 per cent.; "others," 1 per cent. A remarkable feature is the very slow natural increase of the population. Up to 1884 there was even an excess of deaths, and it is only since 1886 that a small yearly excess (4922) of births over deaths has been noticed; thus during the 25 years 1867 to 1891 the natural increase of the population was only 867. This is easily explained, however, by the fact that large numbers of both men and women (especially young girls) are continually moving into the capital. The Government is divided into eight districts, the administrative headquarters of which are: St Petersburg (see below), Gdov (2254 inhabitants), Luga (5687), Novaya Ladoga (4144), Peterhoff (1130), Schlüsselburg (5285), Tsarkoye Selo (23,353), and Yamburg (4166). The other towns are: Gatchina (14,735), Narva (16,577), Oranienbaum (5333), Pavlovsk (4949), Okhta, Kolpino (12,030), Pulkova, and Krasnoye Selo. Most of the towns are summer resorts for the population of the capital. Till the latter part of the 19th century education stood at a very low level, but progress has since been made, and now three-quarters of all who enter the army from the province can read. There were in 1898, 875 primary schools, with 45,500 pupils, which means that more than one-half of all children of school age went to school. The local *zemstvo* (council) has also organized village libraries and lectures on a wide scale. Many improvements have been made, especially since 1897, in the sanitary organization of the province. The *zemstvo* maintains 144 hospitals and dispensaries, with 626 beds, 64 doctors, 144 assistants, and 41 midwives. Out of an area of 10,806,000 acres (still excluding the capital and suburbs), 29 per cent. was owned by the village communities in 1896, and 8 per cent. by the peasants, the remainder being private property, distributed as follows: nobles, 31 per cent.; merchant class, 9 per cent.; Imperial domains, 3 per cent.; members of the Imperial family in private, 3 per cent.; State, 9 per cent.; artisans, &c., 8 per cent. Generally speaking, agriculture stands at a low ebb. There were in 1898, 590,000 acres under cereals (rye, oats, and barley), 43,000 acres under potatoes, and 30,000 acres under green crops, the total area under cultivation being 972,000 acres. The average yield in 1895–99 was: rye 1,941,300 cwt., wheat 17,000 cwt., oats 1,553,000 cwt., barley 386,800 cwt., potatoes 4,400,000 cwt. These crops, which are often ruined by heavy rains in the late summer, are insufficient for the population, which has to live on imported grain. Flax is cultivated to some extent. There were in 1898, 132,500 horses, 192,700 horned cattle, 106,900 sheep, and 22,400 pigs. Dairy-farming is developing. Timber, shipping, quarrying, and fishing are important industries; and the chief factories are paper mills, chemical works, and printing works, but the aggregate returns of all factories amount only to 16,000,000 roubles per annum.

St Petersburg, the capital of the Russian empire, situated at the head of the Gulf of Finland, at the mouth of the Neva, in 59° 56′ N. and 30° 40′ E. It was formerly generally believed that in consequence of the gradual upheaval of land in the Gulf of Finland there would be no more inundations such as occurred in the 18th century and early in the 19th century. There has, indeed, been no very disastrous inundation since that of 1824, but in 1890, 1897, and 1898 the waters of the Neva rose over 8 feet, whereas a rise of 4 feet is sufficient to flood the lower parts of the city, and in the terrible year of 1824 the rise was 14 feet. Consequently, the question whether it would not be advisable to protect the whole of the capital by means of dams has again been raised, and is being seriously considered. Being still partly built of wood, St Petersburg continues to suffer a great deal from fire, the average yearly loss being estimated at from 2,000,000 to 3,000,000 roubles. Electricity is in fair progress, but half of the city continues to have only paraffin oil lamps in the streets. A great number of handsome buildings and wide new streets have been built, and various monuments have been erected to the best Russian writers.

The population of St. Petersburg proper at the five censuses specified was as follows:—

Year.	Total.	Men.	Women.	Proportion of Men to every 100 Women.
1864 .	539,122	313,443	225,679	139
1869 .	667,207	377,380	289,827	130
1881 .	861,303	473,229	388,074	122
1890 .	954,400	512,718	441,682	116
1897 .	1,132,677	616,855	515,822	119

A further increase was revealed by the municipal census of 26th December 1900, when the population of the city was 1,248,739, having thus increased 39·3 per cent. in ten years. The population of the suburbs was 134,710 in 1897, and in 1900, 190,635. Taken with its suburbs, St Petersburg is the 5th city of Europe in point of size, coming after London, Paris, Berlin, and Vienna. The large proportion of men in its population is due to the fact that great numbers come from other parts of Russia to work during the winter in the textile factories, and during the summer at unloading the boats. The consequence of this periodical inflow is that though among children up to 10 years of age the female population is the more numerous (only 97 boys to each 100 girls), among those from 10 to 20 years old the proportion is reversed, and becomes 152 men to each 100 women, while among those aged from 20 to 40 years it is 134 men to each 100 women. After that age the proportion of males rapidly decreases, being only 89 men to each 100 women among those of from 40 to 60 years old. The proportion of strangers to those who are born at St Petersburg itself is as 2 to 1; in 1897 the population included 135,717 males and 168,013 females, total 303,730, born at St Petersburg, while the number of persons born elsewhere was 377,001 males and 273,669 females, total 650,670. The influence of the influx of adult people is seen in this connexion also, for among children the proportion of strangers is only from one-eighth to one-fourth, while among those from 21 to 55 years of age it is as 4 and even 5 to 1. The peasants form more than half the population; and this proportion is likely to increase, for in 1869 they formed only 32 per cent. of the population, in 1881 42 per cent., in 1890 50 per cent., and in 1897, all told, 58 per cent. The census of 1890 also showed that more than one-half of the population (56 per cent.) was engaged in industries and trade, 16 per cent. in the service of the State, State and other companies, and the liberal professions, and 14 per cent. in domestic service, while 7 per cent. received their income from rents and pensions, and 7 per cent. had no definite occupation. The predominance of adult workers is again shown by the very small proportion (338 per thousand) of persons supported by the incomes of others. Russians numbered 828,354 in 1897, or 87 per cent. of the population; Germans 43,798, or 4·6 per cent.; Poles 22,307, or 2·3 per cent.; Finns 16,731, or 1·8 per cent.; and Jews

10,353, or 1 per cent. Of the remainder, the subjects of foreign nations are chiefly Germans, French, English (1881), Austrians, and Swedes. The number of marriages is very low, being only six per thousand in the years 1894–98, births numbered 29 per thousand, and deaths 25·2. The proportion of illegitimate children is nine times higher than in the rest of Russia, namely, from 250 to 286 per thousand births. It is thus nearly the same as in Paris, but lower than in Moscow (292 per thousand) and Vienna (349 per thousand). Out of each thousand women, 424 had their first child illegitimate. The mortality varies very much in the different parts of the city—from 12 per thousand in the best situated, the Admiralty quarter, to 16 in other central parts, and to 25 and 27 in the outlying quarters. It may be stated, however, that the mortality has notably decreased, as it averaged 36 per thousand in the years 1870 to 1874, and only 27 from 1886 to 1895, and 24 in 1897. Infectious diseases, *i.e.*, tuberculosis, diphtheria, inflammation of the lungs, typhoid, scarlet fever, and measles, are the cause of from 37 to 38 per cent. of all deaths. Disorders of digestion come next, various forms of cholerine, and even cholera itself, being endemic in St Petersburg. The high mortality in certain quarters is largely due to overcrowding and bad water. According to the census of 1890, there were in St Petersburg 142,523 separate sets of apartments, with 315,537 rooms, exclusive of kitchens and halls. This number is evidently quite insufficient; and although nearly 500 large stone houses and 500 wooden houses are added every year, the rents run very high, while nearly 50,000 persons live in underground rooms—most insanitary on account of the low ground upon which the city is built. The city is supplied with water from the Neva, which early analyses appeared to show was quite pure. From analyses made in 1893–98, however, it would seem that even the water that is drawn from the middle of the river, at the head of the delta, contains bacteria in far greater numbers than may safely be permitted in drinking-water, and that the powerful filters through which the water supplied to the better parts of the city is passed soon become choked with the germs. So impure, indeed, was the water shown to be, that the wealthier inhabitants of St Petersburg have their water brought in casks from the Duderhof heights. The average daily municipal supply of water was 59,900,000 gallons in 1898, and 65,311,000 gallons in 1899. For sanitary purposes, the city is divided into twenty-one districts, in each of which the municipality maintains one doctor (usually female) and several assistants, while the schools are regularly visited by twenty-eight municipal doctors. Six municipal laboratories are maintained for sanitary purposes.

Water supply. Sanitation.

Justice.

Justices of the peace, though abolished in Russia generally, are still maintained in a few large cities, including St Petersburg, and the city is divided into fifty-two justice of the peace districts. The number of persons arrested during the year 1898 was 128,895, of whom only 46,496 were arrested for crimes, while no less than 54,645 were only charged with breaches of the passport regulations and 18,528 with begging in the streets. Only 12,785 were condemned, 11,048 by the justices of the peace and the remainder by the courts of justice. St Petersburg contains two monasteries, and 247 churches and chapels of all denominations, including Jewish synagogues and Mussulman temples. It is also a great educational centre, to which youths flock from all parts of the empire. It has universities and high schools for male pupils, with an aggregate of 12,000 students; yet this number is so insufficient that there were, in 1897, 3612 applications for admission to the technical institutes, and only 711 vacancies. There is one medical academy for women, with 1630 students in 1900, one university with 839 students, and four other institutions for the higher education of women with 631 students, as also a school for agricultural education (50 students). For secondary education there were for boys sixty-six gymnasia, lyceums, military schools, and technical schools, with 16,000 pupils; and for girls sixty-two lyceums and high schools, with 9690 pupils. The Musical Conservatory has 870 pupils (522 women). The primary schools are in a far less satisfactory condition, as in 1898 there were only 600 schools, with nearly 40,000 pupils, out of which 341 schools, with 20,000 pupils, were kept by the municipality. Six libraries for the people are maintained by the municipality. Of the several modern museums the Historical Museum of Alexander III. deserves special mention. The number of scientific, literary, artistic, musical, and other societies is very great, and grows every year. St Petersburg is a great centre for printing, publishing as many books as Moscow. It contained in 1899, 60 printing offices, 30 lithographic establishments, 140 typo-lithographic offices, 95 photographic establishments, 141 book shops, and 55 public libraries. No fewer than 319 newspapers and reviews (including 25 dailies and 122 monthly reviews), that is, 38 per cent. of all periodical publications published in Russia, were issued at St Petersburg. It is estimated that all these publications represent an aggregate of 1,700,000 copies, and that every year no less than 134,000,000 separate numbers of different periodicals are issued. Nearly two-thirds of these go to the provinces. Philanthropic societies numbered 334 in 1898, and maintained 638 different institutions. They owned a capital of nearly 160,000,000 roubles, and their aggregate yearly income was estimated at over 2,000,000 roubles. No less than 107,000 persons applied to these institutions for assistance during 1898. The Foundling House and the institutions of the Empress Marie, the Imperial Philanthropic society, the Red Cross society, the Merchants' society, the Blue Cross society, the society of cheap restaurants and tea shops, and the society for supplying reading in the hospitals, are the most worthy of mention. The city and different philanthropic institutions maintain fifty-one hospitals, with nearly 14,000 beds, giving every year relief to about 75,500 persons.

Churches. Education.

The Press.

Charities.

Industries.

From 1880 to 1890 was a very critical period in the history of the northern capital. With the development of the railway system, the southern and south-western provinces of Russia began to prosper more rapidly than the Upper Volga provinces; St Petersburg began to lose its relative importance in favour of the Baltic ports of Riga and Libau, and its rapid growth since the Crimean war seemed in danger of being stayed. The danger, however, passed away, and in the last decade of the 19th century it continued its advance with renewed vigour. A great influx of functionaries of all sorts, consequent upon the State taking into its hands the administration of railways, spirits, &c., resulted in the rapid growth of the population, while the introduction of a cheap railway tariff, and the subsidizing and encouraging in other ways of the great industries, attracted to St Petersburg a considerable number of workers, and favoured the growth of its larger industrial establishments. At the present time the province of St Petersburg—that is, properly speaking, the capital—is one of the foremost industrial provinces in Russia, its yearly returns amounting to 289,616,000 roubles, and placing it immediately after Moscow (380,000,000 roubles), and before Piotrków, in Poland (257,000,000 roubles). Out of a population in the capital of 954,400 in 1890, 218,354 were employed in industrial work of all sorts. Factories employed, in 1894, 75,775 workpeople (as against 26,000 only in 1866), of whom 51,095 were men and boys, 24,313 women and girls, and 367 children below 10 years of age. The chief factories were: cottons (17,092 workpeople, yearly returns 37,500,000 roubles), other textiles (7909 workpeople, yearly returns 18,640,000 roubles), metal and machinery works (18,155 workpeople, yearly returns 32,303,000 roubles), tobacco (10,090 workpeople, yearly returns 14,553,000 roubles), paper (2421 workpeople, yearly returns 4,414,000 roubles), soap and candles (2820 workpeople, yearly returns 6,478,000 roubles), breweries (2168 workpeople, yearly returns 6,346,000 roubles), distilleries (1953 workpeople, yearly returns 7,888,000 roubles), pastry and confectionery (1460 workpeople, yearly returns 3,159,000 roubles), chemicals (1314 workpeople, yearly returns 4,455,300 roubles). In all there were 503 factories, with 75,775 workmen, and yearly returns amounting to 173,000,000 roubles. These figures, however, must be below the actual ones, because it was found that 94 public companies showed returns of 204,500,000 roubles in 1898, and there are, besides, over 8000 workshops and small factories showing yearly returns of 73½ million roubles. Trade gave occupation in 1890 to 60,200 persons, and the 12,006 large shops and commercial enterprises showed in 1894 an aggregate return of 1,787,578,600 roubles. The export trade of St Petersburg is chiefly in grain (especially rye and oats), flour and bran, oil seeds, oil cakes, naphtha, eggs (271,236,000 in 1899), flax, and timber. It shows very great fluctuations, varying in accordance with the crops, and was valued during 1895–99, at from 73,000,000 roubles to 96,000,000 roubles. The exports are almost entirely to western Europe by sea (from 52,000,000 roubles to 62,500,000), and to Finland (from 15,000,000 to 27,000,000 roubles). The imports consist chiefly of coal, metals, building materials, herrings, coffee and tea, various better-class woods, raw cotton, wood pulp and cellulose, and manufactured goods. The ports of St Petersburg and Cronstadt were visited in 1898 by 2061 ships, of 1,518,400 tons, engaged in foreign trade, and by 3231 ships, of 261,000 tons, engaged in the coasting trade. Of all of these, only 3494 ships of 389,000 tons were under the Russian flag. Navigation on the Neva, which is the channel for all goods shipped from central Russia by way of the canals, is very great, no less than 20,737 vessels being unloaded in 1898. The number of passengers coming to St Petersburg or leaving it is also very great, the arrivals being (1898) 4,419,756 passengers, of whom nearly 730,000 came from the provinces. For internal communication there is a tramway system 88 miles long, which carried, in 1898, 85,000,000 passengers; and numerous services of steamers, both on the Neva and the canals, by which 9,663,000 passengers were transported in 1898.

Trade and navigation.

There is not the slightest doubt that the population of St Petersburg has made considerable intellectual progress, and that all-round education has begun to reach artisans and factory hands. Sunday schools, since they were reopened, have immensely con-

tributed to this result—chiefly owing to the voluntary efforts of a great number of men and women connected with education. The cheap daily press has penetrated into the masses of the Russian people, and especially of the population of the capitals, to an extent that is hardly realized outside of Russia; while quite a number of well-meaning publishers—some of them women—taking advantage of the fact that Russian books are printed for a population of a hundred million people, have edited the works of the Russian classics and the best authors, as also translations from west European authors, at prices which seem simply ridiculous in western Europe. Thus all works of Turguenieff, Goncharoff, &c., are published as free supplements to an excellent illustrated weekly, which costs only 10s. a year; or, all the works of Darwin are sold for 10s., while the works of the best Russian classics—Pushkin, Gogol, Lermontoff—are sold either for 3s. the complete edition, or for 2, 3, or 5 farthings as separate poems or novels. At the same time the industrial necessity of spreading education amongst the factory hands and artisans contributes to the same result, notwithstanding the opposition of the Government. As to the educated classes of St Petersburg, they have always stood at the head of progressive thought in Russia, and it is well known that it was chiefly owing to their support that it was possible to carry through the great reforms of the years 1861–66. Their demand for political reforms is supported now by a rapidly increasing class of artisans, working-men, and clerks, who all grow more and more conscious of their political rights. (P. A. K.)

Social progress.

St Pierre and Miquelon, two islands belonging to France in the Atlantic, 10 miles from the south coast of Newfoundland. Their united area covers 59,527 acres, or about 93 square miles. Both are mountainous, and several points are over 600 feet in height. Their importance is due to their proximity to the great Bank. In 1898 the settled population numbered 4700, of whom 1611 were men, 1494 women, and 1595 children. The floating population reaches 1650, giving a total of 6350 inhabitants. In 1888 the corresponding number was 6000, but it is doubtful whether the population increases. The chief town is St Pierre.

The islands are administered by a governor, assisted by a privy council and, since 1887, by a general council. They send a delegate to the Superior Council for the Colonies at Paris. The local Budget for 1899 was 519,865 francs; expenditure of France (Budget 1900), 282,938 francs. There is a colonial college for primary and secondary education, with 42 pupils; a higher class school for girls, with 76 pupils; and an *ouvroir* or workroom for training girls, with 40 pupils. Primary instruction is free. There are three commercial schools for boys and three for girls, with (in all) 23 teachers and 720 pupils. There are, besides, infant schools, *salles d'asile*, frequented by 342 children. Agriculture in the islands does not extend beyond vegetable gardens. Fishing is the great resource of the population, lasting from April to September, the port of St Pierre itself equipping 220 boats, which swell the numbers of French fishers at Cancale, St Malo, St Brieuc. In 1899 the catch on the great Bank amounted to 44,870 tons, valued at £296,000. In 1880 the weight caught was 17,000 tons. The subsidy granted to 309 boats of 21,948 tons and 6550 men, amounted to £13,100. The total commerce of the two islands in 1880 amounted to £1,280,000; in 1900, to £880,000: of the value in 1900, £388,000 was for imports and £492,000 for exports. The exports consisted of fish, fresh or dried, £388,000; cod oil, £41,200; lobsters, £16,000. The imports comprise alimentary substances and other articles of consumption. St Pierre is connected with Halifax and St Johns (Newfoundland) by a regular packet service. Besides the English cable, there has been a French cable to St Pierre since 1880.

See Henrique. *Les Colonies Françaises.* Paris, 1889.—Levasseur. *La France*, t. ii. Paris, 1893. *L'Année Coloniale*, 1900.

St Pierre. See Martinique.

St Pölten, a small town and episcopal see in Lower Austria, on the railway from Vienna to Salzburg. Population (1890), 10,906; (1900), 14,510, including garrison of 1219 men, almost exclusively German and Catholic. The industries include cotton spinning and milling, as well as the manufacture of iron and hardwares and small-arms.

St Quentin, chief town of arrondissement, department of Aisne, France, 95½ miles north-north-east of Paris by rail. Besides the very important, extensive, and varied textile industries, of which tulle, lace, and guipure form considerable branches, there are important foundries, large boiler works, machinery works for various special industries, and many brick and tile yards, while in the district are numerous sugar mills. The manufactured products, cotton and linen yarn, and grain are the objects of an active commerce. A monument of the siege of 1557 was erected in 1897, another monument commemorates the defence of the town in 1870, and there are statues of the artist Quentin Delatour (1704–88) and of the historian Henri Martin (1810–83), both natives of St Quentin. Port traffic (1900), 172,391 tons. Population (1901), 50,150.

Saint-Saëns, Charles Camille (1835–——), French composer, was born in Paris on 3rd October 1835. He lost his father when young, was brought up under the care of his mother, and began the study of music at an early age. After having as a child taken lessons in the piano from Stamaty, and learned the elements of composition from Maleden, both distinguished teachers of their time, he entered the Paris Conservatoire in the organ class, then presided over by Eugène Benoist, obtaining the second prize in 1849, and the first two years later. For a short time he studied composition under Halévy, and in 1852 competed without success for the Prix de Rome. Several years later, in 1864, he again attempted to win the much-coveted prize, but with no better result. Notwithstanding these unaccountable failures to obtain academic recognition of his extraordinary gifts, Saint-Saëns worked indefatigably at his art. In 1853, when only eighteen, he was appointed organist at the Church of St Merry. Eight years later he was called upon to preside at the organ of the Madeleine, in succession to Lefébure-Wély, a post which he retained until 1877. An overture entitled "Spartacus," which has remained unpublished, was crowned at a competition instituted in 1863 by the Société Sainte Cécile of Bordeaux. The greatest triumph of his early career was, however, attained in 1867, when the prize was unanimously awarded to him for his cantata "Les Noces de Prométhée" in the competition organized during the International Exhibition of that year, a prize competed for by over two hundred musicians.

The name of Saint-Saëns was gradually becoming known, if not to the bulk of the public, at least to the frequenters of concerts. He had acquired a great name as a pianist, and had made successful concert tours through Europe. So far, however, he had not succeeded in reaching the ears of the larger public by the production of an opera, which in France counts for more than anything else. After the tragic events of 1870, when Saint-Saëns did his duty as a patriot by serving in the National Guard, the opportunity at last offered itself, and a one-act opera from his pen, *La Princesse Jaune*, with words by Louis Gallet, was produced at the Opéra Comique with moderate success on 12th June 1872. *Le Timbre d'Argent*, a four-act opera performed at the Théâtre Lyrique in 1877, was scarcely more successful. In the meanwhile popularity accrued to the composer in the concert room, and his "symphonic poems" "Le Rouet d'Omphale," "Danse Macabre," "Phaéton," and "La Jeunesse d'Hercule" obtained for him a world-wide celebrity. These admirable examples of "programme music" count among his best known works.

His star was now in the ascendant, and was destined to shine on the operatic stage as well as in the concert room. Liszt, most noble-minded and unselfish of artists, ever ready to champion the cause of others, entertained the highest admiration for Saint-Saëns, and it was through his all-powerful influence that the French composer's Biblical opera *Samson et Dalila* was brought out at

Weimar in 1877. This work, which has been generally accepted as the composer's operatic masterpiece, had been begun as far back as 1869, and an act had been heard at one of Colonne's concerts in 1875. Notwithstanding its great success at Weimar, several years were destined to pass before it was to be heard in France, its first performance on French soil taking place at Rouen in 1890. The following year *Samson et Dalila* was given in Paris at the Eden Theatre, and finally in 1892 was produced at the Grand Opéra, where it has since remained as one of the most attractive works of the *répertoire.* Its Biblical subject has unfortunately stood in the way of its being performed on the London stage, but it has frequently been given in concert form with great success. The composer's subsequent operas may show an equal command of resource, but in none has he been so well inspired as in his musical setting of this Biblical tale. No work is better calculated to exemplify the dual tendencies of his style. The first act, with its somewhat formal choruses, suggests the influence of Bach and Handel, and is treated rather in the manner of an oratorio. The more dramatic portions of the opera are not uninfluenced by Meyerbeer, while in the mellifluous strains allotted to the temptress there are occasional suggestions of Gounod. Of Wagner there is but little trace, save in the fact that the composer has followed the German master's lead by dividing his work into scenes, thus avoiding the old-fashioned denominations of "air," "duet," "trio," &c. The score of *Samson et Dalila*, however, is not devoid of individuality. The influences mentioned above, possibly excepting that of Bach in the earlier scenes, are rather of a superficial nature, and do not detract from the originality that asserts itself throughout the work; for Saint-Saëns has undoubtedly a style of his own. It is a composite style, certainly; and all the materials that go towards forming it may not be absolutely his, that is, the eclecticism of his mind may lead him at one moment to adopt an archaic form of expression, at another to employ the current musical language of his day, and sometimes to blend the two. It is perhaps in the latter case that he shows most individuality; for although his works may denote the varied influences of such totally dissimilar masters as Bach, Beethoven, Liszt, and Gounod, he ever contrives to put in something of his own that gives his music the stamp of its authorship.

After the production of *Samson et Dalila*, Saint-Saëns stood at the parting of the ways. Looked at askance by the reactionary section of the French musicians, and suspected of harbouring subversive Wagnerian ideas, a notion strengthened by the enthusiastic articles he had published concerning the production of the *Ring des Nibelungen* at Bayreuth in 1876, but ready to be welcomed by the progressive party, it now remained to be seen which road he would follow. Both sides were doomed to disappointment, for in his subsequent operas Saint-Saëns attempted to effect a compromise between the older and the newer forms of opera. He had for some time caressed the idea of utilizing the history of France for operatic purposes. The first and only result of this project has been *Étienne Marcel*, an opera produced at Lyons in 1879. Although of unequal merit, owing partly to its want of unity of style, this work contains much music of an attractive kind, and scarcely deserves the neglect into which it has fallen. Forsaking the history of France for that of England, Saint-Saëns now set to work on an opera having for its hero "bluff King Hal." *Henry VIII.* was produced at the Paris Grand Opéra in 1883. The librettists had concocted a piece that was sufficiently well knit and abounded in dramatic contrasts. While adhering to his system of compromise by retaining certain conventional operatic features, Saint-Saëns had in this instance advanced somewhat by employing *leit motivs* in a more rigorous fashion than hitherto, although he had not gone so far as to discard airs cut after the old pattern, duets, and quartets. *Henry VIII.*, which was given at Covent Garden during the season of 1898, certainly occupies an honourable place among the composer's works. *Proserpine*, a lyrical drama produced at the Paris Opéra Comique in 1887, may be said to have achieved a *succès d'estime* and no more. A not much better fate befell *Ascanio*, an opera founded on Paul Meurice's drama *Benvenuto Cellini*, and brought out at the Grand Opéra in 1890. *Phryné*, however, a two-act trifle of a light description, produced at the Opéra Comique in 1893, met with success; and his "lyrical drama" *Les Barbares*, given at the Grand Opéra in 1901, has been received with marked favour.

Saint-Saëns worked in every field of his art and succeeded in all. The following condensed list of his compositions proves this better than words. Besides the operas above alluded to, he composed the following oratorios and cantatas: "Oratorio de Noël," "Les Noces de Prométhée," Psalm "Cœli enarrant," "Le Déluge," "La Lyre et la Harpe"; three symphonies; four symphonic poems ("Le Rouet d'Omphale," "Phaéton," "Danse Macabre," "La Jeunesse d'Hercule"); five pianoforte concertos; three violin concertos; two suites, marches, and other works for orchestra; the ballet *Zavotte*; music to the drama *Déjanire*, given at the open-air theatre of Béziers; a quintet for piano and strings, a quartet for piano and strings, two trios for piano and strings, a string quartet, a septet, violoncello sonata, two violin sonatas; a Mass, a Requiem, besides a quantity of piano and organ music, and many songs, duets, and choruses. He also published three books, entitled *Harmonie et Mélodie*, *Portraits et Souvenirs*, and *Problèmes et Mystères*, besides a volume of poems, *Rimes familières.* The honorary degree of Doctor of Music was conferred upon him by Cambridge University in 1893.

St Servan. See St Malo.

St Thomas, an incorporated city and port of entry of Ontario, Canada, capital of Elgin county, on Kettle creek, 13 miles south of London and 8 miles north of Lake Erie. It is an important station on the Grand Trunk, Michigan Central, Lake Erie and Detroit River, and Canadian Pacific railways. The principal public buildings are the city hall, court house, and post office; there are six schools, a collegiate institute, and Alma ladies' college. The Michigan Central railway shops, car-wheel foundry, flour, flax, and planing mills, are the principal industries. Population (1891), 10,366; (1901), 11,485.

St Thomas, St Croix, AND **St John,** three of the Virgin islands of the West Indies, situated—the first-named 40 miles east of Porto Rico, the second 65 miles south-east of Porto Rico and 40 miles south of St Thomas, and the third 4 miles east of St Thomas. Their respective dimensions, areas, and populations are given in the following table:—

Island.	Length. Miles.	Width. Miles.	Area. Square Miles.	Population, 1835.	Population, 1890.	Population, 1901.	Density per Square Mile, 1901.
St Thomas	13	1–4	33	14,022	12,019	11,012	334
St Croix .	22	1–6	84	26,681	19,783	18,567	221
St John .	10	$2\frac{1}{2}$	21	2,475	984	925	44
Total .	...	...	138	43,178	32,786	30,504	221

The population has thus diminished by 29·3 per cent, since 1835. In 1901 there were 14,026 males and 16,478

females; and 58·4 per cent. (17,826) lived in the towns and 41·6 per cent. (12,678) in the country districts. The chief towns are Charlotte Amalie, the capital of St Thomas, with 8540 inhabitants in 1901; Christiansted, the capital of St Croix, with 5483 inhabitants; Frederiksted, also on St Croix, with 3745 inhabitants; and Cruxbay, on St John, with 58 inhabitants. Five-sixths of the inhabitants are the descendants of negro slaves brought from Africa, chiefly in the period of the Napoleonic wars; the remaining one-sixth are whites, mostly Danes and British. The prevailing language is English, but Danish, Dutch, French, Spanish, and German are also used. Except in the southern half of St Croix, the islands are all hilly, the culminating point in St Thomas being West Mountain (1555 feet); in St Croix, Blue Mountain (1155 feet); and in St John, 1270 feet. St Thomas and St John stand on a continuation of the ridge which supports the Greater Antilles (Cuba, Hayti, Porto Rico); but St Croix is the westernmost promontory of the submarine elevation on which the Lesser Antilles stand. All three islands are built up of eruptive rocks (porphyry and granite) of ancient origin and much disintegrated. The cultivable area is relatively small, but the soil is generally from 10 to 50 feet deep. St Croix possesses relatively the largest share of cultivated ground, namely, 57½ per cent. pasture and 32 per cent. planted with the sugar-cane, tobacco, and fruits, while the remaining 10½ per cent. is uncultivated. Sugar, tobacco, bay rum, and tropical fruits are the principal productions, the first-named being by far the most important. Lying as they do within the tropics, these islands are naturally hot, and the daily range of temperature is comparatively small, only 9°; indeed the yearly range is not great, the maximum being 92° in September, and the minimum 69° in January. The annual mean of St Croix (81°) is about 3·5° higher than the annual mean of St Thomas (77·5°). But the heat is greatly modified by the constant and invigorating trade-winds; so that, on the whole, the climate is fine and salubrious. The rain falls, as a rule, in short, heavy showers, the annual mean of both St Thomas and St Croix lying between 44½ and 47 inches. Earthquakes are frequent, but as a rule are not severe. The fierce hurricanes are much more dreaded; those of the years 1713, 1738, 1742, 1772, 1793, 1819, 1837, and 1899 having been especially destructive.

Since the introduction of steam ocean-going vessels St Thomas has gradually lost the greater part of the trade which she had as one of the chief emporia of the West Indies, and the decline has been more marked since 1885, when Barbados took the place of St Thomas as a trade-distributing centre. Whereas in 1885 the total trade was valued at £594,130 (of which £446,290 represented St. Thomas' share), the total value in 1898 did not exceed £342,350. The country which has the largest share in this trade is the United States. In 1821 the trade between these three islands and the United States was valued at £692,222 ($3,461,110); in 1861, £365,880 ($1,829,400); and £234,082 ($1,170,410) in 1901. But the principal value and importance of the little group lies in the suitability of St Thomas for a coaling station, and eventually, no doubt, as a naval base for the United States, for its geographical position invests it with a high strategic value (Captain Mahan). It is a port of call for coaling of the Hamburg-American line, Transatlantic Steamship Company, Royal Mail Company, and others. The port is situated about the middle of the south coast of the island, and consists of an almost landlocked basin, about three-quarters of a mile across, approached by a narrow entrance of only 300 yards at its minimum; the depth varies from 27 feet to 36 feet. It is equipped with a floating dry dock, 300 feet long, which can accommodate vessels up to 3000 tons burden, and with well-fitted ship-repairing yards. The port of Christiansted, on a creek on the north side of St Croix, is to a large extent choked up with mud; and Frederiksted, at the western end of the same island, is little better than an open roadstead. But in Coral Bay St John possesses one of the best harbours of refuge in the Antilles, when the dreaded hurricanes are raging.

From 1865 the islands were continuously governed at a loss to the mother country of Denmark; their total indebtedness on this score amounted in 1898 to the sum of £216,720. The idea of the United States buying these islands from Denmark was first broached by Secretary Seward in 1865, and the islands were virtually sold for the sum of 7½ million dollars, but the treaty failed to get the ratification of the United States Senate. Negotiations were reopened in 1892, and matters were again so far advanced that in 1902 another treaty of cession was signed on 17th February, in virtue of which the purchase price was fixed at 5 million dollars; and this was duly ratified by the United States Senate, and by the Danish Folkething, subject to the assent of the inhabitants of the islands. The earlier history of these islands is given under the several headings in the ninth edition of this work.

See Rev. John P. Knox, *A Historical Account of St Thomas, and Incidental Notices of St Croix and St John* (1850), and James Parton, *The Danish Islands* (1869).

St Vincent, one of the British Windward Islands. Population (1891), 41,054 (2445 white, 7554 coloured, and 31,055 black); (1900), estimated at 44,600. About 330 of these were East Indian coolies, and a few Caribs of somewhat mixed blood, the majority of the aboriginal Caribs having been deported to British Honduras in 1797. Kingstown, the capital, situated on a bay at the south-western extremity of the island, has a population of about 4000. The climate is healthy. The coolest time of the year is from December to May; the wet season is from August to November. The maximum reading of the thermometer during 1899 was 88·5° (in August); the minimum 68·5° (in December). The average annual rainfall is 111·82 inches. There are 77 miles of highway running round the island, for the most part close to the coast; but on the leeward side communication is mainly by boat. There are 129 miles of telephone. Imports in 1899, £103,627; exports, £63,293. In the hurricane of 1898 nearly 300 persons lost their lives, and no less than 30,000 persons were rendered homeless; damage was done to the extent of £225,000. Revenue (1899) (including £31,075 from Imperial funds), £33,575; expenditure (including £17,534 from Imperial funds), £47,855; public debt, £15,710. The principal trade is with the United States of America, trade with the United Kingdom having declined. Sugar and arrowroot were, until 1898, the principal products; the hurricane of that year almost extinguished the sugar industry, which was already decaying; whilst, on the other hand, the arrowroot works then destroyed were replaced by better equipped premises. Other articles of export are cacao, cotton, spices, fruit, vegetables, live stock, and poultry. Crown lands, situated in the centre of the island at altitudes varying from 200 to 4000 feet, comprise between one-half and one-third of the whole island. The tonnage of the vessels entered and cleared during 1899 was 245,588, nearly all being British. The Anglican, Wesleyan, and Roman Catholic churches are well represented, and there are some Presbyterians. In 1898 there were 98 State-aided schools, with 7509 children on the roll, and an average daily attendance of 3158. There is a grammar school at Kingstown, the capital. An agricultural school was opened in 1900.

The present constitution dates from 1877, when the legislative council, consisting of four official and four nominated unofficial members, was formed. In 1899 an important scheme was entered upon, by means of a grant of £15,000 from the Imperial treasury, for settling the labouring population, distressed by the failures of the sugar industry, in the position of peasant proprietors.

In May 1902 the island was devastated by a terrible eruption from the Soufrière, contemporaneously with the eruption of Mont Pelée in Martinique (*q.v.*), and extensive damage and loss of life was caused, the remaining Black Caribs being reported to be entirely wiped out. An account of the calamity was given in a letter to the *Standard* by Mr F. H. Watkins, the Commissioner of Montserrat, which, in the absence of fuller details at the

time when this article had to go to press, may here be quoted:—

"St Vincent is divided by a high mountain ridge, running from north to south, at the northern end of which is the *Soufrière*, which, rising to about 3000 feet in the centre of the island, dominates both the leeward and windward districts in that portion of it. The *Soufrière* has, or rather had, two craters, the old and new, the latter, to the south-east of the former, having been formed by the eruption of 1812, which has been so vividly described in Charles Kingsley's *At Last*. The craters are divided by an exceedingly knife-like ridge, along which it required a cool head to creep. The old crater, 3 miles in circumference, contained a lake, reposing at the depth of several hundred feet below the edge, over which clouds of vapour and mist were constantly hovering. The new crater, smaller than its neighbour, but more rugged and precipitous, looked, as it has been graphically described, like 'an opening into the great infernal regions.' At the leeward base of the *Soufrière* lay the estates of Wallibou and Richmond, Morne Ronde, the settlement of the Black Caribs, and, to the south-west, the small town of Châteaubellair; while on the windward side were the great sugar estates of the Carib quarter, Sandy Bay, the settlement of the pure Caribs; and to the extreme north, the arrowroot estates of Owia and Fancy. Almost opposite to Châteaubellair, on the windward coast, is Georgetown, the second town of St Vincent. The *Soufrière* may be said to have at least one-third of the island within its range of possible destruction. Premonitory signs of eruption had been given since February 1901, when shocks of earthquake and deep reverberations were felt; but as they passed away, little attention was given to them. These warnings were repeated as soon as the Mont Pelée volcano at Martinique showed activity, and increased in force until 6th May, when all doubts as to their true meaning were dissipated. At three p.m. on that day huge columns of smoke were seen from Châteaubellair to issue from the old crater, followed by streams of flame. So serious was the condition of affairs, that several officials were sent from the capital, Kingstown, 15 miles off, to report upon what was happening, and they found the mountain in full eruption. Early on the following (Wednesday) morning the eruption ceased, and left the surrounding country in gloom. So far the windward side had escaped with little damage. Shortly after eight the volcano once more burst into activity, the full force being experienced from one o'clock to three o'clock p.m. For more than 400 miles the sound as of heavy cannonading at sea was heard throughout the West Indies. In Kingstown lamps had to be lighted at four o'clock in the afternoon, and ashes fell in Barbados, which lies about 100 miles to windward of St Vincent. On the windward side the estate works at Tourama, Orange Hill, and Lot 14 were completely destroyed; on the leeward side Wallibou was covered up, and the chimney at Richmond was the sole sign of the works."

A Mansion House Fund was at once started in London for the relief of the sufferers, and subscriptions were sent from all parts of the civilized world, and notably from the United States. (F. CU.)

Saiyid Ahmad, SIR (1817–1898), Mahommedan educationist and reformer, was born at Delhi, India, in 1817. He belonged to a family which had come to India with the Afghan conquest, and had held high offices under the Mogul emperors. Although his imperfect acquaintance with English prevented his attainment of higher office than that of a judge of a small cause court, he earned the title of the recognized leader of the Mahommedan community. To the British he rendered loyal service, and when the wave of mutiny reached Bijnaur in Rohilkand in May 1857, the British residents owed their lives to his courage and tact. The same spirit of loyalty made him oppose the Congress movement at a later date. His faithfulness to his religion was pronounced, and in 1876 he defended the cause of Islam in *A Series of Essays on Mahommed*, written in London. Of good ancestry, and true to the faith, he used these advantages to act as interpreter between the Mahommedans and their rulers, and to rouse his countrymen to a sense of the benefits of modern education. The task was no light one. The horrors of the invasions of Nadir Shah and Ahmad Shah were fading from the memories of the rising generation. A flicker of hope excited society when Shah Alam was rescued from his Maratha guard, and in 1803 restored to some measure of independence. Disappointment followed when in 1832 the Company began to administer Delhi, but Hindustan was used to revolutions, and it awaited a turn of fortune. At least the Mahommedans might keep aloof from British officials and English education and study Persian and Arabic in their mosques. Saiyid Ahmad felt their mistake and set himself to alter their resolution. He established a translation society, which became the Scientific Society of Aligarh. He wrote letters from England to draw the hearts of the East to the West. In 1873 he founded the Mahommedan Anglo-Oriental College, and raised funds for the buildings of which Lord Lytton laid the foundation stone. He stimulated a similar movement elsewhere, and among other cities Karachi, Bombay, Haidarabad caught the infection of his spirit. Thus he effected a revolution in the attitude of Mahommedans towards modern education. He was made K.C.S.I., and became a member of the legislative councils of India and Allahabad, and of the Education Commission. These honours marked the official view of his services, but his lasting monument is the Aligarh College, with its regular outflow of educated Mahommedans into public life. He died at Aligarh on 2nd March 1898. (W. L.-W.)

Sakhalin, an island of Russia, in the Pacific Ocean, lying opposite the mouth of the Amur, with an area of 29,336 square miles and a domiciled Russian population which in 1897 numbered 28,113, of whom only 7641 were women. The population is chiefly composed of convicts and exiles, but a number of free settlers have lately gone to the island. There were, in 1897, 4979 hard-labour convicts (755 women), 1566 released convicts (293 women), and 6934 exiles (879 women), making a total of 13,479, or 42 per cent. of the Russian population; besides which there were 4500 natives, Ghilyaks, and Ainos. The chief military posts on the island are Due (1049), Alexandrovsk (3857), Southern (1166), and Korsakovsk (1664). The chief villages are Rykovskoye and Derbinskoye. The convicts are employed in obtaining coal, timber, and fuel, and in making roads. Owing to a dearth of schools, less than one-fourth of the children are educated. Only 7890 acres were under crops in 1898; rye, wheat, oats, barley, and vegetables are grown. There were in 1898, 1890 horses, 6000 horned cattle, and 1020 swine. Some 2300 tons of coal are obtained annually. The natives, as also a number of Japanese and a Russian company, are engaged in fishing, which seems to be productive, as the duty paid on exported fish amounted to 32,220 roubles in 1897. The Japanese also carry on a large export trade in edible sea-weeds.

Sakura-jima, an island belonging to Japan, oval in shape and measuring 7 miles by 5, lying in the northern part of the Bay of Kagoshima (30° 40′ N., 130° 35′ E.). It has a steaming volcano 3743 feet high (last eruption 1779), and is celebrated for its springs, its oranges, and its giant radishes (*daikon*), which sometimes weigh as much as 70 ℔.

Sala, a town of Sweden, county of Vestmanland, between two small lakes, 39 miles west by north of Upsala by rail. It owes its importance to the silver mine of Salberg, 1½ miles south-west of the town, which has been worked since 1510, and produces about 33,000 oz. of silver annually, as well as dolomite. Population (1900), 6593.

Sala, George Augustus Henry (1828–1895), English journalist, was born in London, 24th November 1828; his father (1792–1828) being the son of an Italian who came to London to arrange ballets at the theatres, and his mother (1789–1860) an actress and

teacher of singing. He was at school at Paris from 1839 to 1842, and learnt drawing in London, and in his earlier years he did odd jobs in scene-painting and book illustration, the connexion of his mother and elder brother (Charles Kerrison Sala) with the theatre giving him useful introductions to authors and artists. At an early date he tried his hand at writing, and in 1851 attracted the attention of Charles Dickens, who published articles and stories by him in *Household Words* and subsequently in *All the Year Round*, and in 1856 sent him to Russia as a special correspondent. About the same time he got to know Edmund Yates, with whom, in his earlier years, he was constantly connected in his journalistic ventures. In 1860, over his own initials, "G. A. S.," he began writing "Echoes of the Week" for the *Illustrated London News*, and continued to do so till 1886, when they were continued in a syndicate of weekly newspapers almost to his death. Thackeray, when editor of the *Cornhill*, published articles by him on Hogarth in 1860, which were issued in volume form in 1866; and in the former year he was given the editorship of *Temple Bar*, which he held till 1866. Meanwhile he had become in 1857 a contributor to the *Daily Telegraph*, and it was in this capacity that he did his most characteristic work, whether as a foreign correspondent in all parts of the world, or as a writer of "leaders" or special articles. His literary style, highly coloured, bombastic, egotistic, and full of turgid periphrases, gradually became associated by the public with their conception of the *Daily Telegraph;* and though the butt of the more scholarly literary world, his articles were invariably full of interesting matter and helped to make the reputation of the paper. He collected a large library and had an elaborate system of keeping commonplace-books, so that he could be turned on to write upon any conceivable subject with the certainty that he would bring into his article enough show or reality of special information to make it excellent reading for a not very critical public; and his extraordinary faculty for never saying the same thing twice in the same way had a sort of "sporting" interest even to those who were more particular. He earned a large income from the *Telegraph* and other sources, but he never could keep his money. In 1892, when his popular reputation was at its height, he started a weekly paper called *Sala's Journal*, but it was a disastrous failure; and in 1895 he had to sell his library of 13,000 volumes. Lord Rosebery gave him a civil list pension of £100 a year, but he was a broken-down man, and he died at Brighton on 8th December 1895. Sala published many volumes of fiction, travels, and essays, and he edited various other works, but his *métier* was that of ephemeral journalism; and his name goes down to posterity as perhaps the most popular and most voluble of the newspaper men of the period.

Salaam, Dar-es-. See East Africa, German.

Salado River. See Plate River.

Salamanca, a province of western Spain; area, 4940 square miles, divided into 8 districts and 388 parishes; population, 314,472 in 1887, 317,005 in 1897. The average of births is 4·38 per cent., of deaths 3·36 per cent., and the proportion of illegitimate births is 4·83. It is one of the provinces of Spain which loses least by emigration. The railways of the province have been much developed. Besides the line that branches off from the Northern Railway at Medina del Campo, there are lines from Bejar to Zamora, *viâ* Salamanca, Salamanca to Avila by Peñaranda. The principal industries are connected with agriculture. The cloth manufactories of Bejar, Candelairo, Peñaranda, are decaying.

Three-quarters of the province are well wooded—beech, oak, chestnut, pines, abounding in the south and south-west districts. Timber for building purposes and firewood are largely sent to the rest of Spain. About 2,500,000 acres are cultivated, only a small proportion being well irrigated. In 1897 wheat was grown on 278,127 acres; maize, oats, barley, rye, on 176,137; pod fruit on 172,492; vines on 34,897; olives on 9500. Badajoz, Caceres, and Teruel alone, out of the 49 provinces of Spain, have more live stock than Salamanca. Out of 925,319 head registered in 1897, 8082 were horses, 8745 mules, 35,399 asses, 98,494 cattle, 623,272 sheep, 65,167 goats, and 86,220 pigs.

Salamanca, capital of the above province, with a station on the railway from Medina del Campo to the Portuguese frontier. The oldest of Spanish university towns is still rich in educational establishments, though much shorn of its ancient prosperity, when it had a population of 50,000 souls, including 10,000 students from all parts of Spain and from abroad. Salamanca still keeps up her university, with the separate faculties of letters, philosophy, sciences, law, and medicine; her university and provincial public library, with 100,000 volumes, a provincial institute, a superior normal school, a seminary founded in 1778, economic and other learned societies, and very many charitable foundations. The city has still its 25 parishes, 25 colleges, and as many more or less ruinous convents and 10 yet flourishing religious houses. Side by side with the remains of a great past are the modern buildings: two theatres, casino, a bull-ring, the town-hall, and electric light factory. Salamanca maintains its Irish college, the rector and teachers of which are in general Irishmen. Population (1887), 22,199; (1897), 24,156.

Sálár Jung, Sir (1829–1883), Indian statesman, born in 1829, was the descendant of a family which had held various court and military appointments, first under the 'Adil Sháhí kings of Bíjápúr, then under the Delhi emperors, and lastly under the Nizáms. While he was known to the British as Sir Sálár Jung, his personal name was Mír Turáb Alí, he was styled by native officials of Haidarabad the Mukhtaru 'l-Mulk, and was referred to by the general public as the Náwáb Sáhib. He succeeded his uncle Suráju 'l-Mulk as prime minister, 1853. Owing to the failure of the Nizám to fulfil his treaty obligations to the British Government, the province of Berar had just been separated from his dominions and incorporated with the British possessions. The condition of the Nizám's state was at that time a scandal to the rest of India, and Sálár Jung at once set about reform. He commenced by infusing a measure of discipline into the Arab mercenaries, who composed the more valuable part of the Nizám's army. He then employed them against the rapacious nobles and bands of robbers who had annihilated the trade of the country. When he had attained some degree of internal security, he constituted courts of justice at Haidarabad, organized the police force, constructed and repaired irrigation works, and established schools. On the outbreak of the Mutiny he supported the British, and although unable to hinder an attack on the residency, he warned the British minister that it was in contemplation. The attack was repulsed; the Haidarabad Contingent remained loyal, and their loyalty served to ensure the tranquillity of the Deccan. Sálár Jung took advantage of the preoccupation of the British Government with the Mutiny to push his reforms more boldly, and when the Calcutta authorities were again at liberty to consider the condition of affairs in the native states, his work had been carried far towards completion. During the lifetime of the Nizám Afzalu'd-daula, Sálár Jung was considerably hampered by his master's jealous supervision. His actions were watched by innumerable spies, and in the palace his attitude could only be compared to that of an abject slave. When Mír

Mahbub Alí, however, succeeded his father in 1869, Sálár Jung, at the instance of the British Government, was associated in the regency with the principal noble of the state, the Shamsu 'l-Umára or Amír Kabír, and enjoyed an increased authority. In 1876 he visited England with the purpose of obtaining the restoration of Berar. Although he was unsuccessful, his personal merits met with full recognition. He died of cholera at Haidarabad on 8th February 1883. He was created G.C.S.I. on 28th May 1870, and received the honorary degree of D.C.L. from the University of Oxford on 21st June 1876.

See *Memoirs of Sir Sálár Jung*, by his private secretary, Syed Hossain Bilgrami, 1883. (E. I. C.)

Sale, an urban district, Cheshire, England, in the Altrincham parliamentary division of the county, about 5 miles south of Manchester by rail, on the Mersey and the Bridgewater canal. Among modern buildings are St Paul's Church and Roman Catholic and Wesleyan chapels. In 1892 works for the purification of sewage were constructed at a cost of £18,000. A public free library was erected in 1891. Population of the urban district (1891), 9644; (1901), 12,088.

Sale of Goods.—Sale is commonly defined as the transfer of property from one person to another for a price. This definition requires some consideration in order to appreciate its full scope. The law of sale is usually treated as a branch of the law of contract, because sale is effected by contract. Thus Pothier entitles his classical treatise on the subject, *Traité du contrat de vente*, and the Indian Contract Act (ix. of 1872) devotes a chapter to the sale of goods. But a completed contract of sale is something more. It is a contract plus a transfer of property. An agreement to sell or buy a thing, or, as lawyers call it, an executory contract of sale, is a contract pure and simple. A purely personal bond arises thereby between seller and buyer. But a complete or executed contract of sale effects a transfer of ownership with all the advantages and risks incident thereto. By an agreement to sell a *jus in personam* is created; by a sale a *jus in rem* is transferred. The essence of sale is the transfer of property for a price. If there be no agreement for a price, express or implied, the transaction is gift, not sale, and is regulated by its own peculiar rules and considerations. So too if commodity be exchanged for commodity, the transaction is called barter, and not sale, and the rules relating to sales do not apply in their entirety. Again, a contract of sale must contemplate an absolute transfer of the property in the thing sold or agreed to be sold. A mortgage may be in the form of a conditional sale, but English law regards the substance and not the form of the transaction. If in substance the object of the transaction is to secure the repayment of a debt, and not to transfer the absolute property in the thing sold, the law at once annexes to the transaction the complex consequences which attach to a mortgage. So too it is not always easy to distinguish a contract for the sale of an article from a contract for the supply of work and materials. If a man orders a set of false teeth from a dentist the contract is one of sale, but if he employs a dentist to stop one of his teeth with gold the contract is for the supply of work and materials. The distinction is of practical importance, because very different rules of law apply to the two classes of contract. The property which may be the subject of sale may be either movable or immovable, tangible or intangible. The present article relates only to the sale of goods, that is to say, tangible movable property. By the laws of all nations the alienation of land or real property is, on grounds of public policy, subject to special regulations. It is obvious that the assignment of "things in action," such as debts, contracts, and negotiable instruments, must be governed by very different principles from those which regulate the transfer of goods, when the object sold can be transferred into the physical possession of the transferee.

The Code of 1893.

In 1847, when Mr Justice Story wrote his work on the sale of personal property, the law of sale was still in process of development. Many rules were still unsettled, especially the rules relating to implied conditions and warranties. But for several years the main principles have been well settled. In 1891 the subject seemed ripe for codification, and Lord Herschell introduced a codifying Bill which two years later passed into law as the Sale of Goods Act, 1893 (56 and 57 Vict. c. 71). Sale is a consensual contract. The parties to the contract may supplement it with any stipulations or conditions they may see fit to agree to. The code in no wise seeks to fetter this discretion. It lays down a few positive rules, such, for instance, as that which reproduces the 17th section of the Statute of Frauds. But the main object of the Act is to provide clear rules for those cases where the parties have either formed no intention or have failed to express it. When parties enter into a contract they contemplate its smooth performance, and they seldom provide for contingencies which may interrupt that performance, such as the insolvency of the buyer or the destruction of the thing sold before it is delivered. It is the province of the code to provide for these contingencies, leaving the parties free to modify by express stipulation the provisions imported by law. When the code was in contemplation the case of Scotland gave rise to difficulty. Scottish law varies widely from English. To speak broadly, the Scottish law of sale differs from the English by adhering to the rules of Roman law, while the English common law has worked out rules of its own. Where two countries are so closely connected in business as Scotland and England, it is obviously inconvenient that their laws relating to commercial matters should differ. The Mercantile Law Commission of 1855 reported on this question, and recommended that on certain points the Scottish rule should be adopted in England, while on other points the English rule should be adopted in Scotland. The recommendations of the Commission were partially and rather capriciously adopted in the English and Scottish Mercantile Law Amendment Acts of 1856. Certain rules were enacted for England which resembled but did not really reproduce the Scottish law, while other rules were enacted for Scotland which resembled but did not really reproduce the English law. There the matter rested for many years. The Codifying Bill of 1891 applied only to England, but on the advice of Lord Watson it was extended to Scotland. As the English and Irish laws of sale were the same, the case of Ireland gave rise to no difficulty, and the Act now applies to the whole of the United Kingdom. As regards England and Ireland very little change in the law has been effected. As regards Scotland the process of assimilation has been carried further, but has not been completed. In a few cases the Scottish rule has been saved or re-enacted, in a few other cases it has been modified, while on other points, where the laws were dissimilar, the English rules have been adopted. It is perhaps to be regretted that the process of assimilation was not fully carried out by the Act. In mercantile matters the certainty of the rule is often of more importance than its substance. If the parties know beforehand what their legal position is, they can provide for their particular needs by express stipulation. Still, the way has been paved for future uniformity. The law is contained within the four corners of the Act, and it is

a much easier matter to amend a statute than to alter common law.

Now that the law has been codified, an analysis of the law resolves itself into an epitome of the main provisions of the statute. The Act is divided into six parts, the first dealing with the formation of the contract, the second with the effects of the contract, the third with the performance of the contract, the fourth with the rights of an unpaid seller against the goods, and the fifth with remedies for breach of contract; the sixth part is supplemental. The 1st section, which may be regarded as the keystone of the Act, is in the following terms:—"A contract of sale of goods is a contract whereby the seller transfers or agrees to transfer the property in goods to the buyer for a money consideration called the price. A contract of sale may be absolute or conditional. When under a contract of sale the property in the goods is transferred from the seller to the buyer the contract is called a 'sale,' but when the transfer of the property in the goods is to take place at a future time or subject to some condition thereafter to be fulfilled the contract is called an 'agreement to sell.' An agreement to sell becomes a sale when the time elapses or the conditions are fulfilled subject to which the property in the goods is to be transferred." This section clearly enunciates the consensual nature of the contract, and this is confirmed by section 55, which provides that "where any right, duty, or liability would arise under a contract of sale by implication of law," it may be negatived or varied by express agreement, or by the course of dealing between the parties, or by usage, if the usage be such as to bind both parties to the contract. The next question is who can sell and buy. The Act is framed on the plan that if the law of contract were codified, this Act would form a chapter in the code. The question of capacity is therefore referred to the general law, but a special provision is inserted (section 2) relating to the supply of necessaries to infants and other persons who are incompetent to contract. Though an infant cannot contract he must live, and he can only get goods by paying for them. The law, therefore, provides that he is liable to pay a reasonable price for necessaries supplied to him, and it defines necessaries as "goods suitable to the condition in life of such minor or other person, and to his actual requirements at the time of the sale and delivery."

The 4th section of the Act reproduces the famous 17th section of the Statute of Frauds, which was an Act "for the prevention of frauds and perjuries." The object of that statute was to prevent people from setting up bogus contracts of sale by requiring material evidence of the contract. The section provides that "a contract for the sale of any goods of the value of ten pounds or upwards shall not be enforceable by action unless the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the contract, or in part payment, or unless some note or memorandum in writing of the contract be made and signed by the party to be charged, or his agent in that behalf." It is a much disputed question whether this enactment has done more good or harm. It has defeated many an honest claim, though it may have prevented many a dishonest one from being put forward. When judges and juries have been satisfied of the *bona fides* of a contract which does not appear to satisfy the statute, they have done their best to get round it. Every expression in the section has been the subject of numerous judicial decisions, which ran into almost impossible refinements, and illustrate the maxim that hard cases make bad law. The last edition of the late Mr Benjamin's book on Sale contains 950 pages, of which number no less than 180 are devoted to the decisions on the few lines cited above. Only one thing is certain. The Statute of Frauds has brought much grist to the legal mill. It is to be noted that Scotland is excluded from the operation of section 4. The Statute of Frauds has never been applied to Scotland, and Scotsmen appear never to have felt the want of it.

As regards the subject-matter of the contract, the Act provides that it may consist either of existing goods or "future goods," that is to say, goods to be manufactured or acquired by the seller after the making of the contract (§ 5). Suppose that a man goes into a gunsmith's shop, and says, "This gun suits me, and if you will make or get me another like it I will buy the pair." This is a good contract, and no question as to its validity would be likely to occur to the lay mind. But lawyers have seriously raised the question, whether there could be a valid contract of sale when the subject-matter of the contract was not in existence at the time when the contract was made. The price is an essential element in a contract of sale. It may be either fixed by the contract itself, or left to be determined in some manner thereby agreed upon, *e.g.*, by the award of a third party. But there are many cases in which the parties intend to effect a sale, and yet say nothing about the price. Suppose that a man goes into a hotel and orders dinner without asking the price. How is it to be fixed? The law steps in and says that, in the absence of any agreement, a reasonable price must be paid (§ 8). This prevents extortion on the part of the seller, and unreasonableness or fraud on the part of the buyer.

Warranty.

The next question dealt with is the difficult one of conditions and warranties (§§ 10 and 11). The parties may insert what stipulations they like in a contract of sale, but the law has to interpret them. The term "warranty" has a peculiar and technical meaning in the law of sale. It denotes a stipulation which the law regards as collateral to the main purpose of the contract. A breach, therefore, does not entitle the buyer to reject the goods, but only to claim damages. Suppose that a man buys a particular horse, which is warranted quiet to ride and drive. If the horse turns out to be vicious, the buyer's only remedy is to claim damages, unless he has expressly reserved a right to return it. But if, instead of buying a particular horse, a man applies to a dealer to supply him with a quiet horse, and the dealer supplies him with a vicious one, the stipulation is a condition. The buyer can either return the horse, or keep it and claim damages. Of course the right of rejection must be exercised within a reasonable time. In Scotland no distinction has been drawn between conditions and warranties, and the Act preserves the Scottish rule by providing that, in Scotland, "failure by the seller to perform any material part of a contract of sale" entitles the buyer either to reject the goods within a reasonable time after delivery, or to retain them and claim compensation (§ 11 (2)). In England it is a very common trick for the buyer to keep the goods, and then set up in reduction of the price that they are of inferior quality to what was ordered. To discourage this practice in Scotland the Act provides that, in that country, the court may require the buyer who alleges a breach of contract to bring the agreed price into court pending the decision of the case (§ 59). It seems a pity that this sensible rule was not extended to England.

In early English law *caveat emptor* was the general rule, and it was one well suited to primitive times. Men either bought their goods in the open market-place, or from their neighbours, and buyer and seller contracted on a footing of equality. Now the complexity of modern commerce, the division of labour, and the increase of technical

skill, have altogether altered the state of affairs. The buyer is more and more driven to rely on the honesty, skill, and judgment of the seller or manufacturer. Modern law has recognized this, and protects the buyer by implying various conditions and warranties in contracts of sale, which may be summarized as follows:—First, there is an implied undertaking on the part of the seller that he has a right to sell the goods (§ 12). Secondly, if goods be ordered by description, they must correspond with that description (§ 13). This, of course, is a universal rule—*Si æs pro auro veneat, non valet.* Thirdly, there is the case of manufacturers or sellers who deal in particular classes of goods. They naturally have better means of judging of their merchandise than the outside public, and the buyer is entitled within limits to rely on their skill or judgment. A tea merchant or grocer knows more about tea than his customers can, and so does a gunsmith about guns. In such cases, if the buyer makes known to the seller the particular purpose for which the goods are required, there is an implied condition that the goods are reasonably fit for it, and if no particular purpose be indicated there is an implied condition that the goods supplied are of merchantable quality (§ 14). Fourthly, in the case of a sale by sample, there is "an implied condition that the bulk shall correspond with the sample in quality," and that the buyer shall have a reasonable opportunity of comparing the bulk with the sample (§ 15).

Effects of contract.

The main object of sale is the transfer of ownership from seller to buyer, and it is often both a difficult and an important matter to determine the precise moment at which the change of ownership is effected. According to Roman law, which is still the foundation of most Continental systems, the property in a thing sold did not pass until delivery to the buyer. *Traditionibus et usucapionibus dominia rerum, non nudis pactis, transferuntur.* English law has abandoned this test, and has adopted the principle that the property passes at such time as the parties intend it to pass. Express stipulations as to the time when the property is to pass are very rare. The intention of the parties has to be gathered from their conduct. A long train of judicial decisions has worked out a more or less artificial series of rules for determining the presumed intention of the parties, and these rules are embodied in sections 16 to 20 of the Act. The first rule is a negative one. In the case of unascertained goods, *i.e.*, goods defined by description only, and not specifically identified, "no property in the goods is transferred to the buyer unless and until the goods are ascertained." If a man orders ten tons of scrap iron from a dealer, it is obvious that the dealer can fulfil his contract by delivering any ten tons of scrap that he may select, and that until the ten tons have been set apart, no question of change of ownership can arise. But when a specific article is bought, or when goods ordered by description are appropriated to the contract, the passing of the property is a question of intention. Delivery to the buyer is strong evidence of intention to change the ownership, but it is not conclusive. Goods may be delivered to the buyer on approval, or for sale or return. Delivery to a carrier for the buyer operates in the main as a delivery to the buyer, but the seller may deliver to the carrier, and yet reserve to himself a right of disposal. On the other hand, when there is a sale of a specific article, which is in a fit state for delivery, the property in the article *primâ facie* passes at once, even though delivery be delayed. When the contract is for the sale of unascertained goods, which are ordered by description, the property in the goods passes to the buyer, when, with the express or implied consent of the parties, goods of the required description are "unconditionally appropriated to the contract." The cases which determine what amounts to an appropriation of goods to the contract are numerous and complicated. Probably they could all be explained as cases of constructive delivery, but at the time when the law of appropriation was worked out the doctrine of constructive delivery was not known. It is perhaps to be regretted that the codifying Act did not adopt the test of delivery, but it was thought better to adhere to the familiar phraseology of the cases Section 20 deals with the transfer of risk from seller to buyer, and lays down the *primâ facie* rule that "the goods remain at the seller's risk until the property therein is transferred to the buyer, but when the property therein is transferred to the buyer, the goods are at the buyer's risk whether delivery has been made or not." *Res perit domino* is therefore the maxim of English, as well as of Roman law.

Title.

In the vast majority of cases people only sell what they have a right to sell, but the law has to make provision for cases where a man sells goods which he is not entitled to sell. An agent may misconceive or exceed his authority. Stolen goods may be passed from buyer to buyer. Then comes the question, Which of two innocent parties is to suffer? Is the original owner to be permanently deprived of his property, or is the loss to fall on the innocent purchaser? Roman law threw the loss on the buyer, *Nemo plus juris in alium transferre potest quam ipse habit.* French law, in deference to modern commerce, protects the innocent purchaser and throws the loss on the original owner. "En fait de meubles, possession vaut titre" (*Code Civil*, art. 1599). English law is a compromise between these opposing theories. It adopts the Roman rule as its guiding principle, but qualifies it with certain more or less arbitrary exceptions, which cover perhaps the majority of the actual cases which occur (§§ 21 to 26). In the first place, the provisions of the Factors Act, 1889 (52 and 53 Vict. c. 45, extended to Scotland by 53 and 54 Vict. c. 40), are preserved. That Act validates sales and other dispositions of goods by mercantile agents acting within the apparent scope of their authority, and also protects innocent purchasers who obtain goods from sellers left in possession, or from intending buyers who have got possession of the goods while negotiations are pending. In most cases a contract induced by fraud is voidable only, and not void, and the Act provides, accordingly, that a voidable contract of sale shall not be avoided to the prejudice of an innocent purchaser. The ancient privilege of market overt is preserved intact, and section 22 provides that "where goods are sold in market overt, according to the usage of the market, the buyer acquires a good title to the goods provided he buys them in good faith, and without notice of any defect or want of title on the part of the seller." The section does not apply to Scotland, nor to the law relating to the sale of horses which is contained in two old statutes, 2 and 3 Phil. and Mar. c. 7, and 31 Eliz. c. 12. The minute regulations of those statutes are never complied with, so their practical effect is to take horses out of the category of things which can be sold in market overt. The privilege of market overt applies only to markets by prescription, and does not attach to newly-created markets. The operation of the custom is therefore fitful and capricious. For example, every shop in the City of London is within the custom, but the custom does not extend to the greater London outside. If then a man buys a stolen watch in Fleet Street, he may get a good title to it, but he cannot do so if he buys it a few doors off in the Strand. There is, however, a qualification of the rights acquired by purchase even in market overt. When goods have been stolen and the thief is prosecuted to conviction, the property in the goods thereupon revests in the original owner, and he is entitled

to get them back either by a summary order of the convicting court or by action. This rule dates back to the statute 21 Hen. VIII. c. 11. It was probably intended rather to encourage prosecutions in the interests of public justice than to protect people whose goods were stolen.

Having dealt with the effects of sale, first, as between seller and buyer, and, secondly, as between the buyer and third parties, the Act proceeds to determine what, in the absence of convention, are the reciprocal rights and duties of the parties in the performance of their contract (§§ 27 to 37). "It is the duty of the seller to deliver the goods and of the buyer to accept and pay for them in accordance with the terms of the contract of sale" (§ 27). In ordinary cases the seller's duty to deliver the goods is satisfied if he puts them at the disposal of the buyer at the place of sale. The normal contract of sale is represented by a cash sale in a shop. The buyer pays the price and takes away the goods: "Unless otherwise agreed, delivery of the goods and payment of the price are concurrent conditions" (§ 27). But agreement, express or implied, may create infinite variations on the normal contract. It is to be noted that when goods are sent to the buyer which he is entitled to reject, and does reject, he is not bound to send them back to the seller. It is sufficient if he intimate to the seller his refusal to accept them (§ 36).

Performance.

The normal theory of sale is cash against delivery, but in the great majority of actual cases, especially in commercial transactions, this theory is departed from in practice. The interests of the seller are therefore protected by two rules, namely, those as to lien and as to stoppage *in transitu*. In the absence of any different agreement, as for instance where there is a stipulation for sale on credit, the unpaid seller has a right to retain possession of the goods until the price is paid or tendered. The right may, of course, be waived, even when it is not negatived by the contract. It is to be noted that when the seller takes a bill of exchange or other negotiable instrument for the price, the instrument operates as conditional payment. On the dishonour of the instrument the seller's rights revive (§§ 38–43). If the buyer becomes insolvent the unpaid seller has a further right founded on ancient mercantile usage. He may have parted with both the property in and possession of the goods sold, but he can attach the goods as long as they are in the hands of a carrier or forwarding agent, and have not reached the actual possession of the seller or his immediate agent. "Subject to the provisions of this Act, when the buyer of goods becomes insolvent, the unpaid seller who has parted with the possession of the goods has the right of stopping them *in transitu*, that is to say, he may resume possession of the goods as long as they are in course of transit, and may retain them until payment or tender of the price" (§ 44). The right of stoppage, however, cannot be exercised to the prejudice of third parties to whom the bill of lading or other document of title to goods has been lawfully transferred for value (§ 47).

Rights of unpaid sellers.

The ultimate sanction of a contract is the legal remedy for its breach. Seller and buyer have each their appropriate remedies. If the property in the goods has passed to the buyer, or if, under the contract, "the price is payable on a day certain irrespective of delivery," the seller's remedy for breach of the contract is an action for the price (§ 49). In other cases his remedy is an action for damages for non-acceptance. In the case of ordinary goods of commerce the measure of damages is the difference between the contract price and the market or current price at the time when the goods ought to have been accepted. But this test is often applicable. For instance, the buyer may have ordered some article of special manufacture for which there would be no market. The convenient market-price rule is therefore subordinate to the general principle that "the measure of damages is the estimated loss directly and naturally resulting in the ordinary course of events from the buyer's breach of contract" (§ 56). Similar considerations apply to the buyer's right of action for non-delivery of the goods (§ 51). Section 52 deals with a peculiar feature of English law. In Scotland, as a general rule, a party who complains of a breach of contract is entitled to claim that the contract shall be specifically performed. In England a court of common law could only award damages, and apart from certain recent statutes, a claim for specific performance could only be entertained by a court of equity in a very narrow class of cases when the remedy by damages was deemed inadequate. But now, under the Act of 1893, "in any action for breach of contract to deliver specific or ascertained goods the court may, if it thinks fit, direct that the contract shall be performed specifically without giving the defendant the option of retaining the goods on payment of damages." The buyer who complains of a breach of warranty on the part of the seller has two remedies. He may either set up the breach of warranty in reduction of the price, or he may pay the price and sue for damages. The *primâ facie* measure of damages is the difference between the value of the goods at the time of delivery and the value they would have had if they had answered to the warranty (§ 53).

Remedies of buyer and seller.

The sixth part of the Act is supplemental, and is mainly concerned with drafting explanations, but section 58 contains some rules for regulating sales by auction. It prohibits secret bidding on behalf of the seller to enhance the price, but is silent as to combination by buyers to reduce the price. Such a combination, commonly known as a "knock out," is left to be dealt with by the ordinary law of conspiracy.

The Sale of Goods Act, 1893, was the third attempt made by Parliament to codify a branch of commercial law. It would be out of place here to discuss the policy of mercantile codification, but it may be noted that there are very few reported cases on the construction of the Act, so that its interpretation does not seem to have given rise to difficulty. As has been noted above, the Act preserves some curious anomalies and distinctions between English and Scottish law. But the amendments required to remove them would be few and simple, should the Legislature ever think it worth while to undertake the task.

The ordinary text-books on the law of sale are constantly re-edited and brought up to date. The following among the others may be consulted:—BENJAMIN'S *Sale of Personal Property*; BLACKBURN'S *Contract of Sale*; CAMPBELL'S *Law of Sale and Mercantile Agency*; BROWN'S *Sale of Goods Act (Scotland)*; CHALMERS'S *Sale of Goods Act*; MOYLE'S *Contract of Sale in the Civil Law*; BEDDARRIDE'S *Des Achats et Ventes Commerciales*; STORY'S *Sale of Personal Property* (United States). (M. D. CH.)

Salem, a city and district of British India, in the Madras presidency. The city is on both banks of the river Tirumanimuttar; 3 miles from a station on the Madras Railway, 207 miles south-west of Madras. Population (1881), 50,667; (1891), 67,710, showing an increase of 34 per cent.; (1901), 70,627. Municipal income (1897–98), Rs.80,530. There is considerable weaving industry and some cutlery, and a London mission. The municipal college had 19 students in 1896–97, and the 2 municipal and mission high schools had 471 pupils. There are three printing-presses, one of which issues the district gazette, and 4 reading-rooms and literary associations.

The district has an area of 7529 square miles; population (1881), 1,592,915; (1891), 1,962,591; (1901), 2,205,898, showing an increase of 23 per cent. in the earlier, and 12 per cent. in the

later decade; average density, 261 persons per square mile. The land revenue and rates in 1897–98 were Rs.28,09,847, the incidence of assessment being R.1.6.1 per acre; cultivated area, 1,287,329 acres, of which 169,166 were irrigated from tanks, wells, &c., including 26,534 from Government works; number of police, 1133; boys at school (1896–97), 29,030, being 20 per cent. of the male population of school-going age; registered death-rate (1897), 19·3 per thousand. The principal crops are millet, *ragi*, rice, other food grains, and oil seeds, with a little cotton, indigo, and tobacco. Coffee is grown on 11,271 acres in the Shevaroy Hills. The chief irrigation work is the Barur tank system, on which the capital outlay has been Rs.4,25,025. In 1897–98 the area irrigated was 4421 acres; and the receipts were Rs.9774, compared with an expenditure of Rs.19,939. Salem suffered very severely from the famine of 1877–78. The Madras Railway runs through the district for 131 miles. The chief industry is cotton-weaving, and there is some manufacture of steel. There are 141 saltpetre refineries, but no large industries.

Salem, a city and seaport of Massachusetts, U.S.A., capital of Essex county. It is on the north coast of Massachusetts Bay, in the north-eastern part of the state, and on a line of the Boston and Maine Railroad, by which it is connected with Boston, 15 miles to the south-west. It is situated on a rocky peninsula, has a very irregular street plan, is divided into six wards, has an excellent water-supply pumped from Wenham Lake, four miles distant, and is sewered. The business streets are paved with granite blocks, the residential streets macadamized or gravelled. Salem, once famous as a commercial city and the home port of many sailing vessels engaged in foreign commerce, is now an important manufacturing city. In 1900 there were 446 manufacturing establishments, with a total capital of $7,450,935. They employed 6424 hands, and the product had a value of $12,257,449. Of this not less than $2,974,631, or almost one quarter, consisted of boots and shoes, and $3,076,869 consisted of leather. In 1900 the assessed valuation of real and personal property was $27,876,291, the net debt of the city was but $864,169, and the rate of taxation was $18.00 per $1000. The income of the city, exclusive of loans, was $765,979, and the expenditure for maintenance and operation, $620,552. Population (1890), 30,801; (1900), 35,956, of whom 10,902 were foreign-born and 156 negroes.

Salem, a city of New Jersey, U.S.A., capital of Salem county, on the river Salem, at the mouth of Fenwick Creek, and on the West Jersey and Seashore Railroad, in the south-western part of the state. Its site is low and level, the street plan is irregular, and the city is divided into east and west wards. It is in a rich fruit-growing region, and the town has some manufactures of varied character. Population (1890), 5516; (1900), 5811, of whom 263 were foreign-born and 809 negroes.

Salem, a city of Columbiana county, Ohio, U.S.A. It is on the Pennsylvania Railroad, in the eastern part of the state, at an altitude of 1172 feet. It has varied manufactures, consisting mainly of highly manufactured articles of iron and steel. Population (1890), 5780; (1900), 7582, of whom 677 were foreign-born and 227 negroes.

Salem, a city of Oregon, U.S.A., capital of Marion county and of the state. It is on the river Willamette, and on the Southern Pacific Railroad, in the north-western part of the state, at an altitude of 195 feet. It has broad streets, and a water-supply from the river Santiam. Its manufactures are of a varied character. Willamette University, situated here, had in 1899 a faculty numbering 37, and was attended by 180 students, 68 of whom were women. Population (1890), 4515; (1900), 4258, of whom 522 were foreign-born.

Salerno, a seaport town, archiepiscopal see, and capital of the province of Salerno, Campania, Italy, on the north shore of the Gulf of Salerno, 33 miles by rail south-east of Naples. The chief industry is cotton-spinning and printing, with factories for leather-work, thread, linen, glass, pottery, tiles, macaroni, iron-works, and printing. Good wine is produced in the neighbourhood. There is a technical school. Population (1881), 24,275; (1901), 42,736.

Saleyer (Dutch, *Saleijer*), a group of islands belonging to the government of Celebes and its dependencies in the Dutch East Indies, numbering altogether 73, the principal being Saleyer, Tambalongang, Pulasi, and Bahuluwang; between 5° 36′ and 7° 25′ S. and 119° 50′ and 121° 30′ E. The main island, Saleyer, is 248 square miles in area. The strait separating it from Celebes is more than 100 fathoms deep and, running in a strong current, is dangerous for native ships to navigate. The east coast is very steep. On the west, the Bay of Bontobangun (988 acres) is protected by an island from the onset of the west winds. The strata of the island are all sedimentary rocks: coralline limestone, occasionally sandstone; everywhere, except in the north and north-west, covered by a fertile soil. The watershed (of inconsiderable rivers) is formed by a chain running the length of the island from north to south, reaching in Bontona Haru 5840 feet, sloping steeply to the east coast. There are no lakes or morasses. The island is densely populated, averaging 233 inhabitants per square mile. There are frequent emigrations to Celebes and other parts of the archipelago. For that reason, and also on account of its excellent horses and numerous buffaloes, Saleyer is often compared with Madura, being of the same importance to Celebes as is Madura to Java.

Salgó Tarján, an important mining town of Hungary, in the county of Nógrád, with 9478 inhabitants in 1891. In the coal-mines more than 3000 workmen are employed; the mines produce yearly about 10 million metric centners of coal. There is a special establishment for the workmen, having a hospital, baths, school, &c. There are also an iron-refinery and an iron-plate factory, with about 400 houses for workmen, together with several public institutions. Population (1901), 13,552.

Saliany, a district town of Russian Transcaucasia, in the government and 33 miles from the Adji–Kabul railway station (112 miles from Baku), on the river Kura, at the head of an island of same name. In 1897 its population was 10,168, chiefly Tatar. It is the centre of the fishing-grounds on the river Kura, the yearly revenue derived from which is 1,174,700 roubles; thousands of workers come together from all parts of Russia during the fishing season. Saliany was annexed to Russia in the 18th century, but was retaken by the Persians, and only became Russian finally in 1813. Five miles to the north are situated the ruins of Hershasib, the capital of the Shahs of Shirvan, destroyed by the Mongols in 1285.

Salina, a city of Kansas, U.S.A., capital of Saline county, on the river Smoky Hill, near the mouth of the Saline, and near the centre of the state, at an altitude of 1224 feet. It is situated in a fertile farming region, and has grain elevators and flour-mills, power being obtained from the river. It is the seat of Kansas Wesleyan University, a Methodist Episcopal institution, opened in 1886, which had in 1899 a faculty of 7 professors, and was attended by 79 students. Population (1890), 6149; (1900), 6074, of whom 579 were foreign-born and 356 negroes.

Salisbury, or New Sarum, a city, municipal and parliamentary borough (returning since 1885 only one member), and county town of Wiltshire, England, on the Avon, 83 miles west-south-west of London by rail. In recent years the cathedral tower and spire have undergone considerable repairs. The more important educational establishments comprise a theological college, a diocesan training school for elementary teachers, a school for boys, with numerous scholarships, a school of science and art, a school built by Bishop Wordsworth in 1889, used for technical instruction, and the Godolphin high-class school for girls. Modern erections are a county hall, a free library, and swimming baths. A Victoria Park of 16 acres was provided in 1887, when there was erected a statue of Henry Fawcett, a native of Salisbury. Area of municipal borough, 600 acres. Population (1881), 14,792; (1901), 17,117.

Salisbury, a city of North Carolina, U.S.A., capital of Rowan county. It is on the Southern Railway, in the "piedmont" region, west of the centre of the state. It is the seat of Livingstone College for negroes. Population (1890), 4418; (1900), 6277, of whom 69 were foreign-born and 2408 negroes.

Salisbury (*Rhodesia*). See Rhodesia (South).

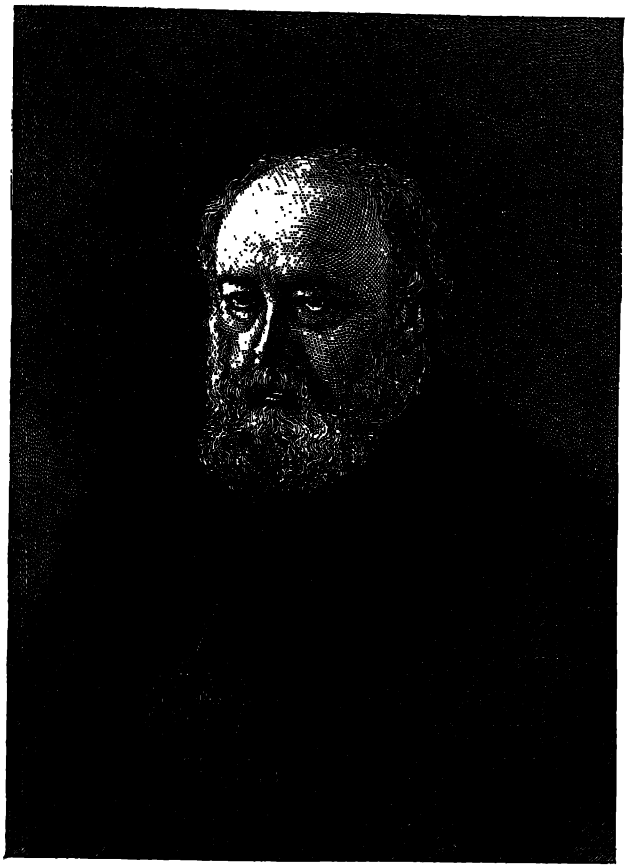
Salisbury, Robert Arthur Talbot Gascoyne-Cecil, 3rd Marquis of, (1830-——), British statesman, second son of James, 2nd marquis (Lord Privy Seal 1852, Lord President of Council 1858) by his first wife, Frances Mary Gascoyne, was born at Hatfield on 3rd February 1830, and was educated at Eton and Christ Church, Oxford, where he took his degree in 1850. At Oxford he was an active member of the Union Debating Society, and filled the office of treasurer. The first few years after leaving the university were spent by Lord Robert Cecil (as he then was) in travel, as far afield as New Zealand; but in 1853 he was returned unopposed to the House of Commons as Conservative member for Stamford, being elected in the same year a fellow of All Souls. He made his maiden speech in Parliament on 7th April 1854, in opposition to Lord John Russell's Oxford University Bill. The speech was marked by scepticism as to the utility of reforms, and Lord Robert prophesied that if the wishes of founders were disregarded, nobody would in future care to found anything. Fifteen months later he was chosen by his party to second "the previous question" in the debate on Mr Roebuck's vote of no confidence in Lord Palmerston's Government. In 1857 he appeared as the author of his first Bill—for establishing the voting-paper system at parliamentary elections; and in the same year he married Georgina Caroline, daughter of Sir Edward Holt Alderson, a baron of the Court of Exchequer, a large share of whose great intellectual abilities she inherited. From that time Lord Robert Cecil continued to be active not only in politics, but, for several years, in journalism, the income he earned by his pen being then a matter of pecuniary importance to him. One of his contemporaries at Oxford had been Thomas Hamber of Oriel, who became editor of the *Standard*, and during these years Cecil was an occasional contributor of "leaders" to that paper. He also contributed to the *Saturday Review*, founded in 1855 by his brother-in-law Beresford Hope, and edited by his friend Douglas Cook; not infrequently he wrote for the *Quarterly* (where, in 1867, he was to publish his famous article on "the Conservative Surrender"); and in 1858 he contributed to *Oxford Essays* a paper on "The Theories of Parliamentary Reform," giving expression to the more intellectual and aristocratic antagonism to doctrinaire Liberal views on the subject, while admitting the existence of many anomalies in the existing electoral system. In February of the next year, when the question was taken up by the Conservative Government, and Disraeli introduced his Reform Bill with its "fancy franchises," the member for Stamford was prominent among its critics from the Tory point of view. During the seven years that followed, Lord Robert was always ready to defend the Church, or the higher interests of Conservatism and property; and his speeches then, not less than later, showed a caustic quality and a tendency to what became known as "blazing indiscretions." For example, when the repeal of the paper duty was being discussed in 1861, he asked whether it "could be maintained that a person of any education could learn anything worth knowing from a penny paper"—a question the answer to which has been given by the powerful, highly organized, and admirable Conservative penny press of a subsequent day. A little later he declared the proceedings of the Government "more worthy of an attorney than of a statesman"; and on being rebuked, apologized—to the attorneys. He also charged Lord John Russell with adopting "a sort of tariff of insolence" in his dealings with foreign Powers, strong and weak.

Early years in Parliament.

It was not, however, till the death of Lord Palmerston and the removal of Lord John Russell to the House of Lords had brought Mr Gladstone to the front, that Lord Robert Cecil — who became Lord Cranborne by the death of his elder brother on 14th June 1865—began to be accepted as a politician of the first rank. His emergence coincided with the opening of the new area in English politics, ushered in by the practical steps taken to extend the parliamentary franchise. On 12th March 1866 Mr Gladstone brought forward his measure to establish a £7 franchise in boroughs and a £14 franchise in counties, which were calculated to add 400,000 voters to the existing lists. Lord Cranborne met the Bill with a persistent opposition, his rigorous logic and merciless hostility to clap-trap tending strongly to reinforce the impassioned eloquence of Mr Lowe. But though he attacked the Government Bill both in principle and detail, he did not absolutely commit himself to a position of hostility to Reform of every kind; and on the defeat of Mr Gladstone's Ministry, no surprise was expressed at his joining the Cabinet of Lord Derby as secretary of state for India, even when it became known that a settlement of the Reform question was part of the Tory programme. The early months of the new Government's tenure were marked by the incident of the Hyde Park riots; and whether or not the fall of the Park railings determined the question of Reform, it is at least certain that if there had been members of the Cabinet and party who believed up to that time that the Reform question was not urgent, the action of the Reform League and the London populace forced them to a different conclusion. On 11th February Mr Disraeli informed the House of Commons that the Government intended to ask its assent to a series of thirteen resolutions; but when, on 26th February, the Liberal leaders decided to oppose them and to demand that the Government should produce a Bill, Mr Disraeli at once consented to do so. The introduction of a Bill was, however, delayed by the resignation of Lord Cranborne, General Peel, and Lord Carnarvon. The Cabinet had been considering two alternative measures, widely different in kind and extent, and the final decision between the two was taken in ten minutes (whence the nickname of the "Ten Minutes Bill") at an informal gathering of the Cabinet held just before Lord Derby was engaged to address a general meeting

Cabinet minister: the Franchise Question: resignation 1867.

of the party. At a Cabinet council, held on 23rd February, measure A had been agreed upon, the three doubtful ministers having been persuaded that the checks and safeguards provided were sufficient; in the interval between Saturday and Monday they had looked more closely into the statistics, and had come to the conclusion that the checks were inadequate; on Monday morning they had gone to Lord Derby and told him so; at two o'clock the rest of the Cabinet, hastily summoned, had been informed of the new situation, and had there and then, before the meeting at half-past two, agreed, in order to retain their three colleagues, to throw over measure A, and to present measure B to the country as the fruit of their matured and unanimous wisdom. Lord Derby at the meeting, and Mr Disraeli a few hours later in the House of Commons, explained their new measure—a measure based upon a £6 franchise; but their own side did not like it, the Opposition were furious, and the moral sense of the country was revolted by the undisguised adoption of almost the very Bill which the Conservatives had refused to accept from their opponents only a year before. The result was that the Bill was never introduced; the Government reverted to measure A, and the three ministers again handed in their resignations. In the debate on the third reading of the Bill, when its passage through the House of Commons without a division was assured, Lord Cranborne showed with caustic rhetoric how the "precautions, guarantees, and securities" with which the Bill had bristled on its second reading had been dropped one after another at the bidding of Mr Gladstone.



THE MARQUIS OF SALISBURY.
(*From a photo by Elliott and Fry, London.*)

In countries where politics are conducted on any other than the give-and-take principles in vogue in England, such a breach as that which occurred in 1867 between Lord Cranborne and his former colleagues, especially Mr Disraeli, would have been beyond repair. But, Lord Cranborne, though an aristocrat both by birth and by conviction, was not impracticable; moreover, Mr Disraeli, who had himself risen to eminence through invective, admired rather than resented that gift in others; and their common opposition to Mr Gladstone was certain to reunite the two colleagues. Nothing of great moment occurred during the session of 1868. Everybody was content to look forward to the new elections in the autumn. But although no legislation of great moment was attempted, Mr Gladstone was not afraid to show his hand, and to announce that he meant to take up the Irish question, and to deal especially with the celebrated "Upas tree," of which the first branch was the Established Church. By way of giving full notice to the electorate, he brought in a series of resolutions on this question; and though the attitude adopted by the official Conservatives towards them was not one of serious antagonism, Lord Cranborne vigorously attacked them, and declared himself altogether in favour of upholding the Establishment. This was his last speech in the House of Commons, for on 12th April his father died, and he became 3rd marquis of Salisbury.

In the House of Lords.

In the House of Lords the new Lord Salisbury's style of eloquence — terse, incisive, and wholly free from false ornament—found an even more appreciative audience than it had met with in the House of Commons. The questions with which he was first called upon to deal were questions in which his interest was keen—the recommendations of the Ritual Commission and, some time later, the Irish Church Suspensory Bill. Lord Salisbury's argument, with which the Lords readily agreed, was that the last session of an expiring Parliament was not the time in which so grave a matter as the Irish Church Establishment should be judged or prejudged; that a Suspensory Bill involved the question of disestablishment; and that such a principle could not be accepted by the Lords until the country had been appealed to upon it and had pronounced decisively in its favour. Even then there were those who raised the cry that the only business of the House of Lords was to register the decisions of the Commons, and that if they refused to do so it was at their peril. Lord Salisbury met this cry boldly and firmly:—

> "When the opinion of your countrymen has declared itself, and you see that their convictions—their firm, deliberate, sustained convictions—are in favour of any course, I do not for a moment deny that it is your duty to yield."

In the very next session Lord Salisbury was called upon to put his view into practice, and his influence went far to persuade the peers to pass the Irish Church Disestablishment Bill. In his opinion the general election of the autumn of 1868 had been fought on this question; his friends had lost, and there was nothing for them to do but to bow to the necessities of the situation. The story of his conduct in the matter has been told in some fulness in the *Life* of Archbishop Tait, with whom Lord Salisbury acted, and who throughout those critical weeks played a most important part as mediator between the two extreme parties—those of Lord Cairns (representing Ulster) and Mr Gladstone. October 1869 saw the death of the old Lord Derby, who was still the titular leader of his party; and he was succeeded as leader of the House of Lords by Lord Cairns. For the dignified post of chancellor of the university of Oxford, Convocation unanimously chose as Lord Derby's successor the marquis of Salisbury. Lord Derby had translated the *Iliad* very well, but his successor was far more able to sympathize with the academic mind and temper. Lord Salisbury was at heart a student, and found his best satisfaction in scientific

research and in scientific speculation; while still a young man he had made useful contributions to the investigation of the flora of Hertfordshire, and at Hatfield he had his own laboratory, where he was able to satisfy his interest in chemical and electrical research. As regards his connexion with Oxford may be mentioned, in particular, his appointment, in 1877, of a second University Commission, and his appearance, in September 1894, in the Sheldonian Theatre as president of the British Association.

It is not necessary to dwell at any length upon the part taken by Lord Salisbury between 1869 and 1873 in respect of the other great political measures of Mr Gladstone's Government—the Irish Land Act, the Act Abolishing Purchase in the Army, Mr Forster's Education Act, &c. Nor does his attitude towards the Franco-German War of 1870–71 call for any remark; an English leader of Opposition is bound, even more than a minister, to preserve a discreet silence on such occasions. But early in 1874 came the dissolution, suddenly announced in the famous Greenwich letter of Mr Gladstone, with the promise of the abolition of the income tax. For the first time since 1841 the Conservatives found themselves in office with a large majority in the House of Commons. In Mr Disraeli's new Cabinet in 1874 Lord Salisbury accepted his old position at the India Office. The first task with which the new secretary of state had to deal was one of those periodical famines which are the great scourge of India; he supported the action of Lord Northbrook, the viceroy, and refused to interfere with private trade by prohibiting the export of grain. This attitude was amply justified, and Lord Salisbury presently declared that the action of the Government had given so much confidence to private traders that, by their means, "grain was pouring into the distressed districts at a greater rate than that which was being carried by the public agency, the amount reaching nearly 2000 tons a day." The Public Worship Regulation Bill of 1874 was the occasion of a famous passage of arms between Lord Salisbury and his chief. The Commons had inserted an amendment which, on consideration by the lords, Lord Salisbury opposed, with the remark that it was not for the peers to attend to the "bluster" of the lower House merely because a small majority there had passed the amendment. The new clause was accordingly rejected, and the Commons eventually accepted the situation; but Disraeli, banteringly criticizing Lord Salisbury's use of the word "bluster," alluded to him as "a man who does not measure his phrases. He is one who is a great master of gibes and flouts and jeers."

Disraeli Cabinet of 1874.

From the middle of 1876 the Government was occupied with foreign affairs. In regard to the stages of Eastern fever through which England passed between the occurrence of the Bulgarian "atrocities" and the signature of the Treaty of Berlin, the part played by Lord Salisbury was considerable. The excesses of the Bashi-Bazouks took place in the early summer of 1876, and were recorded in long and highly-coloured despatches to English newspapers; presently there followed Mr Gladstone's pamphlet on *Bulgarian Horrors*, his speech on Blackheath, and his enunciation of a "bag and baggage" policy towards Turkey. The autumn went by, Servia and Montenegro declared war upon Turkey and were in imminent danger of something like extinction. On 31st October Russia officially interfered and demanded an armistice, which Turkey granted; and England immediately proposed a conference at Constantinople, at which the Powers should endeavour to make arrangements with Turkey for a general pacification of her provinces and of the inflammable communities adjoining. At this conference England was represented by Lord Salisbury. It met early in December, taking for its basis the English terms, namely, the *status quo ante* in Servia and Montenegro; a self-denying ordinance on the part of all the Powers; and the independence and territorial integrity of the Ottoman empire, together with large administrative reforms assured by guarantees. General Ignatieff, the Russian ambassador, was effusively friendly with the English envoy; but though the philo-Turkish party in England professed themselves scandalized, it is certain that Lord Salisbury made no improper concessions to the schemes of Russia, and departed in no way from his instructions and from the agreed policy of the British Cabinet. On 20th January the conference broke up, Turkey having declared its recommendations inadmissible; and Europe withdrew to await the inevitable declaration of war. Very early in the course of that war the intentions of England were clearly indicated in a despatch of Lord Derby to the British representative at St Petersburg, which announced that so long as the struggle concerned Turkish interests alone Great Britain would be neutral, but that such matters as Egypt, the Suez Canal, the regulations affecting the passage of the Dardanelles, and the possession of Constantinople itself would be regarded as matters to which she could not be indifferent. The war went on, and for some nine months none of these British interests appeared to be threatened, nor had Lord Salisbury's own department to concern itself very directly with the progress of the belligerents. Once or twice, indeed, the Indian secretary committed himself to statements which laid him open to a good deal of attack, as when he rebuked an alarmist by bidding him study the Central Asian question "in large maps." But with the advance of Russia through Bulgaria and across the Balkans, English anxiety grew. In mid-December explanations were asked from the Russian Government as to their intentions with regard to Constantinople. On 23rd January the Cabinet ordered the fleet to sail to the Dardanelles. Lord Carnarvon resigned, and Lord Derby handed in his resignation, but withdrew it. The Treaty of San Stefano was signed on 3rd March; and three weeks later, when its full text became known, the Cabinet met and decided upon measures which finally induced Lord Derby, at the end of the month, to retire from the Foreign Office, his place being immediately filled by Lord Salisbury. The new foreign secretary at once issued the famous "Salisbury circular" to the British representatives abroad, which appeared in the newspapers on 2nd April. This elaborate and dignified State paper was at once a clear exposition of British policy, and practically an invitation to Russia to reopen the negotiations for a European congress. These negotiations, indeed, had been proceeding for several weeks past; but Russia having declared that she would only discuss such points as she pleased, the British Cabinet had withdrawn, and the matter for the time was at an end. The bulk of the document consisted of an examination of the Treaty of San Stefano and its probable effects, Lord Salisbury justifying such an examination on the ground that as the position of Turkey and the other countries affected had been settled by Europe in the Treaty of Paris in 1856, the Powers which signed that treaty had the right and the duty to see that no modifications of it should be made without their consent.

The Eastern Question.

Succeeds Lord Derby as foreign minister.

The effect of the circular was great and immediate. At home the Conservatives were encouraged, and many moderate Liberals rallied to the Eastern policy of the Government. Abroad it seemed as if the era of divided councils was over, and the Russian Government promptly recognized that the circular meant either a congress or war with England. For the latter alternative it was by no means prepared, and very soon negotiations were reopened, which led to the meeting of the congress at Berlin on

13th June. The history of that famous gathering and of its results is narrated under EUROPE. Lord Beaconsfield on two or three subsequent occasions referred to the important part that his colleague had played in the negotiations, and he was not using merely the language of politeness. Rumours had appeared in the London press as to a supposed Anglo-Russian agreement that had been signed between Lord Salisbury and the Russian ambassador, Count Shuvaloff, and these rumours or statements were described by the foreign secretary in the House of Lords, just before he left for Berlin, as "wholly unauthentic." But on 14th June what purported to be the full text of the agreement was published by the *Globe* newspaper through a certain Charles Marvin, at that time employed in occasional transcribing work at the Foreign Office, and afterwards known by some strongly anti-Russian books on the Central Asian question. Marvin was prosecuted, but the law as it then was could not touch him for his breach of confidence, and it was only by a subsequent Act of Parliament that such conduct was made penal. Besides the general inconvenience of the disclosure, the agreement, which stipulated that Batum and Kars might be annexed by Russia, made it impossible for the congress to insist upon Russia entirely withdrawing her claim to Batum, though at the time of the meeting of the congress it was known to some of the negotiators that she was not unwilling to do so. In one respect Lord Salisbury's action at the congress was unsuccessful. Much as he disliked the sentimentalism of Mr Gladstone, he was not without a certain sentimentalism of his own, and at the Berlin Congress this took the form of an unexpected and, as it happened, useless pushing of the claims of Greece. But in the main Lord Salisbury must be held to deserve, almost equally with his great colleague, the credit for the Berlin settlement. Great, however, as was the work done at Berlin, and marked the relief to all Europe which was caused by the signing of the treaty, much work, and of no pleasant kind, remained for the British Foreign Office and for the Indian Government before the Beaconsfield Parliament ended and the Government had to render up its accounts to the nation. Russia, foreseeing a possible war with England, had during the spring of 1878 redoubled her activity in Central Asia, and almost at the very time that the treaty was being signed, her mission was received at Kabul by the Amir Sher Ali. Out of the Amir's refusal to receive a counterbalancing British mission there grew the Afghan war; and though he had ceased to control the India Office, Lord Salisbury was naturally held responsible for some of the preliminary steps which, in the judgment of the Opposition, had led to these hostilities. But Lord Granville and his friends entirely failed to fix upon Lord Salisbury the blame for a series of events which, considering the action of Russia, the personal disposition of Sher Ali, and the excited nature of the frontier tribes, was generally seen to be inevitable. A defence of the foreign policy of the Government during the year which followed the Berlin Treaty was made by Lord Salisbury in a speech at Manchester (October 1879), which had a great effect throughout Europe. In it he justified the occupation of Cyprus, and approved the beginnings of a league of central Europe for preserving peace.

At Berlin Congress.

In the spring of 1880 the general election overthrew Lord Beaconsfield's Government and replaced Mr Gladstone in power, and the country entered upon five eventful years, which were to see the consolidation of the Parnellite party, the reign of outrage in Ireland, disasters in Zululand and the Transvaal, war in Egypt, a succession of costly mistakes in the Sudan, and the final collapse of Mr Gladstone's Government on a trifling Budget question. The defeat of 1880 greatly depressed Lord Beaconsfield, who till then had really believed in that "hyperborean" theory upon which he had acted in 1867—the theory that beyond and below the region of democratic storm and violence was to be found a region of peaceful conservatism and of a dislike of change. After the rude awakening of April 1880 Lord Beaconsfield seems to have lost heart and hope, and to have ceased to believe that wealth, birth, and education would count for much in future in England. Lord Salisbury, who on Lord Beaconsfield's death a year later was chosen, after the claims of Lord Cairns had been withdrawn, as leader of the Conservative peers (Sir Stafford Northcote continuing to lead the Opposition in the lower House), was not so disposed to counsels of despair. After the Conservative reaction had come in 1886, he was often taunted with pessimism as regards the results, and he certainly spoke on more than one occasion in a way which appeared to justify the caricatures which appeared of him in the Radical press in his character of Hamlet; but in the days of Liberal ascendancy Lord Salisbury was confident that the tide would turn. We may pass briefly over the years of Opposition between 1880 and 1885; the only policy that could then wisely be followed by the Conservative leaders was that of giving their opponents sufficient rope. In 1884 a new Reform Bill was introduced, extending household suffrage to the counties; this was met in the Lords by a resolution, moved by Lord Cairns, that the peers could not pass it unaccompanied by a Redistribution Bill. The Government, therefore, withdrew their measure. In the summer and autumn there was a good deal of agitation; but in November a redistribution scheme was settled between the leaders of both parties, and the Bill passed. When, in the summer of 1885, Mr Gladstone resigned, it became necessary for the country to know whether Lord Salisbury or Sir Stafford Northcote was the real Conservative leader; and the Queen settled the matter by at once sending for Lord Salisbury, who became prime minister for the first time in 1885.

Leader of Conservative party.

The "Forwards" among the Conservatives, headed by Lord Randolph Churchill, brought so much pressure to bear that Sir Stafford Northcote was induced to enter the House of Lords as earl of Iddesleigh, while Sir Michael Hicks Beach was made leader of the House of Commons, Lord Randolph Churchill secretary for India, and Mr Arthur Balfour president of the Local Government Board. The new Government had only to prepare for the general election in the autumn. The ministerial programme was put forward by Lord Salisbury on 7th October in an important speech addressed to the Union of Conservative Associations assembled at Newport, in Monmouthshire; and in this he outlined large reforms in local government, poured scorn upon Mr Chamberlain's Radical policy of "three acres and a cow," but promised cheap land transfer, and opposed the disestablishment of the Church as a matter of life or death to the Conservative party. In this Lord Salisbury was declaring war against what seemed to be the danger should Mr Chamberlain's "unauthorized programme" succeed; while the comparative slightness of his references to Ireland showed that he had no more suspicion than anybody else of the event which was about to change the whole face of English politics, to break up the Liberal party, and to change the most formidable of the advanced Radicals into an ally and a colleague. The general election took place, and there were returned to Parliament 335 Liberals, 249 Conservatives, and 86 Home Rulers; so that if the last two parties had combined, they would have exactly tied with the Liberals. The Conservative Government met Parliament, and after a short time were put into a minority of 79 on a Radical

Prime minister, 1885.

land motion, brought in by Mr Chamberlain's henchman, Mr Jesse Collings. Mr Gladstone's return to office, and his announcement of a Bill giving a separate Parliament to Ireland, were quickly followed by a great meeting at Her Majesty's Theatre, at which Lord Salisbury, Lord Hartington, Mr Goschen, and some Radical members met on the same platform; the secession of the Unionist Liberals; the defeat of the Bill; an appeal to the country; and the return of the Unionist party to power with a majority of 118. Lord Salisbury at once offered to make way for Lord Hartington, but the suggestion that the latter should form a Government was declined; and the Conservatives took office alone, with an Irish policy which might be summed up, perhaps, in Lord Salisbury's words as "twenty years of resolute government." For a few months, until just before his sudden death on 12th January 1887, Lord Iddesleigh was foreign secretary; but Lord Salisbury, who meanwhile had held the post of lord privy seal, then returned to the Foreign Office. Meanwhile the increasing friction between him and Lord Randolph Churchill, who, amid many qualms on the part of more old-fashioned Conservatives, had become chancellor of the exchequer and leader of the House of Commons, had led to the latter's resignation, which, to his own surprise, was accepted; and from that date Lord Salisbury's effective primacy in his own party was unchallenged.

Unionism: Prime minister, 1886.

Only the general lines of Lord Salisbury's later political career need here be sketched. As a consequence of the practical monopoly of political power enjoyed by the Unionist party after the Liberal disruption of 1886—for even in the years 1892–95 the situation was dominated by the permanent Unionist majority in the House of Lords—Lord Salisbury's position became unique. These were the long-looked-for days of Conservative reaction, of which he had never despaired. The situation was, of course, complicated, so far as Lord Salisbury personally was concerned, by the coalition with the Liberal Unionists, which was confirmed in 1895 by the inclusion of the duke of Devonshire, Mr Chamberlain, and other Liberal Unionists in the Cabinet. But though it appeared anomalous that old antagonists like Lord Salisbury and Mr Chamberlain should be working together in the same ministry, the prime minister's position was such that he could disregard a superficial criticism which paid too little heed to his political faculty and his patriotic regard for the requirements of the situation. Moreover, the practical work of reconciling Conservative traditions with domestic reform depended rather on Lord Salisbury's nephew, Mr Balfour, who led the House of Commons, than on Lord Salisbury, who devoted himself almost entirely to foreign affairs. The new Conservative movement, moreover, in the country at large, was, in any case, of a more constructive type than Lord Salisbury himself was best fitted to lead, and though he was necessarily prime minister and was deeply respected both for his character and his past work, he was not the real source of the political inspiration even of the Conservative wing of the Unionist party during this period. He began to stand to some extent outside party and above it, a moderator with a keenly analytic and rather sceptical mind, but still the recognized representative of the British empire in the councils of the world, and the trusted adviser of his sovereign. Though himself the last man to be selected as the type of a democratic politician—for his references to extensions of popular government, even when made by his own party, were full of mild contempt—Lord Salisbury gradually acquired a higher place in public opinion than that occupied by any contemporary statesman. His speeches—which, though carelessly composed, continued to blaze on occasion with their old fire and their somewhat mordant cynicism—were weightier in tone, and became European events. Without the genius of Disraeli or the personal magnetism of Gladstone, he yet inspired the British public with a quiet confidence that under him things would not go far wrong, and that he would not act rashly or unworthily of his country. Even political opponents came to look on his cautious and balanced conservatism, and his intellectual aloofness from interested motives or vulgar ambition, as standing between them and something more distasteful. Moreover, in the matter of foreign affairs his weight was supreme. He had lived to become, as was indeed generally recognized, the most experienced working diplomatist in Europe. Lord Salisbury's position in this respect was shown in nothing better than in his superiority to criticism. In foreign affairs many among his own party regarded him as too much inclined to "split the difference" and to make "graceful concessions"—as in the case of the cession of Heligoland to Germany—in which it was complained that Great Britain got the worst of the bargain. But though occasionally, as in the withdrawal of British ships from Port Arthur in 1898, such criticism became acute, the plain fact of the preservation of European peace, often in difficult circumstances, reconciled the public to Lord Salisbury's conduct of affairs. His patience frequently justified itself, notably in the case of British relations with the United States, which were for a moment threatened by President Cleveland's message concerning Venezuela in 1895. And though his loyalty to the European Concert in connexion with Turkey's dealings with Armenia and Crete in 1895–98 proved irritatingly ineffectual—the pace of the concert, as Lord Salisbury explained, being rather like that of a steam-roller—no alternative policy could be contemplated as feasible in any other statesman's hands. Lord Salisbury's personal view of the new situation created by the methods of the Sultan of Turkey was indicated not only by a solemn and unusual public warning addressed to the sultan in a speech at Brighton, but also by his famous remark that in the Crimean war Great Britain had "put her money on the wrong horse." Among his most important strokes of diplomacy was undoubtedly the Anglo-German agreement of 1890, delimiting the British and German spheres of influence in East and West Africa; but it is impossible in this place to give a final appreciation of the actual part played by Lord Salisbury in the various diplomatic questions of so busy a time.

1886-1902.

A peer premier must inevitably leave many of the real problems of democratic government to his colleagues in the House of Commons. In the Upper House Lord Salisbury was paramount. Even when the peers had rejected the second reading of the Government Vaccination Bill, as emasculated in the House of Commons by the introduction of the "conscientious objector," Lord Salisbury brought all his authority to bear and got the vote reversed at another sitting, in spite of the obvious sense of the majority both of that House and of the Conservative party outside Parliament. Yet while vigorously opposing the Radical agitation for the abolition of the House of Lords, he never interposed a *non possumus* to schemes of reform. He was always willing to consider plans for its improvement, and in May 1888 himself introduced a Bill for reforming it and creating life peers; but he warned reformers that the only result must be to make the House stronger. To abolish it, on the other hand, would be to take away a necessary safeguard for protecting "Philip drunk" by an appeal to "Philip sober."

Lord Salisbury suffered a severe loss by the death in 1900 of his wife, whose influence with her husband had

been great, as her devotion had been unswerving. Her protracted illness was one among several causes, including his own occasional ill-health, which after 1895 made him leave as much as possible of the work of political leadership to his principal colleagues—Mr Arthur Balfour more than once acting as foreign secretary for several weeks while his uncle stayed abroad. But for some years it was felt that his attempt to be both prime minister and foreign secretary was a mistake; and after the election of 1900 Lord Salisbury handed over the seals of the Foreign Office to Lord Lansdowne, remaining himself at the head of the Government as lord privy seal. In 1902, upon the conclusion of peace in South Africa, he felt that the time had come to retire from office altogether; and on 11th July his resignation was accepted by the king, and he was succeeded as prime minister by Mr Arthur Balfour.

Salmon.—Since the appearance of the article SALMONIDÆ in the ninth edition of the *Encyclopædia Britannica*, important advances have been made in our knowledge of the life-history of the salmon, and the extension of our information promises to have a considerable influence on the future management of salmon fisheries. These advances are chiefly due to the investigations of Professor Miescher on the Rhine at Basel, of Professor Hoek in Holland, of Mr Archer as lessee of the river Sands in Norway and as inspector of salmon fisheries for Scotland in conjunction with Messrs Gray and Tosh, and of a number of workers in the laboratory of the Royal College of Physicians of Edinburgh. With regard to the *food* of salmon, the enormously rapid growth of smolts to grilse and of salmon from year to year shows that they feed in the sea. In a few months a smolt will increase from a few ounces to 4 or 5 ℔; while Mr Archer's weighings of 16 salmon which had been marked and recaptured in the following year showed an average gain of 36 per cent., reckoned on from kelt stage to kelt stage. During the season of 1895 Mr Tosh, at Berwick-on-Tweed, opened between March and August 514 fish, and found food in the stomachs of 76, or over 14 per cent. of the whole. As to the nature of the food, it was found to be as follows:—

Herring in	36 or 47 per cent.
Crustacea, amphipods, &c. . .	14 ,, 18 ,,
Sand eels	11 ,, 14 ,,
Haddock and whiting . . .	8 ,, 10 ,,
Feathers and vegetable matter .	7 ,, 9 ,,

Excluding the feathers and vegetable matter, which are not really of the nature of food, all the material found in the stomach was of marine origin. Hoek, out of 2000 fish examined by him, found 7 with food in the stomach, and, curiously enough, 4 of these were taken on the same day. In each case marine fish constituted the food. As to where salmon go to feed in the sea, our information is still very deficient, but the prevalence of herring in the stomach would seem to indicate that they must follow the shoals of these fish which approach the coast during the summer months. While there can be no doubt that salmon feed in the sea, the question of whether they feed in fresh water has been much debated. It is difficult for the popular mind to conceive of an active fish like the salmon subsisting for several months without food, and the fact that the fish so frequently not only takes into its mouth but actually swallows worms and various lures has still further tended to confirm many people in the conviction that salmon do feed in fresh water. In discussing the question it is well clearly to understand what is meant by feeding. It is the taking, digesting, and absorbing of material of use in the economy in such quantities as to be of benefit to the individual. Accepting this definition, it may at once be said that all the evidence we possess is entirely opposed to the view that salmon feed when in fresh water. Miescher examined the stomachs of about 2000 salmon captured at Basel, about 500 miles from the mouth of the Rhine, and in only two did he find any indication of feeding. These two fish were male kelts. One contained the remains of a cyprinoid fish, and the other had a dilated stomach with an acid secretion but no food remains. Hoek, who, as already stated, examined about 2000 fish, found food of marine origin in 7, but in none food derived from fresh water. Of the 132 stomachs of salmon from the estuaries and upper waters of Scottish rivers examined in the laboratory of the College of Physicians not one contained any food remains. The stomach of salmon captured in fresh water is collapsed and shrunken. Its mucous membrane is thrown into folds, and it contains a small amount of mucus of a neutral reaction. The intestine, which usually contains numerous tape-worms, is full of a greenish-yellow viscous material which, when examined under the microscope, is found to consist of mucus with shed epithelial and other cells and with masses of crystals of carbonate of lime. In no case does the microscope reveal any food remains such as fish-scales, plates of crustacea, or bristles of worms or annelids. In the fish taken in the estuaries up to the month of August the gall-bladder is distended; in those taken later in the year it is empty. In all the fish from the upper waters the gall-bladder is empty and collapsed. According to the investigations of Hoek and of Gulland, the lining membrane of the stomach and intestine degenerates while the fish is in the river, but the correctness of these observations has been denied by Brown and Kingston-Barton. Gillespie finds that the activity of the digestive processes is low in fish taken from the rivers, and that micro-organisms, which would be killed by the hydrochloric acid of the gastric juice were it actively secreted, flourish in the intestines of the fish from the upper waters. Those who believe that the salmon feeds in fresh water explain the fact that the stomach is always found empty by the supposition that the fish vomits any food when it is captured, and several descriptions of cases in which this has been observed might be quoted; but such observations must be accepted with caution, and the contracted state of the stomach, the absence of the hydrochloric acid of the gastric juice, and lastly the absence of any traces of digested food remains in the contents of the intestine, negative this explanation.[1]

The question may be presented in another way. Is there any reason why the salmon should feed while in fresh water? An animal feeds to get energy for the work it has to do, and to get material to make good the waste from its body and to build up its various tissues. The investigations carried on in the laboratory of the College of Physicians have definitely shown that the salmon leaves the sea with an enormous supply of nourishment stored in its muscles, and that during its sojourn in fresh water it gets its energy and builds up its rapidly growing ovaries and testes from this stored material. The method of investigation was to take specimens, some from the estuary and some from the upper reaches, from the stream of salmon constantly passing from the sea up the rivers. These were carefully examined, measured, weighed, and analysed, and from the difference of composition the

[1] The following extract from the report of the Brighton Aquarium further supports the view that salmon abstain from food for a prolonged period.—"The Usk salmon . . . was placed there [in the Aquarium] as a smolt on April 5, 1878, and in the following month was transferred to salt water, in which it remained for upwards of five years, feeding freely on shrimps, &c., during a portion of the year, but abstaining from food between August and February; this, it may be remarked, is the time when it would naturally have been in the river."

changes they had undergone during their sojourn in the fresh water were determined. Briefly stated, these investigations show that the supply of albuminous material and fats stored in the muscles and used while the fish is in the river is amply sufficient, first, to afford the material for the construction of the ovaries and testes, and, second, to yield an amount of energy so enormous that even the most sceptical must admit that it is amply sufficient for the greatest requirements of the fish. The amount of energy liberated from the fats and albuminous material is 570 times more than is required to raise the fish from the level of the estuary to that of the upper waters! These analyses further show that all the materials required for the construction of the ovaries and the testes are to be found in sufficient quantity in the muscles, with the exception of iron, which is, however, abundantly present in the blood.

It is a very common opinion that kelts feed voraciously while still in fresh water, and this has been used as an argument that they should be destroyed. It is not easy to bring forward such satisfactory evidence as has been adduced in the case of unspawned salmon, since it is illegal to kill kelts; but none of the 25 kelts procured by the Scottish Fishery Board, and examined in the College of Physicians' laboratory, contained any food, and Mr Anderson, formerly of Dunkeld, informs the writer that in the old days, when kelts were habitually killed when captured, he has opened a large number and never found any trace of food in the stomach. On the other hand, some fishers declare that they have seen kelts devouring salmon fry, but it is not easy to make accurate observations in deep water. According to Dr Gulland's investigations, the mucous membrane of the stomach and intestine is completely regenerated while the gall-bladder contains bile, and the digestive activity of the alimentary canal is greater than in salmon before spawning. Kelts thus appear at least to be capable of feeding.

The rate of growth of the genitalia has been carefully studied by Miescher, Archer, and Hoek. From January till about the end of May the growth of the ovaries is slow. In Hoek's series of observations, which are the most complete, they increased from ·35 to ·85 per cent. of the body weight. After this they enlarge more rapidly, and by the end of August are about 3 per cent. in salmon taken at the mouth of the Tweed, about 4 per cent. in the salmon from the mouth of the Rhine, and about 8 per cent. in the salmon from the Basel fisheries. By November they have risen to 20 per cent. in the Tweed and in Holland, and to 23 per cent. in the upper reaches of the Rhine. According to Mr Archer's observations, the development of the ovaries in grilse in the earlier months somewhat lags behind that in the salmon. The growth of the testes has been chiefly investigated by Archer and Tosh in the Tweed and by Miescher at Basel. From March to the middle of July in the Tweed these organs increase from about ·19 to ·35 per cent. of the weight of the fish. In July their rate of growth increases, and they reach their maximum development at the end of September, when they are about 6 per cent. of the body weight. In the Rhine in March they weigh about ·1 per cent., and they reach their maximum development of about 5 per cent. in October.

What leads to the migration of salmon from sea to river and river to sea? It is usually supposed that they come to the river to spawn; that it is the *nisus generativus* that drives them from the sea, where their ova will not develop, to the fresh water where development is possible. But it is found that salmon are passing from sea to river at all seasons of the year, and with their genitalia in all stages of development—some fish running in March with ovaries only 1 per cent. of the body weight, other fish not running till October with ovaries 15 or 16 per cent. of the body weight. It is difficult, then, to accept the theory that the sexual act is the governing factor. That it is a secondary factor seems to be indicated by the great run of fish in June, July, and August, when the genitalia are most rapidly growing. There is one respect, however, in which all the fish leaving the sea for the river agree, and that is in the amount of stored material accumulated in their bodies. In the early running fish this material is largely confined to the muscles, but in the later coming fish it is more equally distributed between muscles and genitalia. The amount of stored material may be measured by the amount of solids, and if we express the results of all the fish examined in terms of fish of uniform size—100 cm. in length—the following results are obtained:—

	Nov.*	Feb.	Mar.	Apr.	May and June.	July and Aug.	Oct. and Nov.	Kelts.
Muscles .	2481	2214	2355	2599	2210	2270	1750	946
Ovaries .	23	24	24	33	47	72	545	9
Total .	2504	2238	2379	2632	2257	2340	2295	955

* Winter fish not due to spawn till following November.

It would thus appear that, when the salmon has in the sea accumulated a certain definite amount of nourishment, it ceases to feed, and returns to the river irrespective of the state of its genital organs. Nutrition, and not the *nisus generativus*, appears to be the motive power. That the fish after spawning returns to the sea in search of food is fully recognized by all.

Course of Migration.—It is well known that while salmon run all the year through in greater or lesser numbers, the run of grilse takes place in the summer months, from May to August. But it is further possible to divide the salmon into classes—the so-called winter salmon of the Rhine, large fish running from October to February, with unripe ovaries and testes; and the summer salmon, running for the most part from March to October, with genitalia more or less ripe. These summer fish are small in the early months, but increase in size as the autumn advances. The winter salmon, along with the early summer or spring fish, appear to pass directly to the upper reaches of the river, and to spawn there, while the larger late-coming fish appear to populate the lower waters. This seems to be indicated by the comparison of upper-water and estuary fish throughout the year. The period at which male and female fish enter the rivers also appears to be somewhat different. The following table gives the percentages of males to the total number of salmon captured during the different months of the year, according to the observations of Tosh, Miescher, and Hoek:—

Percentage of Male Fish.

	Tosh. Mouth of Tweed.	Hoek. Mouth of Rhine.	Miescher. Upper Reaches of Rhine.	
			1878.	1879.
January . .	...	34·3	...	...
February . .	26·7	29·7	...	...
March . . .	28·8	29·4	...	...
April . . .	20·5	34·7	...	...
May . . .	22·3	28·7	...	...
June . . .	22·5	32·9	...	...
July . . .	27·3	37·6	29·7	19·4
August . .	26·1	32·7	24	26·8
September . .	29·6	...	44·5	38·4
October . .	...	44	42·4	52·4
November . .	...	39·6	28·8	46·2
December . .	...	31·7	...	...
Total .	24·6	33·2	34·4	40·5

These figures show that throughout the year the female fish exceed the males in number, and, secondly, that during the earlier months of the year female fish run in much larger numbers than do male fish. In fact, it is only in September that anything like an equality between the two sexes is established. But in Great Britain it is not until the end of August that the nets are removed, and one cannot but believe that the destruction of such a very large proportion of females as are captured during the early months of the season must have a most prejudicial effect upon the breeding stock.

Rate of Migration.—By a comparison of the first appearance of winter salmon and of grilse in the markets of Holland and of Basel—500 miles up the river—Miescher gives some data for the determination of the average rate at which salmon ascend an unobstructed stream. It was found that winter salmon appeared at Basel about 54 days after their appearance in Holland, which would give a rate of passage of about 10 miles per diem. From a smaller number of observations on grilse, it appears that they travel at a somewhat slower rate. It is, however, doubtful how far these figures are of value in deciding the rate at which fish pass up the lower reaches of the river.

The Food Value of Salmon from the Estuaries and the Upper Waters at different Seasons.—Dr Dunlop, using the extensive series of analyses made in the laboratory of the Royal College of Physicians of Edinburgh, concludes that "the food value of salmon flesh is greater when the fish is fresh run than when it has been some time in fresh water; that it diminishes as the season advances both in the estuaries and in the upper-water fish; and that the flesh of salmon caught in the upper reaches in October and November has only about one-half the value of the flesh of early estuary fish." The total food value of a salmon depends upon the quantity and quality of the flesh. The amount of flesh depends upon its length and its muscular development. (1) The total food value of estuary fish remains nearly constant throughout the year, the poorer quality of flesh in the later months being compensated for by the larger average size of the fish. (2) From May to August the total food value of fish caught in the upper waters is about one-third less than that of estuary fish. (3) The food value of upper-water fish in October and November is only about one-half that of the upper-water fish earlier in the year, and about one-third that of the estuary fish.

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Salon, a town and railway station, arrondissement of Aix, department of Bouches du Rhône, 30 miles north-west of Marseilles, on the Canal de Craponne. Manufactures of so-called olive oil (but to the preparation of which various oil-seeds largely contribute) and soap are extensively carried on in numerous establishments—about 400 of the former and 20 of the latter. The town is of considerable antiquarian interest. Population (1881), 4983; (1901), 12,872.

Salonica, a vilayet (province) of Turkey, with an area of about 19,375 square miles and an estimated population of 1,050,000 inhabitants. The population of the town numbers 95,000, of whom 32,000 are Turks; 47,000, Jews; and 16,000 Greeks and Europeans. It is divided into 74 "quarters"—45 Turkish, 16 Jewish, 12 Greek, and 1 European. It contains 56 mosques, 23 tekkés, 16 churches, and 25 synagogues. Salonica is the centre of the import trade of the whole of Macedonia and part of Albania, being at the same time the principal port for shipment for the numerous products of that fertile region. The new harbour, which was opened to navigation in December 1901, allows the direct transhipment of all merchandise, whatever may be the direction of the wind, which was previously apt to render shipping operations difficult. The harbour works consist of a breakwater 560 metres long, with 28 feet depth of water on its landward side for a width of 150 metres. Opposite the breakwater is a quay 450 metres long and 85 metres in breadth, at each end of which a pier 200 metres long projects into the sea. Between the extremities of these two piers and those of the breakwater are the two entrances to the harbour. Salonica exports grain, silk cocoons, manganese, hides and skins, cattle, wool, opium, tobacco, oil-seeds, and fennel. In 1900 the exports were valued at £1,220,575—this is exclusive of the coasting trade; and the imports at £2,553,450. The latter consist principally of textiles, iron goods, sugar, tobacco, flour, coffee, and chemicals. The volume of the export trade has appreciably decreased. The main reason for this diminution is to be found in the rude methods of cultivation, which disable farmers from competing, either in quality or price, with the produce of countries wherein agricultural practice is more advanced. The industrial enterprises consist of several steam flour-mills, two cotton-spinning mills, two steam brick and tile factories, a brewery, a soap factory, and a small tannery. The making of morocco leather and other leather-work, such as saddlery, harness, and foot-gear of all sorts, affords employment to a large number of persons. Cutlery of the coarser sort, side-arms, field implements, and other ironmongery are made in considerable quantities. The spirit called mastic or raki is largely produced. Road-making in the vilayet of Salonica is not carried out on any settled plan or fixed principle, and the maintenance and repair of existing roads is equally a matter of chance. These latter, however, are few in number. Three railways traverse the vilayet—(1) a branch of the Oriental Railway, going due north from Salonica to Uskub and Nish; (2) the Junction Railway, between Salonica and Dedéagatch; (3) the Salonica–Monastir line. Salonica is well provided with schools—Turkish, Greek, Jewish, Italian, French, Servian, and Bulgarian.

Salop. See SHROPSHIRE.

Salta, a province in the north-west of the Argentine republic, bounded on the N. by the province of Jujuy and Bolivia, on the E. by the territories of Formosa and of the Chaco, on the S. by the provinces of Santiago, Tucumán, and Catamarca, and on the W. by Chile. Official area at the census of 1895, 62,184 square miles. Population in 1869, 88,933; in 1895, 118,015. The capital, Salta, on the Rio Salta, had a population of 16,672 in 1895, and is distant by rail 1571 kilometres from Buenos Aires. The province is divided into 21 departments. In 1895 there were 7398 farms and 134,993 acres planted in cereals.

Saltash, a municipal borough, Cornwall, England, in the Bodmin parliamentary division of the county, on the river Tamar, 5 miles north-west of Plymouth by rail. It was first incorporated in the reign of King John, and its charter has been confirmed in several reigns, finally in 1883. Until disfranchised in 1832 the borough returned two members to Parliament. It is governed by a mayor, 4 aldermen, and 12 councillors. The Royal Albert bridge, which carries the railway across the river, was built in 1857–59 at a cost of £230,000. A cottage hospital was erected in 1887, and the Wesley centenary chapel in 1891.

In Victoria Park is a monument to General Sir W. Penn-Symons, killed in the South African war, 1899. A steam ferry, free to inhabitants of the town, belongs to the corporation. There is also an efficient service of river passenger steamers. Population (1881), 2563; (1901), 3357.

Saltcoats, a police burgh (1885), seaport, and watering-place of Ayrshire, Scotland, 19 miles north of the county town by rail. Modern erections are a town-hall and a bathing station; there is also a mission coast home. Some fishing is done. A large number of the inhabitants find employment at Ardrossan and Stevenston. Two public schools had an average attendance of 1064 in 1898–99, and a Roman Catholic school 277. Valuation in 1885–86, £14,687; 1899–1900, £33,240. Population (1881), 5096; (1901), 8121.

Saltillo.—See Coahuila.

Salt Lake, the largest city and capital of Utah, U.S.A., and capital of Salt Lake county. It it situated in 40° 46′ N., longitude 111° 54′ W., at the west base of the Wasatch range, near the river Jordan and the west shore of Great Salt Lake. It is in the northern part of the state, and has an altitude in the lower part of the city of 4240 feet. It is the headquarters of the Mormon Church, or the Church of Jesus Christ of Latter Day Saints. The site of the city is a plain, sloping gently towards the north-west. On this it is laid out with the greatest regularity, in blocks 660 feet square, separated by well-shaded streets 132 feet wide. Temple Square, enclosing most of the buildings of the Mormon Church, is the centre of the city, and the streets surrounding it are known respectively as North, East, South, and West Temple Streets. The streets north of North Temple are known as 1st North, 2nd North, &c., and those west, east, and south similarly. The city is divided into five wards. It has an excellent water-supply from small streams flowing out of the Wasatch range, and is well sewered. A few of the streets in the business part are paved with asphalt, but most of them are merely gravelled. The Mormon Temple, which was completed in 1893, forty years after the laying of its corner-stone, is an exceedingly ornate building of grey granite, and is said to have cost $4,000,000. Other buildings in the Temple block are the Tabernacle, assembly hall, endowment house, offices and former residences of Brigham Young, &c. Salt Lake is entered by the Rio Grande Western, the Oregon Short Line, and the Salt Lake and Ogden railways, besides lines running to the resorts on the shore of Great Salt Lake, known as Saltair and Garfield Beach. The manufactures are not of great importance. In 1890 there were 175 manufacturing establishments, with a total capital of $3,354,035. They employed 2287 hands, and the product was valued at $4,624,419. It is the seat of the University of Utah, a non-sectarian institution, opened in 1850. In 1899 it had a faculty numbering 22, and was attended by 641 students, more than half of whom were women. The assessed valuation of real and personal property was, in 1900, $31,950,210, the net debt of the city was $3,383,135, and the rate of taxation was $28.10 per $1000. Population (1890), 44,843; (1900), 53,531, of whom 2741 were foreign-born and 514 coloured, including 278 negroes. Of 13,639 males 21 years of age and over, 203 were illiterate (could not write).

Salto, a city of Uruguay and capital of the department of the same name, situated on the banks of the Rio Uruguay, and an important port for foreign trade, as vessels of heavy draught cannot ascend the river beyond this point. A large amount of merchandise for and from Brazil passes overland through this port. The city was founded in 1817, and has a population of about 16,000. It is well built, has fine public buildings, and well-paved streets lighted by electricity. In 1898 the imports were valued at $634,838, and exports $1,679,095; and in 1900 the imports were $748,375, and the exports $2,067,513.

Saltykoff (Stchedrin), Michael Evgrafovitch (1826–1889), a celebrated Russian satirist, born on his father's estate in the province of Tula, 15th (27th) January 1826. His early education was completely neglected, and his youth, owing to the severity and the domestic quarrels of his parents, was full of the most melancholy experiences. Deprived of all rational instruction and left entirely to himself, he soon developed a love for reading; but the only book in his father's house was the Bible, which he studied with such deep attention that it appears to have exercised a decided influence in the formation of his thought and morals. At ten years of age he entered the Moscow Institute for the sons of the nobility, and subsequently the Lyceum at St Petersburg, where Prince Lobánof Rostofski, afterwards minister for foreign affairs, was one of his schoolfellows. While in this establishment he published several pieces of poetry, and translations of some of the works of Byron and Heine; and on leaving the Lyceum he obtained employment as a clerk in the Ministry of War. In 1884 he published *Zaputennoye Dyelo* ("A Complicated Affair"), which, in view of the revolutionary movements at that time in France and Germany, was the cause of his banishment to Vyatka, where he spent eight years as a minor Government official. This experience enabled him to study the life and habits of civil servants in the interior, and to give a clever picture of Russian provincial officials in his *Gubernskie Otcherki* ("Provincial Sketches"). On his return to St Petersburg he was quickly promoted to administrative posts of considerable importance. After making a report on the condition of the Russian police, he was appointed deputy governor, first of Ryazan and then of Tver. His predilection for literary work induced him to leave the Government service, but pecuniary difficulties soon compelled him to re-enter it, and in 1864 he was appointed president of the local boards of taxation successively at Penza, Tula, and Ryazan. In 1868 he finally quitted the civil service in order to devote the rest of his life to literature. During this period he wrote his principal works, namely, *Poshekhonskaya Starina* ("The Old Times of Poshekhona"), which possesses a certain autobiographical interest; *Istoria odnavo Goroda* ("The History of a Town"); A Satirical History of Russia; *Messieurs et Mesdames Pompadours*; and *Messieurs Golovloff*. At one time, after the death of the poet Nekrasoff, he acted as editor of a leading Russian magazine, the *Contemporary*. He died in St Petersburg, 30th April (12th May) 1889. (G. D.)

Salvador (Republic of), a country of Central America extending from 13° 12′ to 14° 28′ N. and from 87° 37′ to 90° 6′ W. It lies on the Pacific coast, and is bounded inland by the frontiers of Guatemala and Honduras. The lowlands are generally hot and, on the coast, malarial; but on the tablelands and mountain slopes of the interior the climate is temperate and healthy. There are only two seasons: the wet, which Salvadorians call winter, from May to October; and the dry, or summer, season, from November to April. In July and August there are high winds, followed by torrents of rain and thunderstorms; in September and October the rain is not heavy, but is continuous.

The territory comprised within the limits of the republic has an area variously estimated at 7230 square miles and at 8130 square miles. It is divided for political and

administrative purposes into 14 departments, which are subdivided into 31 districts. The population in 1887 was stated to be 664,513; (1892), 703,500; (1894), 803,534; (1st January 1901), 1,006,848, of whom 493,893 were males and 512,955 females. The number of Ladinos (whites and persons of mixed blood) was returned at 772,200, and of Indians at 234,648. The various elements were, before 1901, estimated as follows, and the proportion still holds good in the main: whites (creoles and foreigners) 10 per cent., mestizos 50 per cent., Indians 40 per cent., and a very small proportion of negroes. The whites of pure blood are very few, a liberal estimate putting the proportion at 2·5 per cent. There is no immigration into the country, and the rapid increase with which the population is credited can be due only to a large surplus of births over deaths. The chief towns, with their populations, are given as follows:—San Salvador the capital (59,544), Santa Ana (48,120), San Miguel (24,768), Ahuachapán (14,136), San Vicente (17,832), Sonsonate (17,016), Sensuntepeque (12,456), Nueva San Salvador (18,768), Zacatecoluca (15,120).

The constitution of 1864, modified in 1880, 1883, and 1886, vests the legislative power in a chamber of 42 deputies (3 for each department), chosen by the direct vote of the people. The president and vice-president of the republic are likewise chosen by direct popular vote, and they hold office for 4 years. The president is not eligible for the presidency or vice-presidency during the following presidential term. He is assisted by 4 ministers, the heads of departments of administration. Local government is carried on in each of the 14 departments by governors appointed by the central executive. The municipalities are administered by officers (alcaldes, regidores, &c.) elected by the inhabitants.

The Roman Catholic religion prevails throughout the republic, but there is complete religious freedom, so far as is compatible with public order. Civil marriage is legal, monastic institutions are prohibited, and education is in the hands of laymen. Primary education is gratuitous and obligatory. Statistics of school work are published irregularly, but in 1893 there were within the republic 585 primary schools, with an average attendance of 29,427. For secondary instruction there were 18 higher schools, including 3 institutes, a polytechnic school, and 2 normal schools, one for men and the other for women, these six institutions being supported by the Government. At San Salvador there is a national college for the higher education of women. Private secondary schools are carried on in various parts of the country. Superior and professional instruction is provided at the national university in the capital, where there are faculties of law and of various branches of science. In 1893 the secondary schools had about 1200 pupils, and the university had 180 students.

Justice is administered by a supreme court, and in district, circuit, and local courts. The active army consists of about 3000 men, and the militia, of about 18,000.

Finance.

The revenue of Salvador is mainly derived from import and export duties, but considerable sums are also obtained from excise duties, and smaller amounts from stamps and other sources. The principal branches of expenditure are the public debt, defence, and internal administration. The official figures showing the revenue and expenditure for three years and the estimates for two years are as follows (pesos being converted into sterling at the rate of 10 to £1):—

Years.	Revenue.	Expenditure.
	£	£
1897	766,940	863,600
1898	460,960	526,660
1899	447,890	517,620
1900	499,250	520,170
1901	561,980	575,210

The foreign debt, amounting to £726,420 (£240,000 of a 6 per cent. loan of 1889, and £485,720 of another of 1892) was in 1899 converted into 5 per cent. mortgage debentures of the Salvador Railway Company Limited, to which the Government has guaranteed, for 18 years from 1st January 1899, a fixed annual subsidy of £24,000. The internal debt, on the whole of which interest is paid at the rate of 4 per cent. per annum, amounted at the end of 1900 to 9,225,864 pesos, or about £922,590.

Industry.

The only industry extensively carried on is agriculture, but the methods employed are still primitive. The more important products are coffee, of which 38,626,480 ℔ were produced in 1898; 55,600,000 ℔ in 1901; sugar, 1965 tons in 1898; indigo, 1,041,798 ℔ in 1897; balsam, 105,579 ℔ in 1897. Rubber is collected; tobacco is grown in small quantities; cocoa, rice, cereals, and fruits are cultivated. The Government seeks to encourage cotton-growing, and in August 1900 published a decree offering to supply cotton seeds, to give instruction in the cultivation of the plant, and to bestow a bounty of one silver peso on each centner (about 220 ℔) of cotton exported. The Government has, moreover, established in the suburbs of the city of San Salvador, an agricultural educational establishment and model farm, which is to be stocked with selected breeds of cattle, horses, hogs, and fowls from the United States.

Minerals.

In the cordillera which runs through Salvador there are veins of various metallic minerals—gold, silver, copper, and lead being found mostly in the eastern, and iron in the western, part of the country. Coal has been discovered at various points in the valley of the Lempa. In the republic there are about 180 mining establishments, about half of them being in the department of Morazau, but there are no recent statistics of their operations.

Commerce.

The trade of Salvador is almost entirely confined to the import of cotton goods, woollen goods, sacks, and machinery, and to the export of coffee and a few other agricultural products. In the year 1900 the formation of a statistical office was decreed. The total imports for 1896 were estimated at the value of 3,347,718 pesos, or, approximately, £334,770, and the exports at 7,485,384 pesos, or £748,540. In 1900 the imports amounted to the value of 6,570,000 (£657,000); and the exports to 9,132,958 pesos (£913,290), including coffee, 7,568,339 pesos; indigo, 638,700 pesos; and balsam, 295,439 pesos. In 1900, according to British statistics, the imports from Salvador into the United Kingdom amounted to the value of £137,364, comprising £103,220 for 32,016 cwt. of coffee, and £23,166 for 1659 cwt. of indigo; the exports from the United Kingdom to Salvador amounted to £244,325, comprising £195,301 for cotton goods and yarns, £16,513 for sacks, and £12,138 for iron-work and machinery. The United States in the year 1899–1900 imported from Salvador 6,616,775 ℔ of coffee, valued at £118,740, and 54,971 ℔ of rubber, valued at £3940. The imports are (in order of value) from Great Britain, the United States, France, and Germany; the exports (chiefly coffee) are mostly to the United States and France.

Shipping and communications.

In 1896, 338 vessels entered and cleared at the ports of Salvador. The railway system which formerly connected the port of Acajutla with Sonsonate, Santa Ana, and Ateos, and San Salvador with Santa Tecla, has been improved by the construction of a line from Santa Ana to San Salvador, putting the capital in direct communication with the coast. The old port of Acajutla has been closed, and a new port opened in a more sheltered position about a mile to the north, where an iron pier, warehouses, and custom house have been erected. A railway between San Miguel and La Union (22 miles) is intermittently under construction. The postal system has some 260 post offices, through which pass annually about 232,000 letters and packets in the inland service, and 563,000 in the foreign. In 1896 there were 1730 miles of telegraph wire, and 121 telegraph offices, through which in the year there passed 60,682 messages.

Currency and credit.

At the end of 1899 there were three commercial banks and an agricultural bank within the republic. One of these, an English bank, had a capital of £275,700 and a reserve fund of £10,000; the three other banks had an aggregate capital stated at 8,250,000 pesos, and reserve funds amounting to 1,035,000 pesos. In 1897 a law was passed adopting the gold standard. The currency of the country in 1900 consisted entirely of silver pesos, the fractional money under ·900 fine having, by arrangement with the Government, been all exported by the banks. The peso or dollar at par is valued at 4 shillings; its actual value is under 2 shillings. In foreign exchange at the end of 1899 the premium of gold was 96 per cent., in July 1900 it was 130 per cent.

The metric system of weights and measures was adopted by decree of January 1886, but the old Spanish weights and measures still continue in general use.

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(W. W. R.; I. P. A. R.)

Salvage.—There is no general rule or principle of law which entitles one who saves the life or property of another to be rewarded by him. But in certain special classes of cases the law does require the appointed courts to reward those who by their exertions have rescued lives or property from probable damage or destruction. The reward so given is called salvage, and the same word is often used to denote the service rewarded. The subject divides into (1) civil salvage, (2) military salvage.

(1) *Civil Salvage* is defined as such a service as may become the ground of a reward in the (Admiralty) Court on the civil side of its jurisdiction, and consists in the preservation of life or property from some of the manifold dangers which are at all times incident to the navigation of the sea. The jurisdiction to give it is an Admiralty jurisdiction. But the right to reward was recognized in the courts of common law before the Admiralty Court became, as it now is, a part of the High Court of Justice, *e.g.*, by enforcing a possessory lien of the salvor over the salved property. The origin of the rule has been traced to the doctrine of Roman law that "spontaneous services" in the protection of lives and property should be rewarded. But that doctrine has not found a place in English law, except as part of the maritime law administered in the Court of Admiralty. Thus services on land, say in rescuing lives or houses or goods from fire, do not entitle the person rendering those services to reward, unless he has acted under some contract or employment. But at sea the right to reward springs from the service itself, if it has been rendered to a ship, or her passengers, crew, or cargo, or to property which has been thrown or washed out of her. And such a service entitles to salvage though the ship may be in harbour, or within a river, or even in a dock. This connexion of the lives or property with a ship seems essential. The right does not arise upon saving goods which have got adrift in river or harbour, even if they have been washed out to sea, nor upon saving property of other kinds which may be in peril on the sea, or on the seashore. Thus a claim to reward for saving a gas-buoy, or beacon, which had broken from its moorings in the Upper Humber, and was aground on the Lincolnshire coast, was disallowed by the House of Lords, affirming the Court of Appeal, in the case of the Gas-float Whitton No. 2, 1897, A.C. 337. The buoy was not a ship; and the Admiralty jurisdiction hitherto confined to salvage of ships, apparel, cargo, and freight could not be extended to the buoy merely because it was property connected with navigation.

The definite right to salvage for saving lives from ships is the creation of modern statutes (now the Merchant Shipping Act, 1894, § 544). Formerly the Admiralty judges treated the fact that lives had been saved as enhancing the merit of a salvage of property by the same salvors, where the two could be connected; and so indirectly gave life salvage. And this is still the position in cases where the Merchant Shipping Act does not apply. This Act (§ 544) applies to all cases in which the "services are rendered wholly or in part within British waters in saving life from any British or foreign vessel, or elsewhere in saving life from any British vessel." Also (§ 545) it can be applied, by Order in Council, to life salvage from ships of any foreign country whose Government "is willing that salvage should be awarded by British courts for services rendered in saving life from ships belonging to that country where the ship is beyond the limits of British jurisdiction." By section 544 the life salvage is made payable "by the owner of the vessel, cargo, or apparel saved"; and is to be paid in priority to all other claims for salvage. Where the value of the vessel, cargo, and apparel saved is insufficient to pay the life salvage, the Board of Trade may in their discretion make up the deficiency, in whole or in part, out of the Mercantile Marine Fund. The effect of the Act is to impose a common responsibility upon the owners of ship and cargo to the extent of their property saved. Whatever is saved becomes a fund out of which life salvors may be rewarded, and to which they are entitled in priority to other salvors. In the case of the cargo *ex Schiller* (1877, 2 P.D. 145) salvage was allowed out of specie raised by divers from the sunken wreck, to persons who had saved some of the passengers and crew.

This limitation of liability to the amount of the property salved is also true with regard to salvage of property. The ordinary remedy of the salvor is against the property itself; by proceedings *in rem*, to enforce the maritime lien given him by the law upon that property. This enables him to arrest the property, if within the jurisdiction, into whose hands soever it may have come; and, if necessary, to obtain a sale, and payment of his claim out of the proceeds. The salvor has also a remedy *in personam*, used only in exceptional cases, against the owners or others interested in the property saved (Five steel barges, 15 P.D. 142); but it seems certain that that depends upon property having been saved, and having come to the owner's hands; and that the amount which can be awarded is limited by the value of that property.

An essential condition is that the lives or property saved must have been in danger—either in immediate peril, or in a position of "difficulty and reasonable apprehension." Danger to the salvor is not essential, though it enhances his claim to reward; but to constitute a salvage service there must have been danger to the thing salved. Again, the service must have helped usefully towards saving the lives or property. Ineffectual efforts, however strenuous and meritorious, give rise to no claim. But the service need not be completely successful. If it has contributed to an ultimate rescue it will be rewarded, though that may have been accomplished by others. And as we have seen, there must have been ultimate success. Some of the property involved in the adventure must have been saved. And the value of that, or the fund realized by its sale, limits the total of the awards to all the salvors. Cases, of course, occur in which services at sea are employed by ships in danger; as where a steamer with a broken propeller shaft employs another steamer to tow her; or where a vessel which has lost her anchors employs another to procure anchors for her from shore. In such cases the conditions of reward above set out may not apply. Reward may be payable, notwithstanding entire failure of success, by the express or implied terms of the employment. But such a reward is not truly "salvage."

Services rendered in the performance of a duty owed do not entitle to salvage. The policy of the law is to stimulate voluntary effort, not to weaken obligation. Thus the crew cannot (while still the crew) be salvors of the ship or cargo; nor can the passengers, useless they have voluntarily stayed on the ship for the purpose of saving her. Nor can a pilot employed as such be salvor, unless he has boarded her in such exceptional circumstances that his doing so for pilotage fees could not reasonably be required; or unless the circumstances of the service,

entered upon as pilotage, have so changed as to alter its character; and it may be doubted whether such a change of circumstances is a valid ground for a claim of salvage remuneration by the pilot where he has had no opportunity of leaving the ship. So again of the owners and crew of a tug employed to tow a ship. They cannot claim salvage for rescuing her from a danger which may arise during the towage, unless circumstances have supervened which were not contemplated, and are such as to require extraordinary aid from the tug, or to expose her to extraordinary risk. Officers and crew of a ship of the royal navy may have salvage where they have rendered services outside the protection which their ship ought to afford. But by the Merchant Shipping Act, 1894, § 557, such a claim must be with consent of the Admiralty; and no claim can be made in respect of the ship herself.

The kinds and degrees of service are very various. The rewards given vary correspondingly. Regard is paid, first, to the degree of the danger to the property salved, to its value, and to the effect of the services rendered; next, to the risks run by the salvors, the length and severity of their efforts, the enterprise and skill displayed, and to the value and efficiency of the vessel or apparatus they have used, and the risks to which they have exposed her. In a modern case (the *Glengyle*, 1898, A.C. 519) a specially large award was given to vessels kept constantly ready for salving operations in Gibraltar Bay. It was owing to that readiness that the rescue had been possible. On the other hand, any negligent or improper conduct of the salvors will be considered in diminution of the award: as where they have negligently exposed the ship to damage, or have plundered the cargo, or dealt with it contrary to the owner's interests. And where the rescue has been from a danger which was brought about by the negligent or improper conduct of those who effected the rescue, no salvage is allowed. So that where two colliding ships were both to blame for the collision, the master and crew of one of them were not allowed salvage for services in saving cargo of the other (cargo *ex Capella*, L.R. 1 A. and E. 356).

In apportioning the total award given for a salvage service among the owners, master, and crew of the vessel by means of which it has been rendered, the special circumstances of each case have to be considered. In nearly all cases a large portion goes to the owners, and as in recent times the value and efficiency of ships (especially of steamships) have increased, so the proportion of the whole usually awarded to the owners has also increased. In an ordinary case of salvage by a steamship towing a distressed ship into safety, the share of the owners is usually about three-fourths; of the remainder the master usually gets about one-third; and the officers and crew divide the rest in proportion to their ratings. But where the salving ship has sustained special damage in the service, or her owners have been put to loss by it, that is taken into account. On the other hand, where special personal services have been rendered by members of the crew they are specially rewarded.

As an illustration take the case of the *Rasche* (L.R. 4 A. and E. 127). The brigantine *Rasche*, derelict, was fallen in with by the ship *Scythia* (carrying a very valuable cargo) 220 miles north of the Lizard. The mate and three hands of the *Scythia* were put on board, and in circumstances of much hardship and danger they brought her after eighteen days safely to Liverpool. After deducting expenses incurred by the owners of the *Scythia*, the value of the property saved was £6294. Sir R. Phillimore awarded £3290; and of this he gave £600 to the mate, £510 to each of the three men who had accompanied him; £500 to the owners of the *Scythia*; and £350 to her other officers and crew.

An agreement as to the salvage to be paid is sometimes made at the time the assistance is given. When made fairly the court will act upon it, though it may turn out to be a bad bargain for one or other of the parties. But if the facts were not correctly apprehended by one or both, or if the position was one of such difficulty that those salved had no real option as to accepting the salvor's terms, the courts will set the agreement aside.

This happened, for instance, where the salving ship refused to rescue 550 wrecked pilgrims from the Parkin Rock in the Red Sea for a less sum than £4000. An agreement had in consequence been signed for their conveyance for that sum to Jedda, two or three days' sail. The Parkin Rock stands six feet above the water, and had bad weather come on the lives would have been in great danger. It was held that the sum asked for was exorbitant; and that the agreement, made under practical compulsion, could not stand (the *Medina*, 2 P.D. 5). On the other hand, an agreement to tow, for a fixed sum, a vessel which had suffered considerable damage, was set aside, and salvage awarded, on the ground that the damaged condition had not been disclosed to the tug when the contract was made (the *Kingalock*, 1 Spink, 265).

The award of salvage is generally made in one sum against ship, freight, and cargo; and those interests contribute to the amount in proportion to the values saved. No distinction is made between the degree of service rendered to one interest and another. But, with a possible exception in the case of life salvage, there is not a joint liability of the several interests. Each is liable to the salvors for his own share, and for no more. The ship cannot be made to pay the cargo's share, nor the cargo the ship's. If, however, the shipowner pays the cargo's share, he has a lien upon it for the amount. In practice the liabilities for salvage are ordinarily adjusted as part of general average. Strictly, however, there is a difference. The liability to pay salvage is a direct liability to the salvors, arising at once, *e.g.*, at the port of refuge, and proportional to the values there; whereas the liability to contribute to a general average loss or expenditure is postponed until the completion or break up of the adventure, and depends upon the values of the interests which have arrived there; which may be very different. (See GENERAL AVERAGE.)

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(2) *Military Salvage* is analogous to civil salvage. It is defined as such a service as may become the ground for the demand of a reward in the court as a prize court, and consists in the rescue of property from the enemy in time of war. Such cases almost invariably relate to ships and their cargoes; and they have always been dealt with by courts having Admiralty jurisdiction, sitting as prize courts. They involve the determination of two questions: first, whether the property is to be restored to its original owner or condemned as prize to the recaptor; and second, what amount of salvage, if any, is to accompany restitution. Generally speaking, the first question depends upon the law of nations, which may be taken to be that where a ship has been carried by an enemy *infra præsidia*, and especially after a sentence of condemnation, the title of the original owner is divested, and does not revest upon recapture by third parties. In such a case, therefore, *jure gentium* restitution cannot be claimed. The municipal law of civilized countries, however, does not encourage subjects to "make reprisals upon one another," (the *Renard*, Marr. Adm. Dec. 222), and laws are generally found, as in England, which as between subjects of that particular state provide for restitution irrespective of any change in the title to the subject matter which may have occurred. But (speaking henceforth of England), in cases which do not fall strictly within these Acts, the old maritime law, which was in unison with the general law of nations, is applied by the courts. Moreover, the English Prize Acts do not

apply to foreign owners of recaptured prizes, and therefore no award can be made against them unless in accordance with the law of nations. In practice the courts have acted upon the "rule of reciprocity" where recaptures have been made of the property of formal allies, dealing with them as the allied state would have dealt with English property. In the case of neutral recaptures restitution is always ordered. An exception to the rule of restitution as between British subjects is made in the case of a British ship which has been "set forth as a ship of war" by the captor, and subsequently retaken by a British ship. Such a ship is not liable to restoration, but is the prize of the recaptor. This exception, the object of which is to encourage the capture of armed ships, dates from 1793, previous Acts having provided for restitution upon payment of a moiety as salvage. The condition of setting forth as a ship of war is satisfied, where under a fair semblance of authority, which is not disproved, the ship "has been used in the operations of war, and constituted a part of the naval force of the enemy" (the *Ceylon*, 1 Dod. 105). Such a user permanently obliterates the ship's original character, and extinguishes all future claims to restitution (*L'Actif*, Edw. 185).

As to the right to salvage and the amount which will be allowed, this is also a question of the *jus gentium*, though usually governed by municipal law. The right was recognized so long ago as the 11th century, when the "Consolato del Mare" laid down elaborate provisions on the subject. In England the first statutory recognition of the right occurs in 1648, when an Act of the Commonwealth, which in its outline has been the model for all subsequent Prize Acts, provides that British vessels captured by an enemy and retaken by British ships shall be restored upon payment of one-eighth of the value of the property in lieu of salvage, or one-half in the case of a prize "set forth as a ship of war." From that date until 1864, the date of the Act now in force, there have been thirteen Prize Acts dealing with recapture, each of which, except that of 1864, has been passed to meet a particular occasion, and has expired with the cessation of the then existing hostilities. Since the first Act, and down to the Act of 1805 inclusive, a distinction has always been drawn between a recapture effected by one of the royal ships of war and a recapture by a privateer or other vessel. In the former case the allowance has always been one-eighth, in the latter it varied, but was usually one-sixth. In the Act of 1692 a clause taken from a Dutch law gave salvage to a privateer, rising in amount from one-eighth to one-half according to the number of hours the prize had been in the enemy's possession, but this clause has disappeared since 1756. There is no provision in the present Act for the payment of salvage, except in case of recapture by one of His Majesty's ships, but it seems beyond question that recaptors are entitled at law to salvage, although they may hold no commission from the Crown. "It is the duty of every subject of the king to assist his fellow-subjects in war, and to retake their property in the possession of the enemy: no commission is necessary to give a person so employed a title to the reward which the policy of the law allots to that meritorious act of duty" (the *Helen*, 3 C. Rob. 226, *per* Sir W. Scott). Though it is improbable that privateers will figure in any future war, it may reasonably be anticipated that recaptures may be made by private vessels, and in such cases salvage would probably be awarded, the proportion lying in the discretion of the court. Similarly, salvage is awarded in the case of recapture from pirates or from a mutinous crew. In the case of royal ships the present Act allows one-eighth salvage, which in cases of "special difficulty or danger" the court may increase to a quarter. The latter provision is an innovation.

It may appear that the grant of salvage to ships of war, the duty of whose commanders it is, according to the naval instructions, "if possible, to rescue any British vessel which he may find attacked or captured by the enemy," needs some justification. Objections on this ground have never been seriously treated, it being urged that it is politic to encourage the undertaking of such enterprises, even where they coincide with the path of duty. Where, however, a transport was rescued from under the guns of an enemy by a ship of war, under whose charge she sailed, salvage was refused on the ground that the salvor was only doing what he was bound to do (the *Belle*, Edw. 66). So no salvage is due to a crew who rescue a ship from mutineers, this being only their duty under a subsisting contract (the *Governor Raffles*, 2 Dod. 14). On the other hand, a crew who rescue their ship from the prize crew of a belligerent are entitled to salvage, since the capture discharges them from their contract with the owner, and they act as volunteers (the *Two Friends*, 1 C. Rob. 271). In the case of a neutral captured by one belligerent and recaptured by the other, which has been already alluded to, no salvage is as a rule allowed, upon the supposition that if the vessel had been carried into the port of the enemy justice would have been done and the vessel restored. In the case of the French war at the opening of the 19th century no such supposition existed, and salvage was usually awarded on the recapture of neutral property from the French.

(M. Bt.)

Salvage Corps.—The London Salvage Corps is maintained by the fire offices of London. The corps was first formed in 1865 and commenced operations in March 1866. The staff of the corps when first formed consisted of 64. Since that time, owing to the many improvements that have taken place in the system of dealing with salvage, and the increase in the work to be done, the corps has necessarily been strengthened, and the staff now numbers 106. The various stations of the corps are well placed, and the Metropolis has been mapped out so that when a fire takes place the various districts may be attended to at the earliest possible moment, and the salvage operations commenced at once before any great damage has been done. The headquarters are situated at Watling Street, which is called the No. 1 station, and this station protects the large and valuable risks in the City of London enclosed by the Euston Road, Tottenham Court Road, City Road, and the river Thames; this is known as the "B" district. No. 2 station is situated at Commercial Road, and this station attends to the fires occurring within the whole of the eastern and north-eastern portion of London to the north of the Thames, and is known as the "C" district. No. 3 station, opposite the headquarters of the Metropolitan Fire Brigade Station in the Southwark Bridge Road, protects the whole of south London, and is known as the "D" district. No. 4 station, at Shaftesbury Avenue, is in constant attendance at fires in the west of London, called the "A" district, which extends to and embraces the vast district and the valuable risks of the West End and Kensington. Finally, No. 5 station, in Upper Street, Islington, acts as guardian to the large parish of Islington. The working staff of the corps, which is mainly recruited from the royal navy, consists of the chief officer, and a superintendent, foreman, and crew of men at each station, ready to turn out immediately on receipt of a "call." The stations of the corps are connected by telephone with the fire brigade stations from whence the "calls" are received. In addition to the home staff, there is also a staff constantly employed during the daytime in inspecting docks, wharves, Manchester goods and uptown warehouses, and reports are made weekly to the committee, when various defects that have been pointed

out by the inspectors are considered and definite action taken in order to prevent disaster from the continuance of the evils.

Generally speaking, the work of the London Salvage Corps may be divided into two distinct classes—(1) services at fires; (2) watching and working salvage.

(1) *Services at Fires* form the most important feature of the work. Much depends upon the method of dealing with the salvage. If, for instance, a large Manchester goods warehouse was on fire in the top part, it would be very little advantage to the offices interested in the risk if the men were set to work removing the stock off the ground floor. The best method would be to cover up with tarpaulin all goods there, and prevent the water from collecting on the lower floors. It will be gathered that the most important work of the corps is to prevent damage to goods, and that water is mostly looked after. Of course the damage likely to accrue from fire is not overlooked, though this is left almost entirely to the fire brigade. The traps, which immediately on receipt of an alarm proceed to the scene of the fire with their crew of men, carry every kind of appliance for the saving of goods from destruction by fire or damage by water, such as waterproof cloths, torches, axes, hand-pumps, buckets, shovels, sawdust, crowbars, ropes with large iron hooks attached (for pulling down dangerous walls or pulling out burning bales of goods), picks, &c., as well as lime-light apparatus for use in working after the fire has been extinguished, thus enabling the men to note the position of dangerous walls, &c.; and a portable coal-gas apparatus, which can be employed in the interior of buildings when the ordinary means of illumination has failed; in addition to ambulance appliances for emergencies. The following table contains statistics of the working of the London Salvage Corps for the years specified:—

Year.	Fires attended by Corps.		Services rendered.	
	Within Metropolitan Area.	Without Metropolitan Area.	Contents.	Buildings.
1892	2324	109	903	615
1893	2241	118	830	558
1894	1936	84	596	521
1895	2193	119	777	542
1896	2035	137	744	640
1897	1999	136	700	527
1898	2122	116	741	473
1899	2180	149	804	590
1900	2170	122	1056	794
1901	2488	167	1167	850

(2) *Working Salvage.*—When a fire takes place, a man is left behind in charge of the salvage if the property is insured; or if that fact cannot be ascertained, but it appears probable that it is, a man is left until the information is obtained later. The duty, if an important one, is divided into a day and night duty. This enables an experienced man to be sent on day duty to meet the surveyor, and to carry out his instructions regarding the working out of the salvage; and a junior man at night. The duties vary so considerably that it would be impossible to frame one set of rules to apply to all cases. Each man on picking up his duty is given certain orders by the superintendent, and fully informed as to the nature of the duty and any special points requiring attention. The day man, if working out salvage, would employ a number of men called strangers, over whom he acts as a kind of foreman. The "working out" may take the form of dividing up damaged goods into certain lots ready for a sale to be held by the surveyor, or it may be for the purpose of sifting over the débris to find remains of certain articles claimed for. If, for instance, a large fire occurred at a pianoforte manufacturer's, and the débris was all in one common heap, if considered advisable the men of the London Salvage Corps would have to arrange certain quantities of pegs and wires in order to give an idea as to the number of pianos before the fire. The watching continues until the loss is settled, when the charge of the premises is given over to the assured.

It would be absolutely impossible to estimate in any degree the large sums that are saved by this valuable body every year.

There are also salvage corps on similar lines, but on a smaller scale, in Liverpool and Glasgow. (C. J. F.)

Salvation Army, The.—A religious philanthropic organization founded by the Rev. William Booth, who in 1865 began to hold meetings for preaching in the streets of London, and in tents, music halls, theatres, and other hired buildings. Large numbers attended, many of whom had never before entered a place of worship, and presently an organized society was formed, called "The Christian Mission." Mr Booth was assisted by his wife, Catherine Booth, a woman of remarkable gifts, who won the sympathy for the new movement of many among the cultured classes. In 1878 the Mission, which had spread beyond London, was reorganized on a quasi-military basis. The local societies became "Corps," and their evangelists "Officers," with Mr Booth as "General" of the whole body. The operations of the Army at once rapidly expanded; and in spite of much disorderly opposition in particular places, its work has grown ever since, large numbers of outcasts having been reclaimed. In 1878 there were reported 80 corps and 127 officers in the United Kingdom. In doctrine, the Army is in harmony with the main principles of the evangelical bodies, "as embodied in the three creeds of the Church." Its preaching is practical and direct, asseverating the reality of Sin and Redemption. The Army proclaims the supreme duty of self-sacrifice for the sake of the salvation of others.

The Army is under the control of the General for the time being, who issues all orders and regulations; but large powers devolve upon other officers, such as the "Chief of the Staff," the "Foreign Secretary," and the "Chancellor," who direct affairs from the "International Headquarters" in London. The Army is divided, usually in harmony with national boundaries, into "Territories," each under a "Commissioner," with headquarters in the capital of the country. The Territories are again divided into "Provinces" or "Colonies," and these again into "Divisions," which include a number of Corps, each supporting its own "Captain" and "Lieutenant." The "soldiers" or members are drawn from all classes of the community. The property of the Army in the United Kingdom is held by the General for the time being, for the benefit of the Army exclusively, he being constituted a trustee of the property, in the disposal of which and in the appointment of his successor he is placed under the government of a deed poll, enrolled in the Court of Chancery in August 1878. In other countries various modifications have been necessary, but the General's ultimate control has been practically assured. Funds are raised from the voluntary offerings of the Corps, from friends interested in charitable work, and from the profits on publications. A strict system of accounts and audit is everywhere observed, the financial statements of the various national headquarters funds being annually published, certified by public accountants, in each country. The total receipts for 1899 from all sources at home and abroad was reported as £1,659,782.

Statistics reported October 1901.

	Corps.	Outposts.	Officers.
The British Isles	1281	238	4859
The United States, South America, and West Indies	697	104	3052
Canada and Newfoundland	319	140	938
Australia and Java	484	874	1810
India, Ceylon, and Japan	570	1260	1745
South Africa and St Helena	64	13	239
France, Switzerland, and Italy	132	170	467
Germany, Holland, and Belgium	168	39	682
Sweden, Norway, Denmark, Finland, and Iceland	447	383	1709
Gibraltar and Malta	2	...	8
Total	4164	3221	15,509

Mr Booth's scheme for *Social Relief*, described in *In Darkest England, and the Way Out* (1890), attracted widespread interest, and was started with subscriptions amounting to £100,000. A separate trust was declared for the property and funds of this branch of work. Since then, both in Great Britain and abroad, the scheme has been actively carried out. The amount received in the year ending 30th September 1901 for cheap food and lodging in the United Kingdom was returned at £35,925. Help has been given to large numbers of unemployed, ex-criminal, and lost persons. In the year ending 30th September 1901, the number of persons received into factories was reported as 3515, of women and girls received into rescue homes as 2223. The farm colony at Hadleigh in Essex has a large acreage under cultivation, with fruit and market gardens and various industrial undertakings.

Summary of Social Operations throughout the World, October 1901.

	Number of Institutions.			
	Great Britain.	Abroad.	Total.	Total Accommodation.
Children's Homes	2	31	33	1,014
Rescue Homes	23	88	111	2,526
Ex-Criminal Homes	1	12	13	511
Food and Shelter Depôts	24	133	157	16,709
Labour Bureaux	13	10	23	...
„ Factories	9	67	76	...
Farm Colonies	1	15	16	...
Other Social Institutions	8	51	59	...
Total Institutions	81	407	488	20,760
Slum Posts	41	91	132	

Total number of officers engaged exclusively in social work, 2669.

In the Army there are a number of subsidiary branches of work, such as the Orphanages, the Naval and Military League for work among the troops in peace and war, and the Life Assurance Branch in England. Women take the same rank as men. All officers and many of the rank and file wear a special uniform. Music is universally employed.

AUTHORITIES.—WILLIAM BOOTH. *Salvation Soldiery. Interview with W. E. Gladstone. In Darkest England, and the Way Out.*—BRAMWELL BOOTH. *Social Reparation. Servants of All.*—BOOTH-TUCKER. *The Life of Mrs Booth.*—RAILTON. *Heathen England. Twenty-one Years' Salvation Army.*—ARNOLD WHITE. *Truth about the Salvation Army.* Various Reports and Accounts. The *War Cry*, &c.

(G. E. N.)

Salvini, Tommaso (1829-——), Italian actor, was born at Milan, 1st January 1829. An actor from the age of fourteen, he had the advantage at an early stage in his career of joining the company headed by the famous actress Ristori, with whom he was for long associated. He fought in the cause of Italian independence in 1849; otherwise his life was an unbroken series of successes in his art. He acted on various occasions in England and in America, as well as in most of the European capitals. His most famous impersonations included Othello, Conrad in *La Morte Civile*, Egisto in Alfieri's *Merope*, and Paolo in *Francesca da Rimini*. He took part in January 1902 in the celebration of Ristori's eightieth birthday.

Salween. This river, called Nam Kông by the Shans, Thanlwin by the Burmese, Lu Kiang, or Nu Kiang, or Lu Tzu Kiang by the Chinese, is the longest river in Burma, and one of the wildest and most picturesque streams in the world. Its sources are still undetermined, but there seems little doubt that it rises in the Tanla mountains, south of the Kuen Luen, somewhere in 32° or 33° N., and that perhaps it draws some of its water from the Kara Nor. It is thus a much longer river than the Irrawaddy. From the time it leaves Tibet it has a very narrow basin, and preserves the character of a gigantic ditch, or railway cutting, with for long stretches no other affluents than the mountain torrents from the hills, which rise from three to five or six thousand feet above the level of the river-bed. In the dry weather the banks are alternate stretches of blinding white, fine sand, and a chaos of huge boulders, masses, and slabs of rock, with here and there, usually where a tributary enters, long stretches of shingle. In the rains all these disappear, and the water laps against forest trees and the abrupt slope of the hills. The average difference between high and low water level of the Salween throughout the Shan States is between fifty and sixty feet, and in some places it is as much as ninety. There are many rapids, caused by reefs of rock running across the bed, or by a sudden fall of from one to several feet, which produce very rough water below the swift glide; but the most dangerous places for navigation are where a point juts out into the stream, and the current, thrown back, causes a violent double backwater. Nevertheless, long stretches of the river, extending to scores of miles, are habitually navigated by native boats. The current is extremely variable, from half a mile an hour to ten knots. For this reason the river is practically unnavigated. Launches ply regularly from Moulmein to the mouth of the Yônzalin, in Lower Burma. The worst part of the whole Salween, so far as is known, is the gorge between the mouth of the Yônzalin and Kyaukhnyat. It is quite certain that steam launches could ply over very long sections of the river above that, perhaps as far as the Kaw ferry, or even the Kun Lông ferry. In British territory, however, there are very few settlements on the river itself, and frequently the ferry villages are built a thousand feet above the river.

The Chinese believe the Salween valley to be deadly to all strangers, but it is in Chinese territory—particularly in the Lu Kiang, or Mŏng Hkö state—that there is the largest population on the river of any place until Lower Burma is reached. A description of the Salween resolves itself into a list of the ferries at which it can be crossed, for no one marches up the river. The river is bridged by the Chinese on the main route from Têng Yüeh (Momien) and Bhamo to Tali-fu. There are two spans; these are not in a straight line, but parallel to one another at the distance of the breadth of the central pillar. Each span is formed by twelve or fourteen massive iron chains, with planks laid across them. There was a bridge some 20 miles lower down, but this was destroyed in 1894. In British territory there are no bridges, and the ferries are the same as those maintained before the annexation. There are a great number of these ferries, but only a few are used, except by the local people. From Ta Hsang Lô large trading boats ply regularly to Kyaukhnyat, whence the traders make

their way by land over the hill to Papun, and so down the Yônzalin.

The chief tributaries of the Salween in British territory are the Nam Yu and the Nam Oi or Nam Mwe on the right bank, and the Hsipa Haw on the left. These are short but fair-sized streams. Near the Kun Lông ferry the Nam Nim, on the right bank, and the Nam Ting, on the left, are considerably longer, and the Nam Ting is navigable by native craft for considerable stretches up to Mêng Ting, and farther. To the south the next tributary is the Nam Kyek, on the right bank, down the valley of which the railway will reach the Salween. Below this are two streams called Nam Ma, one entering on the right bank, the other on the left, at no great distance from one another, but of no great length. A little below is the Nam Nang, on the left bank, coming from the Wa country. The Nam Kao enters in a cascade of nearly 200 feet in the cold weather from the right, and then there are no affluents till the Nam Hka comes in on the left. This has a great volume of water, but is unnavigable because of its steep gradient and many gorges. After the Hwe Lông, entering from the left at Ta Kaw, is passed, the Nam Pang comes in 22 miles lower down on the right bank. This is probably the largest tributary of the Salween; some distance above its mouth, at Kēng Hkam, it is 400 yards wide and quite unfordable. The next important tributary is the Nam Hsim, on the left bank, rising in the latitude of Kēng Tūng. It is a large but quite unnavigable stream. Except the Mē Sili and Mē Sala, from opposite sides, and the Nam Hang, which burrows its way through a range of hills from the east, and the Nam Pan, coming from the west, there is no considerable tributary till 19° 52′ N., where the Nam Tēng comes in on the right from the central Shan States. This is a considerable river, and navigable for long stretches in its upper course, but the last few miles before it enters the Salween are little better than a cataract. Below this the only large affluent is the Nam Pawn, which drains all Karenni and a considerable portion of the Shan States, but is quite unnavigable. Below this the tributaries are again only mountain streams till the Thaung-yin comes in from the south-east. Thirty miles lower down is Kyodan, the great timber depôt. Here a cable, stretched across the river, catches all the timber, which is then made up into rafts and floated down to Kado, near Moulmein, where the revenue is collected. The Yônzalin enters the Salween from the right about 10 miles below Kyodan. Boats can ply from Kyodan southwards, and light draught steamers ascend as far as Shwegôn, 63 miles from Moulmein. The Salween cuts the British Shan States nearly in half, and is a very formidable natural obstacle. It seems probable, however, that long stretches of it can be opened to trade. It is certainly no less navigable than the Middle Mekong or the Yangtzu above I-chang.

Salween, a district in the Tenasserim division of Lower Burma. Area, 2666 square miles. Population (1891), 31,439; (1901), 19,500. The district is in charge of a superintendent of police, and had 229 villages in 1898–99. The revenue of the district is incorporated with that of the Amherst district. The population in 1891 was made up of aboriginal tribes, Karens and Shans, 26,677, Buddhists and Jains 4322, Mahommedans 209, Hindus 173, Christians 58. Of the total area of 1,706,240 acres, 180,721 were cultivated in 1898–99. Of the remainder, about half of the acreage was uncultivable, and there were 98,240 acres of grass. The total rainfall in 1898–99 was 101·1 inches, recorded at Papun, which is the headquarters of the district.

Salzburg, a duchy and crownland in the Cisleithan part of the Austro-Hungarian monarchy. It lies between 40° 57′ 20″ and 48° 2′ N. and 12° 5′ and 13° 59′ E., and is bounded on the W. by Bavaria and Tirol, on the E. by Upper Austria and Styria, on the N. by Upper Austria and Bavaria, and on the S. by Carinthia and Tirol. It has an area of 2762 square miles. The surface is for the most part mountainous, the duchy lying on the northern slope of the Eastern Alps. Its most fertile portions belong to the series of longitudinal valleys of that region and the surrounding hills. It falls into three divisions: first, the high-lying valleys of the Hohe Tauern, which open on the depression of the river Salzach; then, to the south, the valleys and slopes of the limestone region; and finally, the undulating forelands. A portion of the Dachstein lies within the duchy. Salzburg is almost entirely within the watershed of the Danube, its principal river being the Salzach, a tributary of the Inn. The Enns and Mur rise in this province. Salzburg has some 200 lakes in all, of which the most important are Lake Zell, celebrated for its beautiful mountain panorama, and the Waller, Fuschel, and Traumen lakes. It has a total area of over 7000 acres of peat moss, and numerous mineral and thermal springs. The climate, although healthy, is very changeable, with great extremes of temperature—at Salzburg from 82·4° to 18·4° F. below zero—and heavy rains.

The mineral wealth of Salzburg includes salt (at Hallein), copper (at Mitterberg), iron-ore (at Werfen), and small quantities of gold, together with marble and precious stones. In 1898 the iron, gold, and copper ore amounted in value to about £18,500, and the salt to £183,100. Although a large portion of the soil is unproductive (13·71 per cent. occupied by glaciers, snow-fields, &c.), and 32·4 per cent. consists of forest, Salzburg is one of the principal pastoral regions of Austria. Of its total area, 28·9 per cent. consists of Alpine pastures available during the summer months, 4·95 per cent. of lowland pasturage, and 8·3 per cent. of meadows, while only 9·2 per cent. is arable. The chief resource is cattle-breeding and dairy-farming. Sheep, goats, and pigs are kept in large numbers. The great quantities of game constitute a considerable resource of the population, large numbers of whom are also engaged in the important timber trade. For administrative purposes the province is divided into six departments, of which the capital, Salzburg, is one and its environs the second. The other four are Hallein, St Johann, Tamsweg, and Zell-am-See. The inhabitants are a handsome and powerfully-built peasant race, very conservative not merely in the matter of religion, but in the maintenance of their traditional manners, customs, games, and national costume.

Population (1890), 173,510; (1900), 193,247, which is equivalent to 70 inhabitants per square mile. The proportion of females to males was 1019 to 1000 in 1890. The population is almost exclusively German and Catholic, the proportion of Czechs being less than one-third of 1 per cent., while the Jews and Protestants together are less than 1 per cent. In 1896 the marriage-rate was 8·13, the birth-rate 32·50 or, excluding still births, 31·54, and the death-rate 24·05. Of the births, 26·42 per cent. were illegitimate. The marriage- and birth-rates are rising, the death-rate and proportion of illegitimacy declining. The duchy sends 6 members to the Reichsrath. The 26 members of the Diet are all German. The archbishop is an *ex-officio* member of this body, in which the large landed proprietors have 5 seats, the towns and market-places 10, the chamber of commerce 2, and the country communes 8. Elementary education is comparatively advanced, particularly for an Alpine province. In 1890 the illiterates only amounted to 8·2 per cent., an improvement of 3·4 on the preceding census. There are 2 theological seminaries, 3 intermediate and 179 elementary schools, together with 30 technical, musical, and other special schools. In 1899 Salzburg had 236 miles of railway, 800 miles of roads, and 62 miles of waterway, of which 33 miles were only available for floating timber. At the same date there were 114 post and 73 telegraph offices, with 538 miles of line and 2433 miles of wire. (Æ. O'N.)

Salzburg, the capital of the Austrian duchy and crownland of the same name. Population (1890), 27,244, German and Catholic (505 Protestants and 146 Jews); (1900), 32,924, including garrison of 1931 men. The increasing popularity of Salzburg and the entire duchy as a summer resort constitutes a considerable addition to the resources of the town, which is manifest in the construction of new hotels, villas, &c., and in the improvement of the local means of communication. There has been a corresponding development of industry and trade. Among the improvements of the town are a park, a theatre, an art gallery, and baths.

Salzkammergut, a district in the south-west angle of Upper Austria. The annual production of salt (the principal industry) is increasing, and amounted in 1898 to about 90,000 tons, valued at £683,870. This was 26·3 per cent. of the total Austrian production.

Salzwedel, a town of Prussia, province Saxony, 106 miles by rail west by north of Berlin, half-way between Berlin and Bremen, on the navigable Jeetze, a tributary of the Elbe. In 1895 the town-hall was burnt down.

The industries include linen and damask weaving, tanning, brewing, and manufacture of pins, chemicals, machinery, &c. Population (1885), 8883; (1900), 10,175.

Samain, Albert (1859–1900), French poet, was born at Lille on 4th April 1859. He was educated at the lycée of that town, and on leaving it entered a bank as a clerk. He enjoyed no literary associations, and his talent developed slowly in solitude. About 1884 Samain went to Paris, having obtained a clerkship in the Préfecture de la Seine, which he held for most of his life. He presently began to send poems to the *Mercure de France*, and these attracted attention. In 1893 he allowed a friend to collect and print his earliest volume of poems, *Au Jardin de l'Infante*, in a very small edition. This led to the sudden recognition of his talent, and to applause from critics of widely different schools. In 1897 this book was reprinted in a more popular form, with the addition of a section entitled *L'Urne Penchée*. Samain's second volume, *Aux Flancs du Vase*, appeared in 1898. His health began to fail, and he withdrew to the country, where he died, in the neighbourhood of the village of Magny-les-Hameaux on 18th August 1900. A third volume of his poems, *Le Chariot d'Or*, appeared after his death, with a lyrical drama, *Polyphème*, 1901. The fame of Samain rapidly advanced when he was dead, and the general public awakened to the fact that this isolated writer, who formed few friendships and stood entirely aloof from all the Parisian cliques, was a poet of rare originality. He was neither of the old Parnassian nor of the new Symbolist school, but cultivated a delicate, languid beauty of imagery and an exquisite sense of verbal melody without attempting any revolution in prosody or identifying himself with any theory. Samain had no great range of talent, nor was he ambitious of many effects. His poetry has an extreme dignity and distinction in its somewhat morbid melancholy: it celebrates the magic of fading light in twilight gardens, when the shadows of fair ladies cross the dim lawns in a silence only broken by the murmur of a melancholy violin played somewhere far away. Samain's natural life was patiently spent in squalid conditions; he escaped from them into an imaginative world where all was of the most exquisite refinement. He has been compared to Watteau and Schumann; in his own art he bore some resemblance to Baudelaire, and to the English poet Arthur O'Shaughnessy. (E. G.)

Samara, a government of south-east Russia, on the left bank of the Lower Volga, with an area of 58,320 square miles. Its geology has been the subject of careful investigation, and much valuable information about the province has been acquired. It is chiefly built up of Carboniferous sandstones, conglomerates, clay slates, and limestones, representing mostly deep-sea deposits. The Permian formation appears along the rivers Sok and Samara, and is represented by limestones, sands, and marls containing gypsum, all of marine origin, and by continental deposits dating from the same period; sandstones impregnated with naphtha also occur. In the north these deposits are covered with "Variegated Marls" and with a variety of Triassic, Jurassic, and Cretaceous deposits. The Tertiary formation (Eocene) appears only at Novouzensk, the remainder of a vast sheet of this formation, which at one time covered all the region between the Volga and the Urals, having been removed during the Glacial period. Post-Tertiary Caspian deposits penetrate far into the province along the main valleys, and a thick layer of loess spreads in the north. Selenites, rock-crystal, and agates are found, as also copper ores, rock-salt, and sandstone extracted for building purposes.

The domiciled population of the province, which was only 1,388,500 in 1853, numbered, in 1897, 2,763,478, of whom 1,398,263 were women, and 159,485 lived in towns. The bulk of the population was composed of Great and Little Russians, who formed 69 per cent. of the inhabitants; Mordovians formed 8 per cent., Chuvashes and Votyaks 3 per cent., Germans 9 per cent., Tatars 9 per cent., and Bashkirs 2 per cent. Nonconformity is widely spread, and the official figures, which are much below the actual, give 91,400 adherents. Out of a total area of 37,299,400 acres, 4,143,800 acres belong to the Crown, 7,979,000 to private persons, and 22,486,700 acres to the peasants, who rent, moreover, about 6½ million acres. The area under cereal crops in 1900 was 9,623,700 acres, and the average annual yield in 1895–99 was: wheat 13,350,000 cwt., rye 10,518,000 cwt., oats 3,338,500 cwt., barley 768,000 cwt. —all cereal crops 31,813,000 cwt.; also potatoes 3,390,000 cwt. Water melons and sunflowers are extensively cultivated in fields, and gardening is widely engaged in, as also mustard and inferior qualities of tobacco. Cereals being grown in excess of the needs of the population, considerable quantities of cereals and flour are exported during the years of good crops (about 15,000,000 cwt. in 1896), as also are hemp-seed, linseed, and other oil-seeds, bran, &c. However, there are also years of total failure of the crops, when famine harasses the population. Cattle-breeding is widely spread, and there were in the province, in 1897, 553,300 horses, 484,030 horned cattle, 933,540 sheep, and 88,000 swine. Bee-culture is another pursuit that is widely followed, there being no less than 200,000 hives in the province. The export of poultry, especially of geese, has increased greatly. Manufacturing industries are still undeveloped, and all factories, employing an aggregate of 4700 workers, only showed a return of 11,500,000 roubles in 1898. Both the external and the internal trade are very flourishing, 247 fairs being held in the province every year; the chief are those at Novouzensk and Bugulma. Owing to the efforts of the local *zemstvos*, there are more than the average number of primary schools, namely, one school for every 1810 inhabitants; the total number of children receiving primary education is estimated at about 50,000. The province is divided into 7 districts, the chief towns of which are Samara (see below), Bugulma (7577), Buguruslan (12,141), Buzuluk (14,471), Nikolayevsk (12,524), Novo-Uzeñ (13,475), and Stavropol (5974). The Serghievsk sulphurous mineral springs, 57 miles from Buguruslan, are visited by numbers of patients. There are eleven springs, five of which yield 1,353,000 gallons for the baths per day.

Samara, the capital of the above province, 743 miles by rail south-east of Moscow. Its population, which was 63,479 in 1883, numbered 91,659 in 1897; and owing to its situation on the Volga, and at the head of the Siberian and Central Asian railways, it has acquired great commercial importance. All through the autumn and winter the peasants from the neighbouring country and the railways bring in considerable quantities of corn, the imports of which by rail and water alone are estimated at 154,700 tons, and the exports at 386,900 tons yearly; five large steam mills and one water mill are capable of grinding 128,000 tons of grain per annum. A considerable trade is also carried on in animal products, particularly hides, of which nearly 150,000 are exported every year. The port is the best on the Volga; and in 1897, 956 vessels, of 23,000 tons, entered, while 1491 vessels, of 306,000 tons, cleared. The railway returns for 1897 show that 170,000 tons of goods were imported by rail and 139,000 tons exported. Three great fairs are held every year. The city is well provided with schools and philanthropic institutions. It has three public libraries, several scientific societies, a good theatre, and a natural history and archæological museum; four newspapers are published.

Samarkand, a province of Russian Turkestan, of which it occupies the south-east corner, formed in 1887 out of the Zerafshan district. It has on the N. and N.-E. Syr-dariinsk, on the E. Ferghana, on the W. Bokhara, and on the S. the khanates of Hissar, Karateghin, and Darwaz. Its area is 26,627 square miles.

Physical features.

It is very hilly in the south, where it is intersected by a series of mountain ranges belonging to the Alai-Pamir system. The orography of this part of the Tian Shan is not yet well worked out, and they are traced on our maps mainly in accordance with the river system. Thus the high Hissar range is traced along the water-parting between the system of the Zerafshan and the upper tributaries of the Amu; another

high range, the Zerafshan, is traced in the same direction between the two parallel rivers, the Zerafshan and its tributary, the Yagnob; while a third range, often called Turkestan ridge, is traced from west to east parallel to the Zerafshan, on its northern bank. It is very probable, however, from what is known about the structure of the Tian Shan and the western Pamir, and their direction north-eastwards, that the three ranges referred to will, when they are better known, be found to be of a much more complicated character than is at present supposed. All three ranges are snowclad, and in their highest peaks reach altitudes of from 18,500 feet in the west to 22,000 feet in the east, while the passes over them, which afford difficult travelling as a rule, lie at altitudes of about 12,000 feet. Several Alpine lakes, such as Iskander-kul, 7000 feet high, have been found nestling under the high precipitous peaks.

The Alpine zone extends as far north as the 40th parallel, beyond which the province is covered with steppes, which are broken by only one range of mountains, Nuratyn-tau (also known as Sanzar and Malguzar, in its south-eastern, and Kara-tau in its north-western, extremity). This treeless range shoots for 160 miles, from the western Tian Shan, in a north-western direction, reaching 42° N. and 65° E.; it has a width of about 35 miles, and reaches altitudes up to 7000 feet; it is now pierced, in the renowned Sanzar gorge, or Tamerlane's Gate, by the railway leading from Samarkand to Tashkent. The other mountains in the province are well wooded, and it is estimated that nearly 4,500,000 acres are under forests. The north-western portion of the province is occupied by the Famine Steppe—which was for a long time an obstacle to the advance of the Russians southwards, but which probably might be irrigated—and by the desert of Kyzyl-kum, which is covered in places by moving sand. The Famine Steppe (not to be confounded with another desert of the same name, or Bek-pak-dala, to the west of Lake Balkhash) occupies nearly 5,000,000 acres, covered with a loess-like clay; the water is nearly always brackish, and can only be obtained from wells. In the spring the steppe is clothed with grass, and offers good pasture-grounds for the Kirghiz, but the grass withers as summer advances. Nearly 1,500,000 acres might, however, be irrigated and rendered available for the cultivation of the cotton-tree; and indeed a beginning has been made in that direction. The Kyzyl-kum (or Kizyl-kum) Steppe, which occupies 88,000 square miles, is covered partly with rocky hills, reaching an altitude of 3500 feet, and partly with salted clays, patches of prairie land, and sands. The sand is especially prevalent in the parts on the margin, where the moving *barkhans* (crescent-shaped sandhills) invade the Kara-kul oasis of Bokhara. The vegetation is very poor, as a rule; grass and flowers (tulips, *Rheum*, various Umbelliferæ, &c.) appear for a short time in the spring, but for the rest of the year only the bushes and the grasses characteristic of the steppes of Central Asia are to be seen, and the *barkhans* are covered merely with *Haloxylon ammodendron*, *Poligonum*, *Halimodendron*, *Atraphaxis*, and other steppe bushes; occasionally some *Stipa* grass is seen on the slopes of the sand-mounds, while *Artemisia* and *Tamarix* bushes cover the more compact sands. Water can only be obtained from wells, which sometimes have to be 140 feet deep. A few Kirghiz are the only inhabitants, and they are only to be found in the more hilly parts of the steppe.

The chief river of the province is the Zerafshan (see also ninth edition), which, under the name of Match, takes its rise in the Koksu mountain group where the Hissar range meets with the Alai ranges, near the Match Pass (13,800 feet). The glacier from which it flows is 16 miles long, and reaches by its lower end the altitude of 9000 feet; formerly, however, it crept at least 33 miles farther down the valley. The Zerafshan flows first westwards, in a wild gorge, with a fall of 37 feet per mile; near Varzaminor it receives the Fan-daria—formed by the junction of the Yagnob, which flows in a gorge parallel to the Upper Zerafshan, with the Iskander-daria—and pierces the Zerafshan range in a wild transversal gorge. It then bends northwards, receives the Kshtut and the Maghian from the left, and issues from the mountains into the steppes near Penjakent. After flowing past Samarkand, it divides into two branches (the Ak-daria and Kara-daria), 65 to 67 miles long, which unite near the Bokhara frontier; these surround the fertile, well watered, and well populated Miankal Island. To the west of Kermineh (altitude 970 feet) the Zerafshan bends to the south-west, flows past Bokhara, a few miles north of the city, and is lost in the sands 15 miles west of the Kara-kul villages. Its total length is 400 miles, for 260 of which it flows in the province of Samarkand. The current in the Zerafshan is so rapid that navigation is only possible by rafts; these are floated from Penjakent downwards. The quantity of water varies at the junction with the Maghian from 800 cubic feet per second to 27,800, or even 33,400, cubic feet per second in different periods of the year. The name of the Zerafshan, "distributer of gold," is fully explained by its value for purposes of irrigation: 83 main canals are drawn from it in the Samarkand province, watering 1200 square miles; while another 1640 square miles are watered in Bokhara by means of 43 main canals (of which the Shahrud brings to the Bokhara city 1610 cubic feet of water per second) and 939 secondary canals. The north-eastern portions of Samarkand are watered by the Syr-daria. One of the lakes, the Tuz-khan (40 miles from Jizak) yields about 1300 tons of salt.

Climate. The climate is very dry and continental in character. The average temperature for the year is 55° F. at Samarkand, and 58° at Khojent and Jizak; but the average temperature for the winter is only 34°, and frosts of 4° and 11° have been experienced at Samarkand and Khojent respectively; on the other hand, the average temperature for July is 79° at Samarkand and 85° at Khojent and Jizak. The total precipitation (including snow in winter) is only 6·4 inches at Khojent, 12 inches at Samarkand and Khojent, and 24 inches at Jizak. The hilly tracts have a healthy climate, but malaria prevails in the lower regions and the mosquitoes are quite a plague in summer.

Inhabitants, industries, &c. In 1897 the domiciled population numbered 857,847, of whom 384,392 were women, and 135,568 lived in towns. The Uzbegs form over two-thirds of the population, and after them the Kirghiz and Tajiks are the most numerous; Jews, Tsigans, Tatars, Afghans, and Hindus are also met with. The Russians had 9 villages (2000 inhabitants) on the Syr-daria, in the Famine Steppe, in 1897.

In 1898 nearly 1,000,000 acres were irrigated, and about 800,000 acres half-irrigated. The chief crops in 1897 were: wheat 4,156,000 cwt., rice 2,584,000 cwt., and barley 1,240,000 cwt. Sorghum, millet, Indian corn, peas, lentils, haricots, flax, hemp, poppy, lucerne, madder, tobacco, melons, and mushrooms are also grown. Agriculture has reached a high level of perfection, and two crops are often taken from the same land in one season. Over 1100 tons of raw cotton, chiefly American, were obtained in 1897, and 21,000 acres were under vineyards. Sericulture prospers, especially in the Khojent district (15,100 cwt. of raw cocoons). The forests have been already referred to. Plantations of trees near Samarkand have proved very successful. Cattle-breeding forms the chief occupation of the Kirghiz, and there were in 1897 in the province 82,760 horses, 170,890 cattle, 1,087,500 sheep and goats, 39,500 donkeys, and 45,800 camels. Weaving, saddlery, boot-making, tanneries, oil works, and metal works are widely spread in the villages and towns, while the nomad Kirghiz excel in making felt goods and carpets. But all these industries are simply domestic in character, and of large establishments there are only 1 glass works, 24 cotton-cleaning works, 3 steam flour mills, and a few distilleries. Mining is in its infancy; but some coal (5000 tons), sulphur, ammonia, and gypsum is obtained. Trade is considerable, the chief exports being rice, raw cotton, raisins, dried fruit, nuts, wine, and silk. The Central Asian Railway now crosses the province from Bokhara to Samarkand and Tashkent; a branch line runs to Andijan in Fergana.

Education is at a low ebb. There were only 9 schools for Russians in 1899, attended by 350 boys and 240 girls; 8 mixed schools, with evening classes, had 259 pupils; and 1785 Mahommedan schools, about 17,000 pupils. The province is divided into 4 districts, the chief towns of which are: Samarkand (see below), Fort Jizak (16,041), Kattykurgan (10,083), and Khojent, or Hodjent (30,076). (P. A. K.)

Samarkand, the capital of the above province, situated in 39° 39′ N., 97° 18′ E., 5 miles from the left bank of the Zerafshan, at an altitude of 2260 feet. It is connected by rail with Krasnovodsk (938 miles), *viâ* Merv, and with Tashkent (126 miles). In 1897 the population numbered about 40,000 in the native city, and about 15,000 in the new Russian town, inclusive of the military (80 per cent. Russians). Out of the total of 54,900, only 23,194 were women. The Russian town is well built, with broad boulevards, gardens, and a park. Although the building of the railway as far as Tashkent and Andijan has diminished the commercial importance of Samarkand, it still remains an important depôt for the export of raw cotton, rice, raw silk, silk goods (blankets), leather, fruit, horses, and wine.

Sambalpur, a town and district of British India, in the Chhattisgarh division of the Central Provinces. The town is on the left bank of the river Mahanadi, 495 feet above the sea, and has a railway station. Population (1881), 13,939; (1891), 14,571. There is a ruined fort, with old temples. The cantonment contains a wing of a Madras native infantry regiment. The Government high school had 444 pupils in 1896–97. There is considerable trade.

The district of SAMBALPUR has an area of 4948 square miles. Population (1881), 693,499; (1891), 796,413, showing an increase of 15 per cent., which has been continuous since 1872. Average density, 161 persons per square mile. In 1901 the population was 829,823, showing a further increase of 4 per cent. The land revenue and rates are Rs.2,06,334, the incidence of assessment being little more than two annas per acre; cultivated area (1897–98), 1,117,439 acres, of which 18,712 were irrigated from tanks, &c.; number of police, 491; boys at school (1896–97), 8137, being 13·6 per cent. of the male population of school-going age; registered death-rate (1897), 30 per thousand, compared with 38 for the province generally. This last figure is sufficient to show that Sambalpur entirely escaped the famine of 1896–97, which indeed can be said to have brought prosperity to the district by causing high prices for a good rice crop, rice being the staple of cultivation. It was almost equally fortunate in 1900. The main line of the Bengal-Nagpur Railway runs along the northern border of the district, with a branch (30 miles) south to Sambalpur town.

Sambor, the chief town of a government district in Galicia, situated on the Dniester, to the south-west of Lemberg. The industries consist in brewing, corn-milling, and the manufacture of damask silk, oil and salt from the brine wells in the neighbourhood. There is a considerable trade in flax, hemp, eggs, and cattle. Population (1890), 14,324; (1900), 17,027, chiefly Polish and Roman Catholic (estimated at 9 per cent. Ruthenians and 3 per cent. German; 29 per cent. Jewish and 17 per cent. Greek Catholic).

Samnán, a small province of Persia, which, including the city and district of Damghán, is generally known as "Samnán va Damghán." It is bounded on the W. by the districts of Khár (the ancient Choara) and Firúzkúh, on the N. by Mázandarán, and on the E. by Sháhrúd and Bostám. In the S. it extends to beyond the oasis of Jendek in the desert north of Yezd. Its northern part is still known as Komush, or Komish, the ancient Commisene. The revenue which the State derives from the whole province amounts to about £7000 per annum.

Samnán, the capital of the above province, situated 145 miles east of Tehran, on the high road thence to Mashhad, at an altitude of 3740 feet and in 35° 34′ N., and 53° 22′ E. It has a population of about 10,000, post and telegraph offices, and a fine minaret, 100 feet high and some inches out of the perpendicular, built in the 12th century. It exports large quantities of pistachios and almonds and some coarse tobacco grown in the district. In the town and some of the neighbouring villages a dialect with many old Persian forms and resembling the Mázandarán dialect is spoken.

A. Houtum-Schindler, "Bericht über d. Samnán Dialect," *Zeitsch. d. Morgenl. Gesellschaft*, vol. xxxii., 1878.

Samoa, an archipelago which occupies a somewhat central position in the Pacific Ocean, about 150 miles north of Tonga and nearly midway between the New Hebrides and Tahiti, 1600 miles from Auckland (New Zealand), 2410 from Sydney, and 4200 from San Francisco. The group, which was discovered by Bougainville, and by him named the Navigators' Islands, comprises altogether fourteen volcanic islands disposed in the direction from west to east between 13°–15° S. and 168°–173° W., with a total area of 1100 square miles, and a population (1900) of 35,000, all Polynesians except about 500 Europeans (British, American, German). The chief members of the group are:—

	Area in sq. miles.	Population.
Savaii	660	12,500
Upolu	340	16,600
Tutuila	54	3000
Manua, with Ofu and Olosenga .	26	2000

All are forest-clad and mountainous, with several extinct or quiescent craters rising from 2000 feet in Upolu to 4000 (Mua) in Savaii, and the peak of Vaea in the former island will always be associated with the memory of the late R. L. Stevenson, whose monument crowns the summit. Although there are now no active cones, Upolu has in comparatively recent times been subject to violent volcanic disturbances. Several parts of the islands are strewn with modern eruptive matter, and according to a local tradition, the last explosion occurred not more than 200 years ago. In 1866 a submarine volcano near the islet of Olosenga was the scene of a violent commotion, discharging rocks and mud to a height of 2000 feet, and discolouring the surrounding waters for many miles in all directions. The whole group is abundantly watered, and such is the fertility of the igneous soil that the means of subsistence are said to be more easily raised than in any other part of the world. But the archipelago lies in the track of the fierce hurricanes which occur usually between the months of December and April.

Of the extremely limited Samoan fauna, consisting mainly of an indigenous rat, four species of snakes, and a few birds, the most interesting member is the *Didunculus strigirostris*, a ground pigeon of iridescent greenish-black and bright chestnut plumage, which forms a link between the extinct dodo and the living African *Treroninæ*. The Samoans are typical members of the large brown Polynesian race (see POLYNESIA), and according to some ethnologists Savaii was the cradle and centre of dispersion of these aborigines over the Pacific Ocean from Hawaii to New Zealand. This view is largely based on the fact that Samoan is the most archaic of all the Polynesian tongues, and still preserves the organic letter *s*, which becomes *h* or disappears in nearly all the other archipelagoes. Thus the term *Savaii* itself, originally *Savaiki*, is supposed to have been carried by the Samoan wanderers over the ocean to Tahiti, New Zealand, the Marquesas and Sandwich groups, where it still survives in such variant forms as *Havaii*, *Hawaiki*, *Havaiki*, and *Hawaii*. The theory is supported by the local traditions, legends, and cosmogonies in which Polynesian oral literature abounds.

The exports from Samoa (chiefly copra) were valued in 1897 at £48,000 and the imports at £66,000 (£35,000 from British empire), while of the shipping (82,000 tons) about half was British, and 32,000 tons were American. Apia, the capital and chief centre of trade, lies in the German island of Upolu; but Pago Pago (Pango Pango) in Tutuila, is used as a coaling station for the United States Navy in the Central Pacific waters. (A. H. K.)

History.—Subsequently to the year 1881, the Samoan Islands assumed a much greater international importance than before. Their situation in the direct pathway of commerce from the United States to Australia, their central position in the South Pacific, and the fact that European Powers had acquired nearly all other groups of islands and valuable harbours in the South Pacific, made Samoa a desirable possession to any maritime Power. Under a political arrangement between Great Britain, Germany, and the United States, no single Power was to appropriate them. But in 1887 and 1888 civil war prevailed, the Germans supporting their candidate, the native Tamasese, as the lawful king, and the British and American residents of the islands supporting Malietoa. After the latter had been deported by the Germans, the British and American support was transferred to his successor, Mataafa. In the course of the fighting which ensued, some fifty German sailors and marines were killed or wounded by the adherents of Mataafa. A conference between the three Powers was thereupon held at Berlin, and a treaty was executed by those Powers and by Samoa, under date 14th June 1889, by virtue of which the independence and autonomy of the islands were guaranteed,

Malietoa was restored as king, and the three Powers constituted themselves practically a protectorate over Samoa, and provided a chief justice and a president of the municipality of Apia, to be by them appointed, to aid in carrying out the provisions of the treaty. The government was administered under this treaty, but with considerable friction, until the end of 1898, when, upon the death of Malietoa, two rival candidates for the throne appeared, and the chief justice selected by the three Powers decided against the claims of Mataafa, one of the rival claimants, and in favour of a boy, Malietoa Tanu, a relative of the deceased Malietoa. Civil war immediately ensued, in which several American and British officers and sailors were slain by the natives, the Germans upholding the claims of Mataafa, and the British and Americans supporting the rival candidate. The three Powers thereupon sent a commission to Samoa to investigate and adjust the difficulties. The situation, however, was found to be so complicated and embarrassing that, early in the year 1900, the so-called Berlin treaty was abrogated, Great Britain withdrew her claims to any portion of the islands and received compensation from Germany by concessions in other parts of the world, and the United States withdrew from all the islands west of Tutuila, leaving Upolu and Savaii and their outlying islands for exclusive German control, the United States retaining the island of Tutuila and the small islands near to it. The Germans immediately made a Crown colony of their new possessions, and appointed a governor for their control. The United States, having received the written assent of all the chiefs of the islands that fell to it by the partition, assumed sovereignty over them and proceeded, as we have already seen, to erect a well-equipped coaling station in the harbour of Pago Pago.

On 16th March 1889 a hurricane prevailed in the South Pacific, and the heavy tidal waves swept into the harbour of Apia and created great havoc among the warships of the three Powers congregated there. The American warship *Nipsic* was cast upon the beach, but was afterwards floated and saved. Two other United States warships *Trenton* and *Vandalia*, were beaten to pieces upon the coral reef, and sank; and the German warships *Olga* and *Eber* were wrecked. Great loss of life ensued. The British warship *Calliope* was in the harbour, but succeeded in getting up steam and, standing out to sea, escaped destruction. It was fitting that R. L. Stevenson's should be the pen to describe in vivid and dramatic language the heroism of the captain and crew.

The Germans had the largest financial interests in the islands for many years, and acquired by the new treaty the most valuable portions thereof. The particular value of Tutuila lies in the excellence of the harbour of Pago Pago and its central position in the South Pacific. The Samoan climate is equable and delightful, the temperature ranging from 60° to 90° F., the average for summer being about 5° higher than that for winter. The regularity and strength of the trade winds temper the heat and, with the picturesque native life, make the islands an attractive place of residence for Europeans. Robert Louis Stevenson passed his last years there, and his body lies buried on the summit of Mount Vaea, overlooking Vailima, his South Sea home, and the coral-encircled harbour of Apia. The steamers of the Oceanic Steamship Company of San Francisco all touch at the group in their regular trips to Sydney, and communication is also furnished once a fortnight by the Union Steamship Company of New Zealand. (H. C. I.)

Samos, an island of the Aegean, separated from the Anatolian coast by a strait less than a mile wide. It is tributary to Turkey in the sum of £2700 annually, but otherwise is practically an independent principality, governed by a prince of Greek nationality nominated by the Porte. As chief of the executive power the prince is assisted by a senate of four members, chosen by him out of eight candidates nominated by the four districts of the island—Vathy, Chora, Marathocumbo, and Carlovasi. The legislative power belongs to a chamber of 36 deputies, presided over by the metropolitan. The Budget estimate for receipts and expenses for 1900–01 was £31,848. There is no public debt. The seat of the Government is Vathy (5000). There is a telephone service. The island is remarkably fertile, and a great portion of it is covered with vineyards, the wine from the Vathy grapes enjoying a specially high reputation. There are three ports: Vathy, Tegani, and Carlovasi. They were visited in 1899 by 1402 steamships, of 304,250 tons, as compared with 1178, of 287,095 tons, in 1895, and by 3604 sailing vessels, of 449,560 tons, as compared with 3562, of 252,897 tons, in 1895. In 1899 the ships belonging to the principality numbered 368, of 3491 tons, as compared with 306, of 3562 tons, in 1895. The total value of the exports in 1900 was £211,000, as compared with £164,876 in 1895, and of the imports £213,000, as compared with £173,545. The principal exports are wine (£140,000 in 1900 and £13,698 in 1896), olive oil (about £20,000), raisins (£25,000), locust beans, and tobacco (£20,000). The population in 1900 was 54,830, not comprising 15,000 natives of Samos inhabiting the adjoining coasts. The predominant religion is the Orthodox Greek, the metropolitan district including Samos and Icama. In 1900 there were 634 foreigners on the island (523 Hellenes, 13 Germans, 29 French, 28 Austrians, and 24 of other nationalities). In 1881 the remarkable aqueduct and tunnel of Eupalinus, cut through the mountain behind the ancient capital for a distance of about 1400 yards, was discovered.

See TOZER. *Islands of the Ægean*, 1890.

Samosata, now SAMSAT, Turkey in Asia, altitude 1500 feet, the capital of the Seleucid kings of Commagene, and a place of strategical importance. The town was situated on a broad plain, on the right bank of the Euphrates, where there is the first easy passage across the river below the point at which it leaves the mountains. Samosata, according to Strabo, was the starting-point of the great road to India, and it was probably the place at which the Persian "Royal Road" crossed the Euphrates. Taken by Mark Antony, it was finally included in the Roman empire by Vespasian, and was the birthplace of Lucian and of the heretical bishop Paul, who maintained the simple humanity of Christ. A Kúrdish village occupies a corner of the site of the ancient town.

Samothrace (Turkish, *Semadrek*), the "Thracian Samos," a rugged mountainous island in the Aegean Sea, altitude 5248 feet, situated 20 miles south of Dedeagach, on the coast of Thrace. The island is a kaza of the Lemnos sanjak, and has a population of 3500, nearly all Greek. On the north coast are much frequented hot sulphur springs. In 1873 and 1875 excavations were carried out under the auspices of the Austrian Government with interesting results.

Sampson, William Thomas (1840–1902), American naval commander, was born at Palmyra, New York, 9th February 1840, and graduated at the head of his class from the U.S. Naval Academy in 1861. He served in the *Potomac* in 1861, in which year he was promoted to master, and in the following year was made

lieutenant. He was executive officer in the *Patapsco* when she was blown up in Charleston Harbour, 10th January 1865. Varied service on distant stations followed, with promotion to the rank of lieutenant-commander in 1866 and commander in 1874. He was a member of the International Prime Meridian and Time Conference, 1884, and was afterwards a member of the Board of Fortifications. He was superintendent of the Naval Academy from 1886 to 1890, being meanwhile promoted to captain, and serving as delegate at the International Maritime Conference at Washington, 1889.

From the first Sampson threw himself energetically into the work of developing the United States navy. The construction of the gun factory was in his charge, and it fell under his absolute control when he became chief of the Bureau of Ordnance, which position he held until he was appointed to the *Iowa*, shortly before the war with Spain. For a number of years from 1892 onwards all the guns built for the American navy were constructed under his supervision, and the heavier guns were from his own design. It is said that 95 per cent. of the guns employed in the Spanish–American war had been made under his superintendence. He was a member of the Advisory Board and the Board on Construction for five years up to 1897, and his influence was felt not only in the matter of general design, but still more decisively in regard to the distribution of guns and armour. Equally important was his influence in the training of the *personnel* of the navy. He superintended the gunnery training and prepared a new drill-book for the fleet.

When the *Maine* was blown up in Havana harbour in February 1898, Sampson, then a captain, was one of the court of inquiry appointed to investigate the cause of the disaster. At the outbreak of the war with Spain he was placed in charge of the North Atlantic squadron, and conducted the blockade of Cuba. When it was known that Admiral Cervera, with a Spanish fleet, had left the Cape Verde Islands, Sampson withdrew a force from the blockade to cruise in the Windward Passage, and made an attack upon the forts at San Juan, Porto Rico. After his return to the coast of Cuba, he conducted the blockade of Santiago, and the ships under his command destroyed the Spanish vessels when they issued from the harbour of Santiago and attempted to escape. Sampson himself was not actually present at the battle, having started for Guantanamo just before it began. He was, however, only a few miles away at the most, and reached the scene of battle as the last Spanish vessel surrendered, and the engagement was fought in accordance with his instructions. He was promoted to commodore in 1898, to rear-admiral, 3rd March 1899, and was made commandant of the Boston (Charlestown) Navy Yard in October of the same year. He died 6th of May 1902. Admiral Sampson rose from a comparatively humble station in life by distinguished ability, power of command, and sheer force of character. He exercised an influence in every department of naval activity, won the high professional esteem of his brother officers, and was held in warm regard by all but a small section of his countrymen. He was the man whose personal energy entered more largely than that of any other into the construction, armament, organization, and fighting qualities of the American fleet as constituted in the Spanish–American war.

Samshui, a treaty port in the province of Kwangtung, China, situated on the left bank of the river West, 99 miles from Canton. Its position is at the junction of the rivers North and West, and is favourably situated as a distributing centre for foreign goods. The town itself is of no importance, and the trade, which is almost entirely with Hong Kong, so far is not great. The imports by steamer in 1899 amounted to H. taels 2,967,000 (£445,000), but in 1900 to only £355,400. This, however, is only part of the trade, as the country abounds in creeks suitable for junk navigation.

Samsún, the ancient Amisus, the chief town of the Janik sanjak of the Trebizond vilayet of Asiatic Turkey, situated on the south coast of the Black Sea between the deltas of the Kizil and Yeshil Irmaks, and connected by metalled roads with Sivas and Kaisaríeh, and by sea with Constantinople. It is a thriving town, of considerable importance as the outlet for the trade of the Sivas vilayet. Steamers lie about a mile from the shore in an open roadstead, and in winter landing is sometimes impossible. In 1900 the exports — cereals, flour, tobacco, &c. — were valued at £759,760, and the imports—cotton stuffs, iron, &c.—at £468,230. The population rose from about 3000 in 1860 to about 13,000, of whom 10,000 are Christians. Amisus, which stood on a promontory about 1½ miles north-west of Samsún, was, next to Sinope, the most flourishing of the Greek settlements on the Euxine, and under the kings of Pontus it was a rich trading town. By the 1st century A.D. it had displaced Sinope as the northern port of the great trade route from Central Asia, and later it was one of the chief towns of the Comneni of Trebizond. There are still a few remains of the Greek settlement.

Sanaa, capital of Yemen. The journeys of General Haig in January 1887, of Professor Schweinfurth in 1888–89, and of Harris in 1892, have thrown some new light on the physiography of Yemen, and have added some interesting details to our previous knowledge of Sanaa. According to Haig, Sanaa is situated 140 miles to the north and east of the Red Sea port of Hodeida and 260 miles north of Aden. The co-ordinate position in latitude and longitude of Sanaa is most uncertain. The best authorities seem to agree that it is about 44° 30′ E. and 15° 20′ N., but these values have never been satisfactorily verified. Haig makes its altitude to be 7800 feet above sea-level, but Harris, following Glaser, fixes it at 7300. It is approached from the west by the Turkish military road from Hodeida, passing through a succession of steppes and gently sloping valleys, terraced and cultivated, between low hills of trap, a fall of 2000 feet occurring between the western plateau and the open plain of Sanaa.

Turkish occupation and misrule are the predominant features throughout the town. The fortress of Jebal Nigcim has been repaired, and from its citadel, on one of the spurs of the hill, the guns are significantly pointing into the streets of the city. There is much of the atmosphere of a second-class Egyptian port about Sanaa. Restaurants are to be found about the central square, and cafés adjoin the numerous khans or caravanserais. The old palace of the Imams, which is now occupied by the Turkish governor, is whitewashed, and the walls of its rooms are picked out with an inferior style of French decoration. The most flourishing community in Sanaa appear to be the Jews, of whom there are about 20,000 (the total population is estimated at 45,000), who live on distinctly better terms with the Turks than the Arab inhabitants do. They possess 23 synagogues and 20 schools, with 700 boys in them. The whole male population can read, but few of the females. The boys are taught to be masons and artificers, and are preferred to Mahommedans as servants by the few Europeans who live at Sanaa. The pretentious style of the houses seems to have struck all travellers. They are often stone-built (in colour patterns) and three or four storeys high, the upper storeys projecting over the street, with long narrow windows filled in with

stained glass. The streets of the bazaars are winding and narrow, and are arranged (as is usual in Asiatic towns) with reference to particular crafts and trades, each street maintaining its own special business. The manufacture of arms and jewellery, trade in silks and cottons, china, and hardware are all well represented, the jewellery (especially jewelled sheaths) being a speciality of Sanaa.

AUTHORITIES.—HAIG. *R.G.S. Proceedings*, vol. xi.—HARRIS. *Journey through Yemen.* London, 1893. — SCHWEINFURTH. *R.G.S. Proceedings*, vol. xi.—KAY. *Omrah's History of Yemen.* London, 1892.

San Antonio, a city of Texas, U.S.A., capital of Bexar county. It is the largest city in the state, and is situated in 29° 25′ N., 98° 25′ W., on the river San Antonio, at the mouth of the San Pedro, in the southern part of the state, at an altitude of 645 feet. The present city combines three different elements of growth: the old Mexican town, in the district known as Chihuahua, west of the San Pedro; San Antonio proper, including the business part of the city, between the rivers San Antonio and San Pedro, inhabited mainly by Americans; and the portion east of the river San Antonio, settled mainly by Germans. The city has a level site on both banks of the river, its street plan is irregular, and it is divided into eight wards. It has an abundant water-supply from artesian wells and from the San Antonio, and it is well paved and sewered. It is the intersecting point of four railways, the Galveston, Harrisburg, and San Antonio, the International and Great Northern, the San Antonio and Aransas Pass, and the San Antonio and Gulf, making it the most important commercial centre in this part of the state. Its manufacturing interests also are large. In 1900 the city contained 312 manufacturing establishments, with a total capital of $4,252,197. They employed 3073 hands, and the product was valued at $6,821,297. The assessed valuation of property, real and personal, for 1900, was $31,879,369, the net debt $2,015,449, and the rate of taxation $27.00 per $1000.

Within the city is a United States arsenal in spacious grounds, and a mile north of the city is a United States military post, known as Fort Sam Houston. The town contains many fine buildings and many historical relics. Among the former are the new court house, the city hall, and the cathedral of San Fernando. Among the latter the first in interest is the Alamo, an adobe church, which in the Texan War for Independence, in 1836, a garrison of 175 men defended for 12 days against the assaults of 4000 Mexicans, and finally perished to a man. In and about the city are several of the early Spanish mission buildings, still in a good state of preservation. The city is the site of St Louis College, a Roman Catholic institution, opened in 1894, which five years later had a faculty numbering 15 and was attended by 110 students. Population (1890), 37,673; (1900), 53,321, of whom 9348 were foreign-born and 7538 negroes.

San Antonio de los Baños, a small Cuban town, with well-built houses, about 23 miles from Havana, on the road to Guanajay. It has mineral springs and baths, and is frequented as a summer resort by the people of Havana. The population in 1899 was 8178.

San Bernardino, a city of California, U.S.A., capital of San Bernardino county. It is situated in 34° 07′, N., 117° 17′ W., in the valley at the south base of the San Bernardino range, in southern California, at an altitude of 1048 feet. The broad streets are well shaded and bordered with the beautiful grounds of private residences. It is on the Southern California and the Southern Pacific railways, in the fruit region of southern California, and is surrounded by orange and lemon groves, which furnish a large part of its trade. Population (1890), 4012; (1900), 6150, of whom 873 were foreign-born and 166 coloured.

Sancti Spiritus, a Cuban city in Santa Clara province, situated in the centre of a region principally devoted to grazing. It was one of the seven original municipalities founded by Diego Velasquez. The population in 1899 was 12,696.

Sandbach, a market-town, urban district (1894), and parish, Cheshire, England, in the Crewe parliamentary division of the county, 5 miles north-east of Crewe by rail, on the Trent and Mersey canal. The urban district council owns the water-works, constructed at a cost of £7000. In 1889 a town and market hall was erected at a cost of £5000, and in 1891 the old town-hall was demolished. The population of the urban district was in (1881), 5493; (1901), 5556.

Sandefjord, the oldest and most famous spa in Norway, county of Jarlsberg and Laurvik, 53 miles south-south-west of Christiania by rail, with sulphur and other baths and a bath-house. Population (1891), 4238; (1900), 4847.

Sandgate, a town, railway station, and bathing-place, Kent, England, in the Eastern or St Augustine's parliamentary division of the county, 1½ miles west of Folkestone, and about 3 miles east of Hythe with which it is connected by tramway (belonging to the South-Eastern and Chatham Railway) running along the shore. The camp of Shorncliffe, an important military station, lies north of the village on a plateau. It forms three sides of a square and can accommodate more than 5000 troops. A convalescent home with accommodation for 230 patients, erected at a cost of £20,000, was opened in 1897. The population of the urban district in 1891 was 1756, exclusive of 2822 officers and soldiers in camp; in 1901, 2023.

Sandhurst, a parish, Berkshire, England, in the Eastern or Wokingham parliamentary division of the county, 4½ miles south-east of Wokingham by rail, and 1¼ miles from Wellington College station. The Royal Military College was settled here in 1812 in beautiful park-like grounds. Population (1901), 2386.

Sandhurst. See BENDIGO.

San Diego, a city and seaport of California, U.S.A., capital of San Diego county. It is situated on the Pacific coast, near the southern boundary of the state, on a harbour formed by a sand-spit from the south, the entrance being around its northern end. The site is nearly level, with a slight slope towards the harbour; there is a water-supply as well as other municipal improvements. The principal railway to the city is the Southern California, in addition to which there are three small local lines of steam railway, besides trolley lines. On a sand-spit enclosing the harbour has sprung up, around the well-known Coronado hotel, a village of fine residences, known as Coronado. This is connected with the city on the mainland by ferry. Population (1890), 16,159; (1900), 17,700, of whom 3768 were foreign-born and 623 were coloured, including 313 negroes.

Sandoway, a district in the south of the Arakan division of Lower Burma. Population (1891) 78,425; (1901) 90,200. Area, 3784 square miles. Of the population in 1891, 69,250 were Buddhists and Jains; 3128 Mahommedans; 5452 aborigines, mostly Chins; 175 Hindus; and 420 Christians, 384 of whom were natives. Of a total area of 2,421,760 acres, only 61,719 bore crops

in 1898–99, but 2,350,000 were uncultivable, and apart from fallow only 8233 were available for cultivation. The rainfall in 1898–99 was 217·7 inches. Except 1974 acres of tobacco, all the cultivation is rice. The chief town, Sandoway, had a population in 1891 of 2537 persons. It has a municipal committee of eight members, six of whom are elective, four being Burmese and two Mussulmans.

Sandur, or Sundoor, a petty state of southern India, surrounded by the Madras district of Bellary. Area, 161 square miles. Population (1891), 11,388; (1901), 11,205. The chief, whose title is Raja, is a Maratha, tracing back his descent to the 17th century. In 1897–98 the estimated gross revenue was Rs.50,000. On the western border is a hill range of the same name, which contains the military sanitarium of Ramanmalai.

Sandusky, a city of Ohio, U.S.A., the capital of Erie county. It is situated in 41° 32′ N., 82° 42′ W., on Sandusky Bay, an arm of Lake Erie, in the northern part of the state, at an altitude of 596 feet. It has broad streets, and a good water-supply and sewerage systems. It is traversed by five railways, the Baltimore and Ohio, the Cleveland, Cincinnati, Chicago, and St Louis, the Columbus, Sandusky, and Hocking, the Lake Erie and Western, and the Lake Shore and Michigan Southern. These, with vessels on the Lakes, give the city a large commerce, particularly in coal, iron-ore, grain, fruit, and fish. Its manufactures are not large, and consist in great part of agricultural implements. Population (1890), 18,471; (1900), 19,664, of whom 4002 were foreign-born and 295 negroes.

Sandwich, a municipal borough, cinque port, and market-town in the St Augustine parliamentary division of Kent, England, on the Stour, 5 miles north of Deal, with a station on the South-Eastern and Chatham Railway. St Peter's church has been restored and modern grammar-school buildings have been erected. Corporation water-works were constructed in 1894. The St George's golf-links are amongst the finest in England, and are one of the three upon which the Championship contests are held. Area, 756 acres. Population (1881), 2846; (1901), 3174.

Sandys, Frederick (1832–——), English painter and draughtsman, was born at Norwich on 1st May 1832, and received his earliest lessons in art from his father, who was himself a painter. His early studies show that he had a natural gift for careful and beautiful drawing, and that he sought after absolute sincerity of presentment. It was to be expected, therefore, that he would sooner or later join himself to those who were associated with the Pre-Raphaelite Brotherhood, the one great movement in British art during the 19th century. At an early gathering of the P.-R. B. in 1848 Millais showed, as examples of sound work, engravings after the frescoes in the Campo Santo at Pisa by Orcagna, Benozzo Gozzoli, and other painters of the *quattrocento*, and said, "This is what the Pre-Raphaelite clique should follow." Sandys worked along the same lines as Millais, Madox Brown, Holman Hunt, and Rossetti, and it was not long before he was recognized as one of the most promising of the young artists of the day. He first met Rossetti in 1857, and carried away with him the impression of the painter-poet's features, which he reproduced so cleverly in "A Nightmare," a caricature of "Sir Isumbras at the Ford," by Millais. Both the picture and the skit upon it by Sandys attracted much attention in 1857. The caricaturist turned the horse of Sir Isumbras into a donkey labelled "J. R., Oxon." (John Ruskin). Upon it were seated Millais himself—an excellent likeness of him in his handsome youth—in the character of the knight, with Rossetti and Holman Hunt as the two children, one before and one behind. The humour was chiefly directed against Ruskin, but all concerned took it in good part. Rossetti and Sandys, in fact, became intimate friends, and for about a year and a quarter, ending in the summer of 1867, Sandys lived with Rossetti as one of his numerous guests at Tudor House (now called Queen's House), in Cheyne Walk, Chelsea. By this time Sandys was known as a painter of remarkable gifts. He had begun by drawing for *Once a Week*, the *Cornhill Magazine*, *Good Words*, and the other periodicals which contained the best illustration work that has ever been done in England. Among the men who were then drawing for woodcuts, and creating a body of work which was not until long afterwards recognized at its full worth, Sandys took a leading place. He drew only in the magazines. No books illustrated by him can be traced. So his exquisite draughtsmanship has to be sought for in the old bound-up periodical volumes which are now hunted by collectors, or in publications such as Dalziel's *Bible Gallery* and the *Cornhill Gallery* and books of drawings, with verses attached to them, made to lie upon the drawing-room tables of those who had for the most part no idea of their merits. Every drawing Sandys made was a work of art, and many of them were so faithfully engraved that they are worthy of the collector's portfolio. Early in the 'sixties he began to exhibit the paintings which introduced him to a wider public and set the seal upon his fame. The best known of these are "Vivien," "Morgan le Fay," "Cassandra," and "Medea."

The rejection of "Medea" by the hanging committee of the Royal Academy aroused Rossetti to burning indignation. In a letter of April 1868 he wrote: "Sandys's picture of Medea has been turned out of the R.A.—a most disgraceful affair." However, it was exhibited in the following year and won the warm admiration of the judicious. Sandys never became a popular painter. His imagination was too fine for that. He painted little, and the dominant influence upon his art was the influence exercised by lofty conceptions of tragic power. There was in it a sombre intensity and an almost stern beauty which lifted it far above the ideals of the crowd. When he chose classic subjects, he treated them with Gothic freedom from convention and with a passionate determination to lay bare the human soul. The Scandinavian Sagas and the *Morte d'Arthur* gave him subjects after his own heart. "The Valkyrie" and "Morgan le Fay" represent his work at its very best. His portraits also had qualities far more in common with Gothic art than with any other school. His oil-paintings were of a marvellous fidelity, and have been said to be the finest in their way seen in England since the days of Holbein. He made as well a number of chalk drawings of famous men of letters, including Tennyson, Browning, Matthew Arnold, and James Russell Lowell.

See also Esther Wood. *The Artist* (Winter number), 1896, finely illustrated; which also refers to some other sources of information concerning Sandys.

San Fernando, a town of Spain, province of Cadiz, south-east of the capital, with a station on the Seville to Cadiz Railway. Population (1887), 23,756; (1897), 28,951. There are a very handsome, large town-hall, several storeys high, with marble staircases and stately columns, a good hospital for both sexes, a bull-ring, and a fish-market. The place is famous for its private schools and academies, which prepare boys for the navy. Between San Fernando and Puerto Real there is a tract of country studded with gardens, vineyards, and stone quarries. In this region is the arsenal of La Carraca. The principal local industries are salt, alcohol, liqueurs, starch, beer, tanneries, esparto grass rugs, soap, hats.

There are many flour-mills, and manufactures of rope, sails, and barrels.

San Francisco, the 9th city in size in the United States and the metropolis of California and of the Pacific coast, is situated in 37° 47′ 22·55″ N. and 122° 25′ 40·76″ W. Important changes in form of government, the coming of additional transcontinental railways, the Oriental outlook, caused by the control of the Philippine Islands by the United States, the increased trade with China, Japan, and the islands of the Pacific, caused a remarkable development during the last years of the 19th century.

Topography.—Within the decade from 1890 to 1900 the Golden Gate, or entrance to the harbour, was fortified in the most approved modern manner. Within the bay several islands are controlled by the Government, and fortified, while at the Government navy yard at Mare Island, north of the city, and at the Union ironworks, on the peninsula, are docks capable of receiving the largest modern warships. Suburban communities have grown up about the city, chief among which are Oakland, Alameda, Berkeley, San Rafael, Sausalito, San Mateo, Menlo Park, and Palo Alto. Electric and steam railways and ferries bring these places into close communication with the city. There are in the city over 140 miles of electric railways, 77 miles of cable roads, 12 miles of the steam system, and 10 miles of horse railways. The steep hills caused the invention here of the cable railway, now used in many cities of the world. Market Street is the artery from which diverge all the principal streets. It is paved with bituminous rock, material used largely for all the streets. The city has 195 miles of paved streets and 305 miles of sewers. In the early days the number of wooden dwellings was considerable, but builders are no longer hampered by the fear of earthquakes. Brick and stone are extensively employed, excellent stone being found in the Sierra and the Coast range, and business buildings of ten and eleven storeys or higher have been erected. Among the notable modern buildings are the United States post office, the Ferry building, Mills building, Spreckels building, hall of justice, hotel St Francis, mutual savings bank, and the Crocker building.

Population.—The population in 1890 was 298,997 and in 1900, 342,782, of whom 116,885 were foreign-born, and 17,404 were coloured, including a large proportion of Chinese; 1654 were negroes. Out of 128,985 adult males, 3596 were illiterate (unable to write), of whom 3354 were foreign-born. The death-rate in 1890 was 22·5, in 1900 it was 20·5.

Education, Libraries, Newspapers.—There are ten daily newspapers. Three morning and two evening papers are in the English language, the others represent the interests of the foreign population and of commerce and trade. There are six first-class theatres. The chief libraries are the Free Public Library of 143,000 volumes, and those of the Mechanics' Institute and the Mercantile Library Association. The private libraries of the late Adolph Sutro and of Hubert Howe Bancroft contain collections of rare books and pamphlets, including volumes relating especially to the history and development of the Pacific coast. The Free Library has six branches in various parts of the city, and circulated in the year ending 30th June 1901, 711,409 books. Chief among the museums are those of the Academy of Sciences, the State Mining Bureau, the State Board of Trade, and the Alaska collection, the last named controlled by the university of California. There is also a nucleus of an excellent museum owned by the city and situated in Golden Gate Park, the result of the California Midwinter Fair, a successful exhibition held there in 1894, following the World's Fair at Chicago. There are 82 public schools, with 1017 teachers, a total enrolment of 48,517 pupils (30th June 1901), with average daily attendance of 34,771. The university of California, a state institution at Berkeley, an hour's ride from San Francisco, and the Leland Stanford, Jr. University, at Palo Alto, south of the city, afford exceptional advantages for advanced education. The university of California has its departments of medicine, law, pharmacy, and dentistry, and the Mark Hopkins Institute of Arts and other minor departments situated in the city. The city has in all 11 medical and dental colleges. There are 145 churches of all denominations, 102 charitable and benefit organizations, and 44 hospitals and asylums.

Manufactures and Commerce.—For the year ending 30th June 1901 the chief manufactures, with the value of the product, were as follows:—Bookbinderies \$800,000, breweries \$4,000,000, coffee and chocolate, \$2,200,000, confectionery \$700,000, cigars \$2,000,000, crackers \$1,750,000, chemicals \$1,500,000, clothing \$1,500,000, electrical \$3,750,000, flour \$3,000,000, fruit-canning \$3,700,000, gas \$4,500,000, glass \$1,300,000, millinery \$810,000, provisions \$3,500,000, shirts \$1,700,000, ships \$3,000,000, shoes \$2,300,000, sugar \$14,211,516, tanneries \$1,310,000, tinware \$1,750,000, wire \$1,500,000, wool-scouring \$2,000,000.

The harbour and its branches are such that deep-water ships may go directly to docks within short distances of their source of supply, saving large cost of loading. The import of tea in 1890 was valued at \$923,025; in 1899 the valuation had risen to \$1,233,857, representing an import of 10,370,630 lb; 1900, 13,417,970 lb. During the year ending 30th June 1901 wheat exports were 13,262,796 bushels, valued at \$8,232,916, and wheat flour exports for the same period were valued at \$3,083,532. The exports of treasure by sea, 1901, were \$4,330,308, and the imports \$28,649,923. The total merchandise exports for 1901 were valued at \$34,596,792, of which \$11,316,448 were wheat and flour. The total imports for 1901 were \$35,161,753.

Railways, Banks, and Finances.—The city is connected with the Eastern states by three through overland railways, the Central Pacific, the Southern Pacific (which controls the Central Pacific), and the Atchison, Topeka and Santa Fé routes. Besides these, it has traffic connexions with the Canadian Pacific, Northern Pacific, and Great Northern transcontinental roads. Lines of the Southern Pacific and its branches connect the whole state with the city, besides the smaller lines of the California North-Western and other roads that penetrate the agricultural, mining, and lumbering districts. On 1st July 1900 the first train of the Santa Fé Railway left San Francisco for the east, a significant event, since there had been practically but one railway corporation (the Southern Pacific Company) controlling transcontinental traffic, with San Francisco as its western terminus, since the first overland road was completed in 1869. The construction of the Santa Fé was the outgrowth of the building of the San Joaquin Valley Railway, to which citizens subscribed \$2,500,000.

There are 38 banks. The total clearings in 1890 were \$851,066,172; in 1895 they were \$692,079,240. In 1899 they were \$955,851,466, an increase of \$143,638,308 over 1898. In 1901, they were \$1,165,301,561. In the nine savings banks of the city there was due to depositors on 11th August 1900, \$120,480,927. The United States mint during 1899 coined \$63,254,886; since the mint was established in 1854 the total coinage has been \$1,206,122,701.

The assessed valuation of real and personal property in 1901 was \$413,388,420, of which the former amounted to \$289,970,519 and the latter to \$123,417,901. Property is assessed at 60 to 80 per cent. of its value. The tax rate is \$1.556 on the hundred dollars. The city's net debt (funded and floating, less sinking fund) was on 30th June 1902 only \$17,185.77.

Administration.—After many years of notorious "Boss" rule the city in 1896 elected a reform mayor. This was the most important movement for good government in the history of the city since the vigilance committee of 1856. It was followed by the adoption (1899) of a new charter, formed by a board of freeholders, and based upon the most approved models of modern municipal government. The city's control is centralized, giving more power to the mayor, who has the appointment and removal of the following commissions—fire, police, school, election, park, civil service, health, and public works. The principle of the "initiative and referendum" was incorporated in the charter, by which a percentage of the voters can compel the submission of measures for public approval. There are 12 departments of the superior court, 5 justices' courts, and 4 police courts. The board of supervisors has 18 members. The board of education has 4 members. There is a paid fire department of 446 members; the police department

has 588 members, with provision for an increase of one officer for each 500 of the population. The board of public works controls the streets, sewers, and public improvements of the city, and is composed of engineers of recognized standing. The water-supply is excellent, being furnished by a private corporation, but the city plans for the ownership of its water and lighting system.

(J. D. P.)

San German, a primitive and decadent inland city near the west end of the south coast of Porto Rico, settled in 1511. It is a picturesque place with narrow streets, churches, and convents, largely constructed in the 16th century. It has several religious retreats and hermitages, which are frequented by the devout. The population in 1899 was 3954.

San Gimignano, a town of the province of Siena, Tuscany, Italy, 24 miles north-west of Siena (16 by rail to Poggibonsi), at an elevation of 1181 feet. Being surrounded by its ancient walls, and retaining thirteen out of its original fifty towers, it is, with its predominantly Gothic architecture, a thoroughly mediæval-looking town. The most noteworthy of the public buildings are the town-hall (1288–1323), with a museum, and paintings by Benozzo Gozzoli, Sodoma, and others; the cathedral, with fine frescoes by Ghirlandajo (1475); the church of S. Agostino, with famous frescoes (1463–65) by Gozzoli; other churches of the 12th and 13th centuries; and a small public library. Population of commune (1881), 8524; (1901), about 9000.

San Giovanni a Teduccio, a town of the province of Naples, Campania, Italy, on the east shore of the Bay of Naples, and at the foot of Mount Vesuvius, 3 miles south-east of Naples by the railway to Salerno. It has railway workshops, iron and zinc works, flour-mills, distilleries, tanneries, and macaroni factories. Iron is mined here. There is a school of design and the mechanical arts. Population (1881), 14,397; (1899), about 18,000.

Sangli, a native state of India, in the Deccan division of Bombay, ranking as one of the Southern Maratha Jagirs. The territory is widely scattered among other native states and British districts. Area, 1083 square miles. Population (1881), 196,832; (1891), 238,945; gross revenue (1897–98), Rs.11,75,800; tribute, Rs.1,35,000; number of police, 782; number of schools, 101, with 7043 pupils. The chief, whose title is Tatya Saheb Patwardhan, is a Brahman by caste. The town of SANGLI is situated in 16° 51′ N. and 74° 36′, E., on the river Kistna, and has a station on the Southern Maratha Railway, 11 miles from Miraj junction. Population (1881), 13,272; (1891), 14,798; municipal income (1897–98), Rs.10,341. There is a high school, and state printing-press, issuing a monthly gazette.

San Jose, a city of California, U.S.A., capital of Santa Clara county. It is situated in 37° 20′ N. and 121° 53 W., in the beautiful Santa Clara valley, which lies between two of the coast ranges. It is 46 miles south-east of San Francisco, and at an altitude of 87 feet. The site is level, with broad streets well shaded with semi-tropical vegetation. It has excellent water-supply and sewerage systems. The city is upon lines of the Southern Pacific Railroad, connecting it with San Francisco, Monterey, and other points. The Santa Clara valley is one of the most fertile and most productive of the fruit regions of California, and the chief business of San Jose is the treatment, handling, and marketing of its fruit crop. Population (1890), 18,060; (1900), 21,500, of whom 4577 were foreign-born and 810 were coloured, including 209 negroes.

San José de Costa Rica, the capital of the republic of Costa Rica, situated in 9° 56′ N. and 84° W. Population (1897), 25,000. Altitude above sea-level, 3868 feet. It is connected with Port Limón by a railway. The city is well laid out and paved, and has many fine buildings and public gardens. It possesses a national theatre, numerous charitable institutions, a museum, public library, and a number of learned societies.

San Juan, the full name of which is San Juan Bautista de Puerto Rico, a city on the northern coast of Porto Rico, on a small and narrow island which is united to the mainland by the bridge of San Antonio. It is the political capital of Porto Rico, and is known throughout the country as "El Capital." The city was founded about 1577 by Governor Juan Ponce de Leon. It is chiefly noteworthy for its fortifications and public buildings. A strong mediæval wall faces the land, and steep fortified cliffs overlook the sea. The fine strongholds include the Morro at the entrance of the harbour, Forts Santa Elena and San German, and the citadel of San Cristobal, which overshadows the city and commands the sea front. There are many large and handsome public edifices, including all the island administration buildings, the captain-general's palace, the casa de ayuntamiento municipal (city hall), the barracks of Ballaja, the artillery barracks, and the casa blanca, which is said to have been built by Ponce de Leon. As building space is scarce, the houses are all two or three storeys high. The streets and public plazas are neatly paved. The harbour is capacious and landlocked, except on the north. A highway running across the island from north to south connects San Juan with Ponce. The city is purely a political and social capital, and not a distributing or commercial centre, except for a small surrounding local area. Population (1899), 32,048.

San Lucar de Barrameda, a town of the province of Cadiz, Spain, near the mouth of the Guadalquivir, on the railway from Bonanza to Jerez. The town has an active trade in wines and agricultural products. Population (1887), 22,667; (1897), 23,377. The town is divided into two parts, Alta and Baja, the former being the older and crowned with the ruins of a strong castle. Besides the old parish church, there are the palace of the dukes of Medina Sidonia and several convents, and in both church and palace there are interesting pictures and works of art. There are good schools, chiefly directed by religious Orders. In 1898, 232 English steamers, of 194,854 tons, entered Bonanza, the port of San Lucar. The chief imports were coal from England, sulphur and dry vegetables from France; the exports, salt, oats, wine, and fruit.

San Luis, a city in Brazil, and capital of the state of Maranhão. It is well built, and has fine public buildings and gardens, an episcopal palace, and thirteen churches. Population, 38,000.

San Luis, interior town of Santiago province, Cuba, about 25 miles from Santiago. It is the terminus of the railway leading from that city across the Sierra Maestro to the thickly populated district of Cauto valley. The population in 1899 was 5059.

San Luis Potosí, a state of Mexico, bounded on the N. by the state of Coahuila; on the S. by those of Hidalgo, Queretaro, and Guanajuato; on the E. by Vera Cruz, Tamaulipas, and Nuevo Leon; on the W. by Zacatecas. Area, 25,323 square miles. Population (1879), 516,486; (1895), 568,449. The state is noted for the salubrity of its climate, being high and dry on the table-lands, and is rich in agricultural and mineral resources. The Mexican National Railway traverses the state from

north to south, and the Mexican Central Railway from east to west. The internal commerce is very extensive. It is one of the most progressive states of the Mexican Republic, and agriculture and mining are in a flourishing condition. Stock-raising is also extensively carried on. The principal agricultural products are cereals, sugar-cane, coffee, oranges, and tropical fruits. The value of the agricultural produce of this state in 1897 was $3,834,541. Some of the richest silver mines in the republic are found in the mining district of Catorce. The value of the mineral products in 1897 was $3,105,941. The state is divided into thirteen districts or partidos. San Luis Potosí, the capital, population in 1895, 69,050, is one of the most important cities of the republic. It is at an altitude of 1810 metres above sea-level, and is noted for its fine public buildings and churches. It is also one of the smelting centres, large quantities of argentiferous lead and gold-bearing ores being sent there for reduction. The chief towns in the state are Matehuala (13,101), Catorce (9547), Rio Verde (6628), Santa María del Rio (6589), Cedral (6333), Venado (5750), Soledad Diez Gutierrez (5730).

San Marino, the smallest republic in the world—its boundary-line measures about 18½ miles. It lies about the three peaks, together known as Monte Titano, which terminate the Apennines towards Rimini. It is enclosed on all sides by Italian territory, but maintains complete independence, and treats with Italy as one sovereign Power with another. During the twenty-five years 1874–99 the population increased from 7816 to 11,000, or more than 40 per cent., and San Marino is now relatively the most thickly populated country in Europe, having in 1899, on an average, 443 inhabitants to the square mile. It is divided into eight parishes: Pieve (in which stands the Città or town), Serravalle, Montegiardino, Faetano, Fiorentino, Chiesanuova, Domagnano, and Aquaviva.

Though the government is now conducted by a council of sixty, it was originally purely democratic, public business being transacted by the "fathers of families" at a mass meeting known as the "Arengo." This mass meeting is still held twice a year, when the retiring captains-regent (two in number) give place to those newly elected. The captains-regent have no executive power; they are merely the representatives of the council. The meetings of the latter are held whenever necessary. Its debates are carried on with closed doors in the main hall of the Government palace, which was restored in 1894, and is a fine specimen of mediæval architecture. Justice is administered by a legal commissary who resides in the republic, and must be an Italian. Three years is the term of office, and it may be renewed. Like the captains-regent, the commissary is answerable to the great council. Two judges, one of appeal, reside in the kingdom of Italy, and send their judicial sentences to be read before the council. Capital punishment was abolished within the republic in 1848, and in 1865 a penal code was promulgated. The civil legislation is mainly contained in the ancient statutes, but there are a few additional laws: a bill relating to mortgages (1854), a short modern code concerning bills of exchange, and some fiscal laws dealing with stamp duties, &c. Taxation is so slight as to be practically non-existent, the two most important taxes being those of 1 per cent. (about) on country property and ⅘ per cent. on town property. The revenue ranges from 350,000 lire to 450,000 lire (£14,000 to £18,000). There is no public debt, but for the last few years of the 19th century the Budgets showed a deficit. It has been proposed to levy fresh taxes, but the council has refused to vote them. San Marino possesses an army of 900 men and 60 officers, but the military spirit is lacking among the people, and it is only on high days and holidays that the troops, with their excellent military band, are called on for service. Attendant on the council is the Guardia Nobile, with picturesque uniform. The carabineers must be foreigners. Trade is carried on by means of large fairs, there being no railway nearer than Rimini. Among the exports are oxen, corn, wine, and building-stone, while the imports include all the manufactured goods used by the inhabitants. Building-stone, which is the almost only source of mineral wealth possessed by San Marino, is extracted around the Città, or town, the central point about which is gathered the historical interest of the republic. Small deposits of chalk, sulphur, and iron are found in various places, and Valle Sant' Anastasio is known for its mineral waters. San Marino has a coinage of its own, but Italian money is used by preference. It has hitherto retained its own intricate system of weights and measures, and issues a complete set of stamps. Public charity is widely distributed, and there is an excellent hospital and refuge, the operating-room in which has been lately furnished with modern appliances. Three doctors and a qualified surgeon, all foreigners, are maintained at the expense of the State.

The Italo-Sanmarinese Treaty, renewed in 1896, is on the same basis as before the renewal. Thereby either State recognizes the validity of contracts by deed signed in the other, and promises to grant extradition for criminal (not political) offences, provided that the criminal be not a citizen of the State in which he shall have taken refuge, nor have been domiciled there for a space of ten years. In 1899 San Marino concluded a similar extradition treaty with England. The republic exercises its right of representation by consuls and chargés d'affaires, having representatives in London, Paris, Vienna, Budapest, and several Italian cities (Rome, Naples, &c.).

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San Miguel, a city of Central America, in the republic of Salvador, about three-quarters of a mile from the right bank of the Rio Grande and 107 miles east of the capital, at an altitude of 360 feet above sea-level. It is the 3rd city in importance as to population, having about 25,000 inhabitants, and is a handsome town, with fine buildings and streets, and transacts considerable foreign trade. It is not deemed healthy, being exposed to malarial exhalations arising from the swamps to the south-east.

San Miguel de Mayumo, a town in the northern part of the province of Bulacan, Luzon, Philippine Islands. It has a cool and very healthy climate, commands a beautiful view of the surrounding country, and was one of the finest provincial towns in the Philippines until its principal buildings were destroyed in a fire started by a band of thieves in 1901. Near the town are quarries of limestone, and the agricultural lands in its vicinity produce rice, sugar-cane, Indian corn, and cotton in abundance. Cotton fabrics are woven in considerable quantity by the women; and there are a few good cabinet workers, who utilize the beautiful hard woods of the neighbouring forests in their work. The principal language is Tagalog. Population, 20,000.

San Miniato, a town and episcopal see of the province of Florence, Tuscany, Italy, 21 miles west by south of Florence by the railway to Pisa. Its cathedral dates from the 10th century. It manufactures glass, olive oil, leather, and hats. It is notable as the cradle of the Bonaparte family. Population (1881), 7271; (1899), about 8000.

San Pablo, a town in the southern part of the province of Laguna, Luzon, Philippine Islands. Its people engage in agriculture—rice, abacá, and copra being the principal crops raised. The language is Tagalog. Population, 19,000.

San Remo, a famous seaside resort of the province of Porto Maurizio, Liguria, Italy, on the coast of the west Riviera, 84 miles by rail south-west of Genoa and 32 east-north-east of Nice. It has come into increased repute since the stay there in 1887–88 of the German Emperor Frederick III. In 1898–99 the visitors numbered 21,850. A new casino was opened in 1888. There is a meteoro-

logical observatory. Flowers, especially roses and carnations, are extensively grown for export. Olives, lemons, and palms are also reared. The port is shallow, despite dredging in 1896–97, and exposed to east winds. Population (1881), 14,002; (official estimate, 1897), 19,636.

San Roque, a town of the province of Cadiz, Spain, near the northern shore of the bay of Algeciras, with a station on the railway to that place. The country around San Roque is hilly and watered by the river Guadarrunque and the Guadiaro to the north. The neighbourhood produces wheat, wine, fruit, olives, oranges, cork, and the local industries are alcohol, liqueurs, starch, flour, tanneries. The town looks clean and modern. Its streets are steep, and from the heights there is a splendid view of the bay and straits. The fortifications were razed after the War of Independence against Napoleon I. Population (1887), 8792; (1897), 7809.

San Salvador, a city in Central America and the capital of the republic of Salvador, in the valley of Las Hamacas, on the river Acelhuate, in 13° 45′ N. and 80° 8′ W., at an altitude of 2115 feet above sea-level. Population (1892), 30,000. It was founded by Jorge de Alvarado in 1528 at a spot a short distance from the present site, to which it was transferred in 1539. From 1834 to 1839 it was the capital of the republic. Then for a year the chief town was San Vicente. Since 1840 it has remained the capital. Besides all the offices of government, the city has a university, an academy of science and belles-lettres, a national library, an astronomical observatory, a museum, botanical garden, a national institute, polytechnic school, the Rosales hospital, an asylum and poorhouse, orphanage, &c. Considerable commerce and manufactures are carried on. The city has in the past often suffered from earthquakes; but a style of building has been adopted with a view to preventing serious damage to the structures. The railway connecting the capital with the port of Acajutala on the Pacific was opened to traffic on 19th March 1900.

San Salvador Island. See BAHAMAS.

San Sebastian, capital of the province of Guipuzcoa, Spain, the summer residence of the court since 1886. The influx of visitors, attracted by the presence of the court, and by the prolonged local festivities, the bull-fights, the handsome casino and gambling-rooms, increases the permanent population by about twelve thousand to fifteen thousand. Fixed population, 21,355 in 1877; 35,975 in 1897. Until very modern times, San Sebastian was a walled and fortified town. On the hill still stand the castle of La Mota and the batteries and redoubts of both slopes of Monte Urgull. The bull-ring, in Moorish style, will hold 10,000. The new town of San Sebastian begins at the Alameda boulevard on the site of the old fortifications, and occupies the greater part of the peninsula that lies between the river Urumea and the Bay of La Concha. In the new town a fine church and markets have been built since 1895, and a Jesuit college and chapel. On the opposite side of Concha Bay, on the brow of a hill, stands the Queen's summer palace of Miramar in well laid-out grounds. The palace is not remarkable for its architecture, being a châlet-like irregular building, which, however, cost more than £85,000. In few Spanish towns has more been done to improve public education and with better results than in San Sebastian. The industries of the town have developed, and there are many breweries, saw and flour mills, manufactures of preserves, soap, candles, glass, paper, especially in the busy suburb that has sprung up on the right bank of the Urumea, connected with San Sebastian by a fine stone bridge and a wooden bridge. The fisheries are important.

Santa Ana, a city of Salvador and capital of the department of the same name, about 50 miles north-east of the city of San Salvador, and at an elevation of 2093 feet above sea-level. It is a finely built city, the largest in Salvador, its population being about 33,000. Santa Ana has a number of fine public buildings, the municipal palace, barracks, hospital, public market, being the most noteworthy. The city is well supplied with water, and has wide and well-paved streets. It was connected in 1899 by a telegraph line with the capital, and the railway between the two cities was opened to traffic on 19th March 1900. An institute has also been founded.

Santa Ana, a city of California, U.S.A., capital of Orange county. It is in the southern part of the state, 33 miles south-east of Los Angeles, on the Southern California and the Southern Pacific railways, at an altitude of 135 feet. It is in the orange, lemon, and wine region of southern California, and its industries are connected with the handling and transportation of these products. Population (1890), 3628; (1900), 4933, of whom 506 were foreign-born.

Santa Barbara, a city of California, U.S.A., capital of Santa Barbara county. It is on the coast, in the southern part of the state, at the southern foot of the Santa Inez Mountains, and is reached by a branch of the Southern Pacific Railroad. On account of its mild and equable climate, it has become a well-known winter resort. The Spanish mission, founded in 1786, is near the city, and is still well preserved. Population (1890), 5864; (1900), 6587, of whom 1143 were foreign-born and 269 coloured.

Santa Catharina, an Atlantic state of Brazil, between 26° 30′ and 29° 18′ S. and 48° 18′ and 54° 12′ W. Area, 27,434 square miles. Population in 1890, 283,770; in 1900, estimated at 320,000. It is bounded on the N. by Paraná, on the W. by the Argentine republic, on the S. by Rio Grande do Sul, and on the E. by the Atlantic. Coal, iron, silver, gold, and petroleum are found in the state, but very little is extracted. The capital, Desterro, officially called Florianopolis, has a population of about 25,000. Its trade is effected through the port of São Francisco. Amongst other towns are Lages, Laguna, São Francisco, San José, and Tubarao.

Santa Clara, the capital of Santa Clara province, Cuba, an old town in the interior, founded in 1689. It is surrounded by fertile plains cultivated in cane, which are interspersed with many picturesque hills, and is the eastern terminus of the railway system from Havana. Population (1899), 13,763.

Santa Cruz, a city of California, U.S.A., capital of Santa Cruz county. It is on the north side of Monterey Bay, and on a branch of the Southern Pacific Railroad, 75 miles south of San Francisco. It is a popular seaside resort. The city has asphalt pavements, water-works, a sewerage system, and several large hotels. It is built on the site of the old Santa Cruz mission, founded in 1791. Population (1890), 5596; (1900), 5659, of whom 1123 were foreign-born, and 189 were coloured.

Santa Fé, a province in the centre of the Argentine republic, bounded on the N. by the territory of Chaco, on the S. by Buenos Aires, on the E. by Entre Rios and Corrientes, and on the W. by Cordoba and Santiago del Estero. Official area at the census of 1895, 50,916 square miles. Population (1869), 89,117; (1895), 397,188, or an increase of 3457 per thousand. The

province is divided into 18 departments. In 1895 there were 19,809 farms, 3,688,118 acres planted in cereals, 2,315,007 head of cattle, 422,101 horses, 1,988,777 sheep. Santa Fé, the capital, stands near the junction of the Salada with the Paraná, 299 miles north-west of Buenos Aires by rail. The town has quite a modern appearance, and the population (24,755) has more than doubled. There is a normal school for teachers. Three tramways run through the city. The building of small trading vessels is one of the chief industries.

Santa Fé, a city of New Mexico, U.S.A., capital of Santa Fé county and of the Territory. It is situated in 35° 42′ N. and 105° 57′ W., on a plain at the west base of the Sangre de Cristo range, north of the centre of the Territory, at an altitude of 6954 feet. The site is nearly level, with a gentle slope to the west, but the town is very irregular in plan, having been laid out centuries ago by the Spaniards, and having undergone little change since it came within the United States. It is the meeting-point of a branch of the Atchison, Topeka, and Santa Fé and of the Denver and Rio Grande railways, but being off the direct line of travel and traffic, it has made no progress. Population (1890), 6185; (1900), 5603, of whom 256 were foreign-born.

Santa Maria, a town of the province of Caserta, Campania, Italy, 4 miles west of Caserta, occupying the site of the ancient Capua. It has a cathedral (restored) and a technical school. Glass, bricks, ropes, and leather are manufactured. Population (1881), 17,896; (1900), about 20,000.

Santa Maura. See Greece (Ionian Islands).

Santander, a province on the north coast of Spain. Area, 2113 square miles. Population in 1887, 244,274, and 263,673 in 1897. The average of births is 3·63 per cent., that of deaths 3·02, and the proportion of illegitimate births 4·60 per cent. The province is traversed by several railways, and possesses besides many good state, provincial, and municipal roads, and several narrow-gauge mining railways. The industries, up to the eve of the loss of the islands of Cuba and Puerto Rico in the Spanish-American war in 1898, had steadily increased, except the glass and crystal factories, which decayed rapidly from 1886. Beer is brewed in large quantity. Salt and tinned fish are extensively prepared for export. The export and coasting trade is chiefly carried on through the ports of Santander, Suances, Santoña, and Castro Urdiales. A hardy race of seamen mans the fishing fleet at these four ports and many small places along the coast, and there are numerous industries connected with the fisheries. The people have shown considerable energy in agriculture, sylviculture, and mining, but have been greatly assisted by foreign capital and enterprise.

In 1897 wheat was grown on 11,272 acres, rye, barley, oats, maize, on 42,957, pod fruit on 4500, vine on 3000. Live stock is both abundant and valuable, especially in the highlands of Santander. In 1897 there were 516,089 head registered, including 5377 horses, 1092 mules, 2228 asses, 193,392 cattle, 178,549 sheep, 65,937 goats, 69,514 pigs. The mining interests are important, and were much developed in the last decade of the 19th century. Thirty-five zinc, 1 graphite, 31 iron, 1 lignite, and 1 salt mines are worked. These mines give employment to 4773 hands, and the output in 1898 was 34,416 tons of zinc, 756,165 tons of iron-ore, 352 tons of lignite, 356 tons of lead (from the zinc mines), and 130 tons of salt. The production of calamine was 33,484 tons, valued at £46,034, chiefly at Reocin; and the Castro Urdiales mines alone produced 188,840 tons of iron-ore.

Santander, capital of the above province and one of the most important ports of the peninsula. It is the terminus of the railway from Madrid and Palencia, and of the Bilbao–Santander coast line and several provincial and mining lines. Population, 42,725 in 1887; 50,640 in 1897. The industries, the trade and fisheries of Santander are prosperous and important. The primary schools, schools for training teachers, the institute, the nautical school, are numerously attended. There is a tobacco factory, where 1800 women are employed. Among the modern improvements of the town are its town-hall, theatre, markets, barracks, bull-ring, clubs, civil and military governors' residences, custom house, hospitals. Many of the houses on the bay front and public buildings have been restored since the catastrophe of 3rd November 1893, when the steamer *Cabo Machichaco*, laden with 1700 cases of dynamite, blew up near the quay. The port of Santander is very important. The dredging of the harbour is satisfactory, and the water in the channel right up to the quays is deep enough to allow heavy-draught vessels to come alongside at almost any state of the tide. In 1898, 222 British vessels entered with cargoes valued at £264,425, and 222 cleared with cargoes valued at £173,682. The vessels of other countries that entered were: 80 French, 39 Swedish and Norwegian, 3 Dutch, and 1176 Spanish, the majority of the last being coasters. The iron-ore trade is steadily increasing, the exports having been 332,974 tons in 1897 and 406,996 tons in 1898, of which 265,549 tons went to the United Kingdom.

Santarem, a city of Portugal, capital of the district Santarem, crowning a height above the right bank of the Tagus, 44 miles north-east of Lisbon. Between the foot of the hill and the river is the suburban port of Ribeira de Santarem, where the Tagus is crossed by a fine bridge. The town is still surrounded by walls, pierced by eight gates. Population (1900), 8704.

The district of Santarem has an area of 2649 square miles. Population (1890), 254,844; (1900), 283,676, or 107 to the square mile. It consists in great part of the fertile valley of the Tagus.

Santa Rosa, a city of California, U.S.A., capital of Sonoma county. It is 51 miles north of San Francisco, on the California North-Western and the Southern Pacific railways, among the Coast ranges, at an altitude of 181 feet. The city is regularly laid out on a level site, and has broad well-shaded streets, and an excellent water-supply. Situated in a region admirably adapted for fruit and grain, its industries in great measure consist in the handling of these products. It has flour-mills and fruit canning and drying works. It is the site of Pacific Methodist College, opened in 1861. This had in 1899 a faculty of 7 teachers and was attended by 42 students. Population (1890), 5220; (1900), 6673, of whom 1029 were foreign-born and 140 were coloured.

Santiago, capital of Chile, and also of the province and department of the same name, in 33° 26′ 26″ S. and 70° 38′ 15″ W.; mean altitude above sea-level, 1600 feet. Population (1895), 256,413; (1900), 269,886. The mean summer temperature is 67° F., the mean winter temperature 47°, that for the whole year 57°. The maximum recorded yearly rainfall is given as 25½ inches, the minimum 4 inches. The city is divided into 10 circumscriptions, and 3 municipalities, which form the *municipilidad*. Besides the Government buildings, the city has 17 charitable institutions, in which are included a lying-in hospital, an orphan asylum, lunatic asylum, poorhouse, &c. Among its educational establishments mention should be made of the university, the medical school, the national institute, the military school, the agricultural school, conservatory of music, schools of

painting and sculpture, of mining, normal schools for both sexes, deaf and dumb schools, and professional schools for girls. It has also an astronomical observatory, and a museum of natural history, a zoological garden, and a national library. Eight large daily papers are published, which have a circulation of over 50,000 copies, and about 26 literary, artistic, economic, scientific, and other periodicals. There are some 10 literary, scientific, and other societies in the city, and 9 clubs. Since 1892 Santiago has a superior council of public hygiene, and an institute of hygiene, with bacteriological laboratory, a museum, &c.

Santiago, or SANTIAGO DE COMPOSTELA, a town of Spain, province of Corunna, on the Sar, with a station on the Carril Railway. Population, 16,223 in 1887, and in 1897, 24,335. In the neighbourhood are pastures and fertile valleys that produce much corn, hemp, maize, and fruit. The local industries are distilleries, breweries, soap, chocolate, matches, crystal, linen, and paper. Santiago is still the seat of a university. There are also a veterinary school, an institute founded in 1501, a high normal school, excellent primary schools for both sexes, and a seminary. The library of the university contains 60,000 volumes and several hundred MSS., many valuable and one dating from 788 A.D. The town has several hospitals and refuges, which are open to the pilgrims, still numerous, who flock to the shrine of the patron saint of Spain.

Santiago de Cuba, the capital of the province of Santiago, Cuba, situated at the north-eastern end of a capacious harbour indenting the straight south coast of the eastern end of Cuba. It is second only to Havana in population, and equals it in strategic and political importance. It was founded in 1514 by Lieutenant-Governor Diego Valasquez, and it was made the capital of Cuba in the place of Baracoa a few years later. It continued to be the capital during the first century of Spanish occupation, and from it were fitted out most of the expeditions, including that of Cortez, which explored Spanish North America. The city is very antique and dilapidated in appearance, and is surrounded by a barren, mountainous country. Extensive iron and manganese mines in the vicinity give material support to the population. Much trade from the interior flows into the city through a gap in the mountains to the northward, through which extends a short railway. Extensive commerce is maintained with the remainder of Cuba by coasting vessels, and there are steamer connexions with New York and Europe. The harbour is completely landlocked and easily defensible, entrance being gained through a passage hardly wide enough for vessels to pass, which opens out into a bay sufficient in area to float the navies of the world. It is noted for many historical events connected with the early settlement of Cuba, and the various insurrections. On 3rd July 1898, during the Spanish–American war, the Spanish fleet issued from this harbour and, in the attempt to escape, was destroyed by the blockading American squadron. The surrender of the town to the American army took place a fortnight later. Population (1899), 43,090.

Santiago de Las Vegas, an interior town of Havana province, Cuba. Population (1899), 7151.

Santipur, a town of British India, in the Nadia district of Bengal, situated on the left bank of the Hooghly, with a railway station, 55 miles north of Calcutta. It is a site of an old commercial factory, and still a centre of the weaving trade. There is a municipal high school. Population (1881), 29,687; (1891), 30,437.

Santley, Charles, (1834– ——), English vocalist, son of an organist at Liverpool, was born 28th February 1834. He was given a thorough musical education, and having determined to adopt the career of a singer he went in 1855 to Milan and studied under Gaetano Nava. He had a fine baritone voice, and while in Italy he began singing small parts in opera. In 1857 he returned to London, and on 16th November made his first appearance in the part of Adam in *The Creation* at St Martin's Hall. In 1858, after appearing in January in *The Creation*, he sang the title-part in *Elijah* in March, both at Exeter Hall; and his future was now assured. In 1859 he sang at Covent Garden as Hoel in the opera *Dinorah*, and in 1862 he successfully appeared in Italian opera in *Il Trovatore.* He was then engaged by Mapleson for Her Majesty's, and his regular connexion with the English operatic stage only ceased in 1870, when he sang as Vanderdecken in *The Flying Dutchman.* His last appearance in opera was in the same part, with the Carl Rosa Company at the Lyceum Theatre in 1876. Meanwhile, in 1861 he sang *Elijah* at the Birmingham Festival, and in 1862 was engaged for the Handel Festival at the Crystal Palace. From that time he was recognized as the first of English baritones, the wonderful conviction which he threw into his singing and his dramatic fire and religious fervour being specially noteworthy. At the musical festivals and on the concert stage his success was immense. In such songs as "To Anthea," "Simon the Cellarer," or "Maid of Athens," he was unapproachable, and his oratorio singing carried on the finest traditions of his art. In 1858 Santley married Gertrude Kemble, and their daughter, Edith Santley, had a great success as a concert singer.

Santos, a city and port of southern Brazil, in the state of São Paulo, 34 miles from the capital of São Paulo by rail. Population (1900), 41,000. It is the principal port of shipment of Brazilian coffee, the total export for 1899 being 364,928,493 kilogrammes, valued at about £8,275,000. In 1900, 5,849,114 bags of 60 kilogrammes each (valued at about £9,000,000) were exported; and in 1896, 4,157,971 bags. In 1900, 699 ships, of 869,718 tons, entered and about the same number cleared at the port of Santos.

Santo Domingo. See HAYTI.

Saône, Haute-, a department of eastern France, resting on the southern end of the Vosges.

Area, 2075 square miles. The population, 280,856 in 1891, had decreased to 265,179 in 1901. The births in 1899 were 5773, of which 494 were illegitimate; deaths, 5809; marriages, 2038. There were in 1896 1061 schools, with 44,000 pupils, 1 per cent. of the population being illiterate. The land under cultivation in 1896 was 1,210,300 acres; 577,980 acres being plough-land and 19,760 acres vineyards. The department in 1899 grew wheat to the value of £692,000; rye, £80,000; oats, £440,000; potatoes, £380,000. The vintage of 1899 was valued at £108,000. The live stock (1899) included 22,730 horses, 155,800 cattle, 71,540 sheep, and 65,480 pigs. Mining in 1898 produced 217,000 metric tons of coal, 9000 tons of lignite, 1760 tons of iron, and 6872 tons of rock-salt. The industry in metals yielded 1209 tons of cast-iron, 188 tons of iron, and 1280 tons of steel. There are also extensive industries in textiles, glass, and distillation. Vesoul, the capital, had in 1901, 9704 inhabitants.

Saône-et-Loire, a department in east central France, traversed by the mountains of Morvan and Charolais, and watered by the Saône and the Loire.

Area, 3331 square miles. The population, 619,523 in 1891, numbered 616,389 in 1901. The births in 1899 were 14,099, of which 655 were illegitimate; deaths, 12,072; marriages, 5005. The schools, primary grade, numbered (1896) 1339, with 104,000 pupils, 2 per cent. of the population being illiterate. Out of 1,962,415 acres of land cultivated in 1896, 1,034,930 acres were arable, and 61,750 were in vines, a wide area of the department being in pasture. A

wheat-growing country, Saône-et-Loire produced in 1899 wheat valued at £1,470,000; rye, £96,000; oats, £205,000; maize, £232,000; mangold-wurzel, £108,000; potatoes, in which this department ranks prominently, £846,000. Its vintage in 1899 was valued at £883,000; its crop of colza, £32,000; its rape, £8800; beetroot, £11,200. While its agricultural value is very considerable, the department is not less noted for its live stock, which in 1899 included 25,830 horses, 352,930 cattle, 126,770 sheep, 223,710 pigs, and 33,190 goats. The mineral basin of the Saône and Loire (Autun, Creuzot) is one of the most important in France, and produced in 1898 2,096,000 metric tons of coal, 125,000 tons of iron, 9000 tons of manganese and other metals, and 142,000 tons of various substances. Creuzot is the chief centre in France of the metallurgical industry, and turned out in 1898 105,000 metric tons of cast-iron, 47,000 tons of iron, and 112,300 tons of steel, of the value of £2,500,000, the workmen employed numbering over 11,000. There are important glass manufactures in the arrondissement of Autun. Distillation produced 44,000 gallons of alcohol. Macon, the capital, had in 1901, 18,928 inhabitants; Châlon-sur-Saône, 29,058; and Creuzot, 30,175.

São Paulo, an Atlantic state of Brazil, between 19° 54′ and 25° 15′ S. and 44° 6′ and 53° 28′ W.; coast line 373 miles. It is bounded on the N. by Minas Geraes, Goyaz, and Matto Grosso; on the W. and N. by Goyaz; on the S. by Paraná; and on the E. by Rio de Janeiro and the Atlantic. Area, 112,330 square miles. Population (1890), 1,384,753. There is a large and constant immigration from Europe, and it is estimated that in 1898 there were about 500,000 Italians in the state. The capital, São Paulo, has a population of about 270,000; other towns, Santos (41,000), Sorocabo (14,000), Parahybuna (11,000), Piracicaba (11,000), Itú (11,000), Iguape (10,000), Botucato (7000), Caconde, Braganza and Cacapava, Franca and São Sebastião, each with about 5000. There are over 100 towns in the state. In 1900 there were in operation over 2000 miles of railway. It is the greatest coffee-producing region in the world, and manufactures cottons and flour.

São Thomé, or St Thomas, an island in the Gulf of Guinea, lying immediately north of the equator and belonging to Portugal. Along with the neighbouring island of Principe (Prince's Island), it forms the province of St Thomas (in Portuguese *São Thomé*). During the dry season (June to September) the temperature ranges in the lower parts between 66·2° and 80·6° F., and in the higher parts between 57·2° and 68°; in the rainy season it ranges between 69·8° and 89·6° in the lower parts, and between 64·4° and 80·6° in the higher parts. On Coffee Mount (2265 feet) the mean of ten years was 68·9°, the maximum 90·5°, and the minimum 47·3°. Area, 318 square miles. Population (1895), 22,000. The natural products of the island embrace oranges, lemons, figs, mangoes, and in the lower-lying districts the vine, pineapple, guava, and banana; and the principal cultivated products are cocoa, coffee, and cinchona. Vanilla, india-rubber, balsam, cinnamon, camphor, cocoa, and kola-nut are also produced. The total trade of the province increased in value from £318,000 in 1888 to £933,900 in 1898; £564,250 being for exports, namely, £234,000 for cocoa, £131,350 for coffee. In 1900 the imports from Portugal were valued at £692,000, and the exports to the same country at £186,310. But the export of cocoa alone to all countries amounted to £587,100 in 1900, and 2405 tons of coffee in all were sent out of the island. The imports coming next in value are cocoa-nut, cinchona, arrowroot, palm oil, bamboo, balsam, kola-nuts, manioc flour, fruit, timber, pepper, and oil-seeds. Cocoa is the principal product of Principe. The total trade in 1899 was valued at £1,188,888.

Sapporo.—The official capital of the island of Yezo, Japan, situated in 43° 04′ N. and 141° 21′ E. It has a population of 37,482. It was chosen in 1870, and owed its prosperity at the outset chiefly to the public institutions established there by the Japanese Government in connexion with the colonization bureau, which had for its object the development of Yezo's resources. It is now a garrison town, being the headquarters of the 7th division. It has an agricultural college, a museum, saw-mills, flour-mills, a brewery, and hemp and flax factories.

Saracco, Giuseppe (1821-——), Italian politician and financier, and knight of the Annunziata, was born at Bistagno on 9th October 1821, and, after qualifying as an advocate, entered the subalpine Parliament in 1849. A supporter of Cavour until the latter's death, he afterwards joined the party of Rattazzi, and became secretary-general of public works in the Rattazzi Cabinet of 1862. In 1864 he was appointed, by Sella, secretary-general of finance, and after being created senator in 1865, acquired considerable fame as a financial authority. In 1879 he succeeded in postponing the total abolition of the grist tax, and was throughout a fierce opponent of Magliani's loose financial administration. Selected by Depretis as minister of public works in 1887, and again by Crispi for the same office in 1893, he contrived, by careful management, to mitigate the worst consequences of Depretis's corruptly extravagant policy, and introduced a sounder system of government participation in public works. In November 1898 he was elected president of the senate, and in June 1900 succeeded in forming a "Cabinet of pacification" after the Obstructionist crisis which had caused the downfall of General Pelloux. His term of office was clouded by the assassination of King Humbert (29th July 1900), and his administration was brought to an end in February 1901 by a vote of the Chamber condemnatory of his ambiguous attitude towards a great dock strike at Genoa. After his fall he resumed his functions as president of the senate. He received the supreme honour of the knighthood of the Annunziata from King Humbert in 1898.

Sáran, a district of British India, in the Patna division of Bengal. Area, 2653 square miles. Population (1881), 2,297,666; (1891), 2,467,477. The average density, 930 per square mile, is the highest rate for all India. Classified by religion, in 1891 Hindus numbered 2,174,734; Mahommedans, 290,980; Christians, 278, of whom 178 were Europeans; "others," 1485. In 1901 the population was 2,361,079, showing a decrease of 4 per cent., compared with an increase of 7 per cent. in the previous decade. The land revenue and rates in 1897–98 were Rs.15,89,076; number of police, 565; boys at school (1896–97), 21,800, being 12·8 per cent. of the male population of school-going age, compared with 28 per cent. for the province generally; registered death-rate (1897), 31·55 per thousand. The principal industry is indigo. There are altogether 42 factories and out-works, with an English capital of £150,000, employing 21,000 persons, and producing 4000 maunds, valued at Rs.7,00,000. Opium also is largely cultivated. Sáran is exposed to the two calamities of drought and flood. It suffered from the famine of 1874, and again in 1896–99. An irrigation scheme from the river Gandak, started in 1878, proved a failure, after a capital expenditure of Rs.7,00,000. The Bengal North-Western Railway runs through the south of the district. The administrative headquarters are at Chapra.

Saransk, a district town of Russia, in the government and 88 miles north of the town of Penza, on the railway from Moscow to Kazañ. Its chief factories are steam flour-mills, oil-mills, tobacco and rope-works, and tanneries. A brisk trade is carried on in corn and hemp,

tallow, spirits, leather, and hemp-seed oil. The town was founded early in the 17th century, when it was a small fort erected against the invasions of the Bashkirs. In 1897 it had a population of 13,743.

Sarapul, a district town of Russia, in the government and 388 miles south-east of the town of Vyatka, on the right bank of the river Kama. This town, the population of which numbered 21,395 in 1897, is an important centre for the manufacture of boots, shoes, and gloves; no less than 450,000 pairs of boots are made per annum and mostly exported to Siberia, the Caucasus, and Turkestan. It has also many tanneries, flax mills, distilleries, iron-works, and rope-works, and is at the same time an important port; more than 1000 boats clear every year, and the movement of the port is 57,500 tons imported, and 32,500 tons, chiefly corn and timber, exported. There are gymnasia for boys and girls, a lace-making school, a municipal library, and a hospital maintained by the local government.

Saratoff, a government of south-east Russia, on the right bank of the Lower Volga, with an area of 32,624 square miles, and a domiciled population which numbered 2,113,077 in 1882 and 2,419,884 in 1897. The density in the different districts in 1897 varied from 55 to 107 inhabitants per square mile, and the urban population amounted to 319,918; the female population numbered 1,230,957. There are a few Germans, but nearly all the inhabitants are Russians; 83 per cent. belong to the Orthodox Church, 5 per cent. are Nonconformists, 6 per cent. Lutherans, and 2 per cent. Catholics. The government is divided into ten districts, the chief towns of which are Saratoff (see below), Atkarsk (9750), Balashoff (12,166), Kamyshin (15,934), Khvalynsk (15,455), Kuznetsk (20,555), Petrovsk (13,212), Serdobsk (12,721), Tsaritsyn (55,967), and Volsk (27,039). Education makes some progress; the number of young men taken into the military service in 1897 who could read was 40 per cent. of the total number taken, as against 21 per cent. in 1874. The proportion of women, however, who know how to read and write continues to remain very small. In 1898 primary schools were attended by 56,180 boys and 22,870 girls. Of the total area (19,956,000 acres), 52 per cent. belonged to the peasants in 1896, 38 per cent. to private landowners, 5 per cent. to the Crown, and 5 per cent. to the Imperial family and the municipal authorities. These figures, however, are rapidly altering, as the peasants constantly buy considerable quantities of land. No less than 58 per cent. of the total area, that is, 11,510,000 acres, is under fields, 19 per cent. under meadows and pasture, and 13 per cent. (490,000 acres) under woods, while 10 per cent. is unavailable for culture. Green crops are now being cultivated more widely, both on the private estates and among the peasants. Agriculture suffers, however, very much from droughts, and the attacks of marmots, mice, and insects, and consequently the yield varies from 3,200,000 cwt. to 11,550,000 cwt. in different years. The average yield in 1895–99 was 6,524,000 cwt. of wheat, 14,797,000 cwt. of rye, 5,181,000 cwt. of oats, 357,000 cwt. of barley—for all cereal crops, 30,065,000 cwt.; also 4,198,000 cwt. of potatoes. The field culture of melons and sunflowers is very widely spread, as also is gardening. Cattle-breeding is on the decline; in 1897 there were 535,660 horses, 792,710 horned cattle, 1,199,430 sheep, and 116,750 swine. On the other hand, the export trade in poultry, especially geese, has developed greatly. In 1897 the factories employed 25,165 workers, their aggregate returns being about 34,400,000 roubles. They mainly comprise steam flour-mills, oil-works, distilleries, timber mills, tanneries, and fur-dressing works. Weaving, the fabrication of agricultural machinery and pottery, boot-making, and a great variety of other trades are widely spread in the villages as domestic industries. The fairs of the province have lost much of their importance; that at Bekovo, however, in the district of Serdobsk, has held its own, especially as regards trade in cattle and animal products. The province is well provided with railways (862 miles in 1900).

Saratoff, the capital of the above government, on the right bank of the Volga, 532 miles by rail south-east of Moscow, and on the railway from Ryazan to the Urals. Its population increased from 86,000 in 1870 to 137,109 in 1897. The city is one of the best built in the provinces. Its factories occupy 3800 workers, and show an aggregate yearly return of 8,400,000 roubles. They chiefly comprise flour-mills, iron-works, oil-works, works for the manufacture of railway plant, and tobacco factories. Saratoff is a very important centre for the trade of eastern Russia. Its port shows an annual movement of 3400 vessels entered and cleared; 125,000 tons of (mainly) corn and flour are sent up the Volga every year, and 557,000 tons, chiefly of naphtha, by rail. In 1896 there were 96 primary schools, with 10,570 pupils, several technical schools, and Radischeff's museum, which is one of the richest in pictures, sculptures, and archæological collections in the provinces. The theatre is also one of the best in provincial Russia. Saratoff is the seat of several scientific societies, and publishes five newspapers. (P. A. K.)

Saratoga Springs, a village of Saratoga county, New York, U.S.A. It is situated in 43° 05′ N. and 73° 47′ W., in the southern foothills of the Adirondack mountains, in the eastern part of the state, at an altitude of 323 feet. The village has a fine water-supply from mountain springs. It is reached by three railways, the Delaware and Hudson, the Adirondack, and the Fitchburg. Saratoga is one of the best-known and most fashionable of American summer resorts. There are about forty springs, which differ widely in the constituents of their waters. The city contains many large hotels, boarding-houses, and hundreds of costly and beautiful villas. It has been a popular place for holding political conventions, and contains a Convention Hall, seating 5000 people. Saratoga Lake, 4 miles east of the city, is a favourite place for rowing races. Saratoga is known as the scene of the surrender of Burgoyne's army to the Americans under General Gates, which took place about 12 miles south-east of the village, on 17th October 1777, after a month's fighting in the neighbourhood. Population of the village (1890), 11,975; (1900), 12,409, of whom 1684 were foreign-born and 619 negroes.

Saravia, a town on the north-west coast of the island of Negros, Philippine Islands. It is situated in a rich sugar-producing region, and sugar culture is its only important industry. The language is Panay-Visayan. Population, 15,000.

Sarawak, a state situated in the north-west of Borneo, with an area of 50,000 square miles and a population of about 500,000. The coast line extends from Tanjong Datu, a prominent cape in 2° 3′ N., northwards to the mouth of the river Trusan, in 4° 58′ N. and 115° 13′ W., but a tract—80 miles in length—of Brunei territory still remains between the mouth of the river Baram and the river Limbang, the whole distance being about 440 miles in a straight line (but following the sinuosities, about 560 miles). In the year 1842 the government of the district from Tanjong Datu to the entrance of the river Sumarakan was obtained from the sultan of Brunei by Sir James

Brooke. The frontier of the southern portion of Sarawak is formed by the Serang, Kelingkang, and Batang Lupar ranges of mountains; inland, on the eastern side, the territory, along the watershed, is bounded by the following mountains: Batu Puteh (5000 feet), Tebang (10,000 feet), Ubat Siko (5000 feet), Bela Lawing (7000 feet), and Batu Leihun (8000 feet), from which the Rejang and Baram, on the Sarawak side, and the Koti and Balungun, on the Dutch side, take their rise. To the north of Sarawak is the Pamabo mountain range (8000 feet), situated in 3° 30′ N. and 115° 15′ W.—whence flow the rivers Limbang and Trusan—and the mountains Batu Lawei (8000 feet) and Lawas (6000 feet). The interior of Sarawak is mountainous, the greatest elevations being that of Mount Mulu (9000 feet), of limestone formation; Batu Lawei (8000 feet), Pamabo (8000 feet), Kalulong, Poeh, and Penrisan.

The Rejang is the largest river, the Baram ranking second, the Batang Lupar third, and the Limbang fourth. A formidable bar at the mouth of the Baram proves a great hindrance to shipping. The Rejang is navigable for small steamers for about 160 miles from its mouth. The chief town of Sarawak is Kuching, with a population of about 25,000. In 1885 the state was placed under British protection.

The fauna is exceedingly rich in all branches. The most important mammals are the mias, or orang utan, the gibbon, the proboscis, semnopithecus and macacus monkeys; lemurs, cats, otters, bears, porcupines, rhinoceros, wild pigs, wild cattle, deer, and pangolin. Bats, shrews, rats, and squirrels are included among the smaller mammals, while sharks, porpoises, and dugongs are found on the coast. Of birds, Sarawak has over five hundred species, including many kinds of thrushes, flycatchers, swifts, cuckoos, barbets, hawks, owls, pigeons, pheasants, and herons. Fish and reptiles are abundant; the jungle swarms with insect life, and is rich in many varieties of fern and orchid.

The mineral wealth gives promise of considerable development in the future. The Borneo Company have commenced working gold from the quartz reefs at Bau, on the Sarawak river, by the cyanide process, and have met with great success. Antimony and cinnabar are worked successfully in the same district by this company. Antimony occurs in pockets in various localities, notably at Sariki, in the Rejang district, and at Burok Buang and Telapak, in the Baram district, and in the river Atun. Cinnabar has also been found in small quantities at Long Liman and in the streams about the base of Mount Mulu. Sapphires of good quality, but too small to be of commercial value, are found in large numbers in the mountain streams of the interior.

Coal is worked at Sadong and Brooketon, whence it is shipped to Singapore. The great coal-field of Selantik, along the Kelingkang range in the Batang Lupar district, is about to be developed. Indications of coal seams have also been found in the river Mukah; at Pelagus, in the Rejang; at Similajau and Tutau and on Mount Dulit, in the Baram district.

Timber is one of the most valuable products, but at present, with the exception of billian (iron wood) from the river Rejang, very little is exported. The most important timbers to be found in the Borneo forests are: billian, merebo, rasak, kruin, tapang, kranji, benaga, bintangor, gerunggang, medang, meranti, and kapor. Except near the banks of the rivers, which have been cleared by the natives for farming purposes, the whole country is thickly clothed with timber.

The industrial establishments also comprise sago-mills, brick-works, cyanide-works, and saw-mills.

In 1900 the total trade was valued at $13,025,000, as compared with $4,564,200 in 1890. The following are the principal articles of export, with quantity and value given for the year 1900:—

Gutta	7,964 piculs	$78,829
Rubber	3,464 ,,	35,181
Rattans	41,340 ,,	27,999
Gambier	36,624 ,,	20,060
Pepper	32,967 ,,	125,442
Sago flour	215,910 ,,	75,026
Gold	45,180 oz.	84,370
Value of total imports		$6,159,120 or £615,912
,, ,, exports		$6,865,860 or £686,586

The revenue for 1900 amounted to $915,966 (as compared with $413,000 in 1890), and the expenditure to $901,172, leaving a surplus of $14,794.

The population of the state, in addition to a very small number of European government officials and others, consists of Malays, Dyaks, Melanaus, Kayans and Kenyahs, Kedayans and Muruts, with a large number of Chinese traders, and pepper planters.

The Government consists of the Raja, Sir Charles Johnson Brooke, G.C.M.G., who is absolute, assisted by a supreme council of seven, consisting of three chief European residents and four natives nominated by himself; there is also a general council of fifty, which meets every three years. For purposes of administration the country is arranged in four divisions, these being subdivided into districts. The first division consists of Sarawak proper, which comprises the districts of the river Sarawak and those of Lundu and Sadong. The second division is formed by the Batang Lupar, Saribas, and Kelakah districts. The third division consists of the Rejang, Mukah, Oya, and Bintulu districts; and the fourth division, of the Baram, Limbang, and Trusan districts. Each district is in charge of a Resident.

Since 1880 there has been a considerable increase of both population and territory, the increase of the former being estimated at 170,000 people, and of the latter at 15,000 square miles. On 12th August 1882 the Baram district from Kidurong Point to Baram Mouth, situated in the northern part between 3° and 4° 30′ N. and 113° and 115° 30′ W., with 100 miles of coast line and an area of 10,000 square miles, was ceded to Sarawak by the late sultan Mumin of Brunei. Three years later the Trusan district, in the far north, was also ceded to the Raja by the same sultan. A few years after these cessions had been obtained, many of the people of the Limbang—a large river which has one of its outlets passing through the town of Brunei—rose in rebellion against the sultan of Brunei, and as a solution of the difficulty their territory was annexed by Sarawak, with the subsequent approval of the British Government. The total area is therefore now 50,000 square miles.

The coast is well lighted, lighthouses having been built and maintained in good order at Tanjong Po, Sirik, Mukah, Oya, Tanjong Kidurong, Baram Mouth, and Brooketon.

The climate is equable, the daily temperature ranging on the average between 70° and 90°. The nights are generally cool. The rainfall averages about 200 inches annually; but falls during both the fine (S.W.) and the wet (N.E.) monsoon. (C. H.)

Sarcey, Francisque (1828–1899), French journalist and dramatic critic, was born at Dourdan, 8th October 1828. After his education was finished, he spent some years as schoolmaster in various lycées, but his independent and impetuous temperament was little fitted to the work. He abandoned it in 1858, and henceforward devoted himself to journalism. He contributed miscellaneous papers to the *Figaro*, *L'Illustration*, *Le Gaulois*, *Le XIX[e] Siècle*, and other periodicals; but his chief bent was towards dramatic criticism, of which he had his first experience in *L'Opinion Nationale* in 1859. In 1867 he began to contribute to *Le Temps* the "feuilleton" with which his name was associated till his death. His position as dictator of dramatic criticism was unique, and his influence enormous. He had the secret of taking the public into his confidence, and his pronouncements upon new plays were accepted as final. This was to a great extent justifiable, for he was a masterly judge of acting and of stage effect; his views as to the drama itself were somewhat narrow and indifferent to the march of events. He published several miscellaneous works, of which the most interesting are *Le Siège de Paris*, an account compiled from his diary (1871), *Comédiens et Comédiennes* (1878–84), *Souvenirs de Jeunesse* (1884), *Souvenirs d'âge mûr* (1892), *Quarante Ans de Théâtre* (1900, &c.). He died in Paris, 16th May 1899. (R. F. S.)

Sardhana, a town of British India, in the Meerut district of the North-Western Provinces; station on the North-Western Railway, 12 miles north-west of Meerut. Population (1891), 12,059; municipal income (1897–98), 11,046. Though now a decayed place, it is historically famous as the capital of the state founded at the end of the 18th century by the Begum Sumru. This extraordinary woman, who survived till 1836, was a Mussulman who married Reinhardt or Sombre (Sumru), the perpetrator of the massacre of British prisoners at Patna in 1763. On her husband's death in 1778 she succeeded

to the command of his mercenary troops. Ultimately she was baptized into the Roman Catholic Church, and bequeathed an immense fortune to charitable and religious uses. Her estate of Sardhana was the subject of litigation, and is now under the Court of Wards. She built here a Roman Catholic cathedral, a college for training priests, and a handsome palace.

Sardinia (Italian, *Sardegna;* French, *Sardaigne;* Spanish, *Cerdeña*), an island in the Mediterranean, about 140 miles from the west coast of Italy, of which kingdom it forms a part. Although the Italian Government neglected considerably the needs of the island during the last quarter of the 19th century, progress has undeniably been made. In 1881 the population was 682,002, and in 1901 it was estimated to be 789,314, or an average density of 85 per square mile. The populations of the chief cities are—Cagliari, 53,700; Sassari, 38,200; Iglesias, 12,000; Alghero, 12,000; Tempio, 12,000; Oristano, 8000; Ozieri, 8800; Bosa, 7000; Nuoro, 7000. The Sardinians are passionately attached to their island, and as a consequence emigration is comparatively small. The year 1896 furnished an exception to this general rule; in that year 2510 emigrants left the island, as compared with 150 in 1895 and 66 in 1892; the statistics for the years 1897–99 showed that emigration soon fell once more to insignificant proportions. The Sardinian is, as a rule, mild in character, hardworking, simple, and temperate in his habits. His domestic affections are extremely strong, as is also his attachment to the soil. This last sentiment is the chief cause of the excessive splitting-up of landed property. Politically the Sardinians are tenaciously attached to the existing institutions. At Sassari there exists a republican party which puts up its own candidates in general elections, but it is by no means *intransigéant* and still less subversive. The Sardinian clergy is favourably distinguished from the rest of the Italian clergy by its patriotic spirit. The Catholic party is most tolerant. Socialism counts few adherents. For administrative purposes the island retains the old division into 9 districts (*circondarii*) with a total of 364 communes. There are 12 parliamentary constituencies, but the island is represented in the senate by only 2 senators. Sardinia has a single court of appeal at Cagliari, 5 assize courts, and 6 common courts. There are 3 archbishoprics and 9 suffragan bishoprics; 2 intendants of finance, 2 chambers of commerce, and 9 agricultural unions.

Agriculture.—At least three-fifths of the Sardinian population are engaged in agriculture. Most of the remaining two-fifths are occupied in subsidiary industries, based upon the manufacture of agricultural products. Considerable progress was made in agriculture during the last twenty-five years of the 19th century, mainly as a result of the special agricultural schools established throughout the island. The old Sardinian plough is being replaced by modern ploughs, and attempts are being made to spread the use of artificial manure. Improved methods are being adopted for protecting vines against disease, and the importation of American vines has now ensured immunity against a repetition of former disasters. The cultivation of the vine prevails especially in the province of Cagliari, considerable progress having been made of late both in the extent of land under cultivation and in the ratio of produce to area. Between 1889 and 1896, the area under vines had increased from about 110,000 acres to 180,000 acres in four of the districts alone. The total extent of land covered by vineyards is calculated at 222,000 acres, giving a total average annual product of 5 million gallons. The entire island produced 19,809,000 gallons of wine in 1900, but 28,613,000 in the year 1899. The most flourishing districts are those of the Campidano of Cagliari, where intelligent and enterprising proprietors have pushed specialization in vine culture to a high degree, the district of Ogliastra, and the Campidano of Oristano, where the celebrated *vernaccia* is produced. Everywhere notable progress has been made.

Though much land previously devoted to grain culture has been planted with vines, the area under wheat, barley, beans, and maize is still considerable. Most of the Sardinian soil, except the rugged mountain regions, is adapted to corn growing. In 1896 the grain area was 380,000 acres, a slight diminution having taken place since 1882. The yield of corn varies from six to ten times the amount sown. In 1900 the total production of wheat in the island was 3,025,000 bushels. The low price of corn renders corn cultivation hardly profitable. The cultivation of olives is widespread in the districts of Sassari, Bosa, Iglesias, Alghero, and Callura. The Government is taking steps to check the decrease of olive culture in Sassari by offering prizes for the grafting of wild olive trees, of which vast numbers grow throughout the island.

Next to the wine-making industry, cattle-raising is becoming the principal source of wealth in Sardinia. Whereas in 1881 Sardinia was estimated to possess only 157,000 head of cattle, 478,000 sheep, and 165,000 goats, the numbers in 1896 had increased to 1,159,000 head of cattle, 4,960,000 sheep, and 1,780,000 goats. The nomadic system prevails in the island. Breeding is unregulated and natural selection prevails. The weaker animals either die off or do not breed, while those that do survive are poor in quality and in yield of products. A more progressive form of pastoral industry is that of the *tanche*, or enclosed holdings, in which the owner is both agriculturist and cattle raiser. On these farms the cultivation of the soil and the rearing of stock go hand in hand, to the great advantage of both. Nevertheless the idea of the value of improving breeds is gaining ground. Good cattle for breeding purposes are being imported from Switzerland and Sicily, and efforts are likewise being made to improve the breed of horses.

Trade and Industry.—Next to agriculture, mining is the principal Sardinian industry. It is carried on on a large scale, with capital and costly machinery. Although 583 mines of various metals have been assayed, only 100 are actively worked. The principal are those of Monteponi, near Iglesias, and those of Montevecchio, near Guspini. Lead, mixed with silver, zinc, copper, magnesium, and antimony are the chief minerals; lignite has been discovered, and is extracted in considerable quantities. In 1899 the province of Cagliari exported minerals to the value of 15,883,428 lire (nearly £600,000), an increase of 3,404,427 lire over 1898. The mines give employment to 12,060 workmen. The extraction of salt, monopolized by the Government, is another important industry. Formerly the Government leased the industry to a private company, but in 1900 resumed direct control of the works. The annual average production is 1,500,000 quintals (cwt). In 1899, 1,247,525 quintals were exported, a diminution of 412,148 quintals as compared with the total for 1898. The value of the salt produced in 1899 was 1,175,342 lire (£47,000). The tunny fisheries yielded in 1899 a value of nearly £62,000; but the industry is rapidly declining; and the coral fishery is almost extinct. Distilleries have grown up in large numbers since the Government abolished, by special laws for Sardinia, the heavy tax upon alcohol. It has, however, abolished also the premium previously accorded to distillers for exportation. Thus exportation has become practically impossible. Progress worthy of note has also been made in the tanning industry, the manufacture of artistic furniture, and in all kinds of printing.

Communications and Transport.—There exists a network of railways and ordinary roads, while numerous lines of steamers place the principal ports of the island in direct communication with Italy, Sicily, France, and the North African coasts. The high level of tariffs, both railway and maritime, has, however, prevented the realization of the advantages previously hoped for. Nevertheless the international trade of the province of Cagliari, where the chief ports are situated, attained in 1900 a value of £981,075, of which imports represented £238,340, and exports £742,735, 88 per cent. of this being for minerals. In 1899 this trade reached the value of £771,590; and the coasting trade a total of £1,449,550, making a total traffic of £2,221,140. While the ports of the island are entered annually by vessels aggregating 150,000 to 200,000 tons, engaged in foreign trade, the total entries of the foreign and coasting traffic by sea amounts to about 800,000 tons annually. The tariff war with France between 1887 and 1898 struck a heavy blow at Sardinian trade. Before that period Sardinian wine found its chief market in France. The loss of the chief market rendered inevitable a crisis, the consequences of which were scarcely counterbalanced by the efforts to find new outlets. Other industries were equally affected. Since the conclusion of the Franco-Italian commercial treaty of September 1898, and especially since the abrogation of the French decree, prohibiting the importation of Sardinian

cattle, in April 1899, trade with France has revived to some extent. Considerable trade is done in charcoal, but it leads to increasing deforestation without any rational provision for replanting.

Taxation.—It is estimated that Sardinia pays, in local and general, direct and indirect taxation of all kinds, 23,000,000 lire (£920,000), a sum corresponding to 35·44 lire per head.

Banks and Institutions of Credit.—In 1887 a severe banking crisis occurred in Sardinia. Though harmful to the general economic condition of the island, the crisis left agriculture comparatively unaffected, because the insolvent institutions had never fulfilled the objects of their foundation. Agricultural credit operations in Sardinia are carried on by the Bank of Italy, which, however, displays such caution that its action is almost imperceptible. An agricultural loan and credit company has been formed on the ruins of the former institutions, but hitherto no charter has been granted it. Institutions possessing a special character are the *monti frumentarii*, or public grain deposits, founded for the purpose of supplying peasant proprietors with seed corn, debts being paid in kind with interest after harvest. After passing through a period of decadence, the *monti frumentarii* are working well under regulations drafted and applied by the Rudini ministry in 1897.

Education.—Sardinia holds a low place in regard to education. In the province of Cagliari 73 per cent., and in that of Sassari 69 per cent., of the inhabitants neither read nor write. These figures, however, are steadily diminishing now that every commune in the island has at least a mixed school, and other schools are being opened year by year even in the mining districts. The university of Cagliari, which in 1874–75 had only 60 students, had 226 in 1899–1900. At Sassari in the same year there were 151. There are besides in the island 10 gymnasia, 3 lycées, 6 technical and nautical schools and institutes, and 9 other institutes for various branches of special education. A tendency is growing up towards the extension of technical and commercial education in place of the exclusively classical instruction hitherto imparted. To the growth of this tendency the excellent results of the agricultural schools have especially contributed.

Police.—A noteworthy improvement in the conditions of public safety has taken place. Robberies by armed bands, formerly frequent, have become rare, and the classical type of bandit is practically extinct.

The great needs of the island are (1) a legal remedy for the excessive subdivision of landed property; (2) regulation of the water-courses and mountain torrents; (3) replanting of forests; (4) a system of irrigation; (5) a vigorous administration; and (6) reduction of land and sea transport tariffs.

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Sardou, Victorien (1831– ——), French dramatist, was born at Paris on 5th September 1831. The Sardous were settled at Le Cannet, a small village in the vicinity of Cannes, where they owned a fairly large estate, planted with olive trees. A night's frost killed all the trees and the family was ruined. The father of Victorien came to Paris in search of employment. He was in succession a book-keeper at a commercial establishment, a professor of book-keeping, the head of a provincial school, then again a private tutor and a schoolmaster in Paris, besides editing grammars, dictionaries, and treatises on various subjects. With all these trades and manifold occupations, he hardly succeeded in making a bare livelihood, and when at last he gave up the unequal struggle and retired to his native country, the boy Victorien was left to fight out the battle with his own resources. He had begun studying medicine, but had to desist for want of funds. He taught French to foreign pupils; he also gave lessons in Latin, history, and mathematics to students, and wrote articles for cheap encyclopædias. At the same time he was trying to make headway in the literary world. His precocious talents had been noticed and encouraged by an old *bas-bleu*, Mme de Bawl, who had published novels and enjoyed some reputation in the days of the Restoration. But she could do very little for her young *protégé*. Victorien Sardou made desperate efforts to attract the attention of Mlle Rachel, and to win her support by submitting to her a drama, *La reine Ulfra*, founded on an old Swedish chronicle. A play of his, *La Taverne des Étudiants*, was received and actually produced at the Odéon on the 1st April 1854, but met with a very stormy reception, owing to a rumour which had been circulated to the effect that the young *débutant* had been instructed and commissioned by the Government to insult and provoke the students. The unlucky *Taverne* was withdrawn after five nights. Another drama by M. Sardou, *Bernard Palissy*, was, however, accepted at the same theatre, but the arrangement was cancelled in consequence of a change in the management. A Canadian play, *Fleur de Liane*, would have been produced at the Ambigu but for the untimely death of the manager. *Le Bossu*, which he wrote expressly for Fechter, did not satisfy the actor; and when the play was at last successfully produced, the nominal authorship, by some unfortunate arrangement, had been transferred to other men. M. Sardou submitted to Montigny, manager of the Gymnase, a play entitled *Paris à l'Envers*, which contained the love scene, afterwards so famous, in *Nos Intimes.* Montigny thought fit to consult Scribe, who was revolted by the scene in question, and pronounced: "It is filthy! Where are we going to?" Such was the old man's verdict on the young playwright who was destined to follow closely in his footsteps and to uphold his dramatic system to the last.

Sardou felt the pangs of actual want, and the long series of misfortunes culminated in a severe attack of typhoid fever. He was dying in his garret, surrounded with his rejected manuscripts. A lady who was living in the same house unexpectedly came to his assistance. Her name was Mlle de Brécourt. She had theatrical connexions, and was a special favourite of Mlle Déjazet. She nursed him, cured him, and, when he was well again, introduced him to her old friend. Then fortune began to smile on the young author, and her favours rained on him as fast as her cruelties had done formerly. It is true that *Candide*, the first play he wrote for Mlle Dejazet, was stopped by the censor, but *Les Premières Armes de Figaro*, *Monsieur Garat*, and *Les Prés Saint Gervais*, produced almost in succession, had a splendid run, and *Les Pattes de Mouche* obtained a similar success at the Gymnase. Then Victorien Sardou carried everything before him, and all theatres were open to him.

He soon ranked with the two undisputed leaders of dramatic art, Augier and Dumas. He lacked the powerful humour, the eloquence and moral vigour of the former, the passionate conviction and pungent wit of the latter, but he was a master of clever and easy flowing dialogue. He adhered to Scribe's constructive methods, which combined the three old kinds of comedy—the comedy of character, of manners, and of intrigue—with the *drame bourgeois*, and blended the heterogeneous elements into a compact body and living unity. He was no less dexterous in handling his materials than his master had been before him, and at the same time opened a wider field to social satire. He ridiculed the vulgar and selfish middle class person in *Nos Intimes*, the gay old bachelors in *Les Vieux Garçons*, the modern Tartufes in *Séraphine*, the rural element in *Nos Bons Villageois*, the old-fashioned customs and antiquated political beliefs in *Les Ganaches*, the revolutionary spirit and those who thrive on it in *Rabagas* and *Le Roi Carotte*, the then threatened divorce laws in *Divorçons.*

He struck a new vein by introducing a strong historic element in some of his dramatic romances. Thus he borrowed *Théodora* from Byzantine annals, *La Haine* from

Italian chronicles, *La Duchesse d'Athènes* from the forgotten records of mediæval Greece. *Patrie* is founded on the rising of the Dutch *gueux* at the end of the 16th century. The French Revolution furnished him with three plays, *Les Merveilleuses, Thermidor*, and *Robespierre*. (The last named was produced by Sir Henry Irving at the Lyceum, and has never yet been seen on any French stage.) The Imperial epoch was revived in *La Tosca* and *Madame Sans Gêne*. In many of these plays, however, it was too obvious that a thin varnish of historic learning, acquired for the purpose, had been artificially laid on to cover modern thoughts and feelings. But a few—*Patrie* and *La Haine*, for instance—exhibit a true insight into the strong passions of past ages.

M. Sardou married his benefactress, Mlle de Brécourt, but eight years later he became a widower, and soon after the revolution of 1870 was married a second time, to Mlle Soulié, the daughter of the erudite Eudore Soulié, who for many years superintended the Musée de Versailles. He was elected to the French Academy in the room of Autran, and took formal possession of his seat on the 22nd May 1878.

Sarikol. See PAMIRS.

Sark. See CHANNEL ISLANDS.

Sarnen, the capital of the west half (or Obwalden) of the Swiss canton of Unterwalden. It stands at a height of 1558 feet above the sea, at the north end of the Lake of Sarnen (3 square miles in extent), and on the river Aa. In 1900 the little town contained 3949 inhabitants. It has a large parish church on a knoll above, as well as two convents. In the archives is preserved the famous MS. known from the colour of its binding as the "White Book of Sarnen," which contains the earliest known version of the Tell legend. Sarnen is a station on the Brünig Railway, being 4½ miles from Alpnachstad, its port on the Lake of Lucerne, and 12½ miles below the summit of the Brünig Pass.

Sarnia, town and port of entry, Ontario, Canada, capital of Lambton county, 55 miles north-east of Detroit, on the left bank of the river St Clair. It is on the Grand Trunk and Lake Erie and Detroit River railways, and is a port of call for steamers plying on the Great Lakes. It contains a large oil-refinery which handles the whole product of the Ontario oil region; also salt, stove, carriage, and agricultural implement works, and flour-mills. The Grand Trunk Railway crosses the river at this point by the famous St Clair tunnel, 6025 feet long, or, including the approaches, 2¼ miles. Population (1891), 6692; (1901), 8176.

Sárospatak, a market-town of Hungary, in the county of Zemplén, on the Bodrog, with 6350 inhabitants in 1891 and 7911 in 1901, partly engaged in stone-industry. Its famous Calvinist high school (gymnasium, seminary, law academy) was founded in 1530, and conducted in the years 1650–54 by the celebrated pedagogue Amos Comenius. It possesses rich foundations and an excellent library (54,700 vols.), and affords free support and instruction yearly to some 300 students. There is an old fort, built in the 11th century, and near it a castle with an extensive park.

Sarpsborg, a seaport and manufacturing town of Norway, county Smaalenene, 68 miles by rail south-south-east of Christiania. It sprang into importance through the utilization of the falls in the river Glommen (Sarpsfos, 140 feet wide, 74 feet descent) for driving saw-mills, and especially for generating electric power. Since 1895 there have been built wood-pulp factories (one by an English company employing over 1000 hands), factories for calcium carbide (used for manufacturing acetylene gas), paper and aluminium factories, and spinning and weaving mills. There are two large electric supply stations, one of which furnishes Fredrikstad (7 miles to the south-west) with electric light. The port is at Sannesund, one mile south; its quays can be reached by vessels drawing 20 feet of water. The town was originally founded in the 11th century, and destroyed by the Swedes in 1567. The existing town dates from 1839. Population (1875), 3272; (1900), 6888.

Sarthe, a department in the north-west of France, watered by the river Sarthe.

Area, 2412 square miles. The population, 438,917 in 1881, had decreased to 422,944 in 1901. The births in 1899 were 8593, of which 705 were illegitimate; deaths, 9596; marriages, 3223. There were in 1896 821 schools, with 54,000 pupils, 8 per cent. of the population being illiterate. The land cultivated in 1896 measured 1,424,990 acres, of which 948,480 acres were arable and 22,230 acres vineyards. The department in 1899 raised wheat valued at £880,000; meslin, £160,000; rye, £120,000; barley, £280,000; oats, £223,000; potatoes, £492,000; mangold-wurzel, £44,000; vines, £143,000. Sarthe takes the first rank among the departments of France for the production of hemp, which in 1899 was valued at £108,000, while its crop of apples (1899) was estimated at £480,000. It owned in 1898 59,250 horses, 7440 asses, 209,680 cattle, 47,990 sheep, 100,530 pigs, and 20,690 goats. Mining in 1898 produced 10,000 metric tons of coal and 2277 tons of peat, but only 30 tons of iron. The spinning of hemp is extensively carried on. The distillation of 1898 counted only 81,000 gallons of alcohol. Le Mans, the capital, numbered in 1901, 62,948 inhabitants.

Sarzana, a town and episcopal see of the province of Genoa, Liguria, Italy, 10 miles east of Spezia, on a branch of the railway to Pisa. Its principal buildings are the cathedral (1355–1470), the former citadel (now gaol), and the castle of Sarzanello. It was the birthplace of Pope Nicholas V. It has one of the most important glass-bottle factories in Italy, also brick-works, and a patent fuel factory. Fruit, wine, and olive oil are cultivated in the vicinity. Population of commune (1881), 9845; about 14,500 (1899).

Saskatchewan River. See NELSON RIVER.

Saskatchewan Territory. See NORTH-WEST TERRITORIES.

Sassari, a town, archiepiscopal see, and capital of the province of Sassari, Sardinia, Italy, situated near the north-west corner of the island, 12 miles south-east of its port, Porto Torres, on the Gulf of Asinara. Fine modern quarters have been built on and beyond the site of the old Genoese walls and the citadel. It possesses provincial offices, the modern Gothic Giordano Palace, and the Duke's Palace (now municipal offices). The university, which in 1898 was attended by 148 students (24 professors), owns scientific collections, a library of nearly 40,000 volumes, and a collection of Carthaginian and Roman antiquities. There is a bronze bust of Mazzini (1889). The chief industries are the manufacture of matches, tobacco, and macaroni, tanning, and printing. Population (1881), 31,596; (1901), 38,178.

Satara, a town and district of British India, in the Deccan division of Bombay. The town is 2320 feet above the sea, near the confluence of the rivers Kistna and Yena, 56 miles south of Poona. Population (1881), 29,028; (1891), 29,601. The high school had 363 pupils in 1897–98. There are sixteen printing-presses, most of which issue a vernacular newspaper.

The district of SATARA has an area of 4987 square miles. Population (1891), 1,225,989, showing an increase of 15 per cent. after the disastrous famine of 1876–77; (1901), 1,146,521; average density, 229 persons per square mile, considerably the highest in the Deccan. The land revenue and rates are Rs.27,50,808, the incidence of assessment being R.1.1.3 per acre, again the highest in Deccan; cultivated area (1897–98), 1,529,541 acres, of which 124,738 were irrigated from wells, &c., including

9395 acres from Government canals; number of police, 1022; children at school (1897–98), 17,290, being 1·5 per cent. of the total population; registered death-rate (1897), 54 per 1000. The principal crops are millet, pulse, oil-seeds, and sugar-cane. The only manufactures are cotton cloth, blankets, and brass-ware. The district is now traversed from north to south by the Southern Mahratta Railway, which, however, passes 9 miles from Satara town. The Satara Agency comprises the two feudatory states of Phaltan and Aundh. Total area, 844 square miles. Population (1891), 131,529; (1901), 109,614. The estimated revenue of Phaltan is Rs.2,29,000; tribute, Rs.9600; estimated revenue of Aundh, Rs.18,900; no tribute. The chief of Aundh is the descendant of a Brahman official of Sivaji, called the Pratinidhi.

Sátoraljaujhely, a corporate town of Hungary, capital of the county of Zemplén, at the foot of Hegyalja, with 13,017 inhabitants in 1891 and 16,886 in 1901. The most remarkable buildings are the gymnasium, the hospital, and the tobacco factory. Its population is partly engaged in viticulture. In the vicinity is the village of Széphalom, where dwelt Francis Kazinczy, the initiator of modern Hungarian literature.

Sâtun. See MALAY PENINSULA.

Satsuma Islands, a group of islands belonging to Japan, lying westwards of the province of Satsuma (31° 40′ N. and 129° 40′ E.). The two principal are Kami-Koshiki-jima, which measures 24½ miles by 5½, and Shimo-Koshiki-jima, which measures 8½ miles by 5¼.

Saugor, or SAGAR, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is 1758 feet above the sea; railway station. Population (1881), 44,416; (1891), 44,674. The cantonments contain a battery of artillery, a detachment of a European regiment, a native cavalry and a native infantry regiment. The town is handsomely built, and an emporium of trade. The Government high school had 849 pupils in 1896–97.

The district of SAUGOR has an area of 4007 square miles. Population (1891), 591,743, showing an increase of 5 per cent.; (1901), 470,666; average density, 117 persons per square mile. The land revenue is Rs.5,70,000, the incidence of assessment being R.0.4.7 per acre; cultivated area, 754,777 acres, of which 5943 were irrigated from wells; number of police, 735; boys at school (1896–97), 6343, being 13·8 per cent. of the male population of school-going age; girls at school, 1391, being 3·2 per cent., the highest proportion in the province; death-rate (1897), 85·39 per 1000. The principal crops are millet, wheat, pulse, oil-seeds, and a little cotton. The branch of the Indian Midland Railway from Etawah to Saugor was extended to Damoh in 1898, and opened throughout to Katni, on the East Indian line, in 1899.

Saújbulágh, the principal town of the Mukri district, in the province of Azerbaiján in Persia, in a fertile valley, about 30 or 40 miles south of Lake Urmia, at an elevation of 4270 feet, in 36° 46′ N. and 45° 47′ E. It has post and telegraph offices, and a population of about 7000, mostly Kurds of the Mukri tribe, and exports dried fruit, grain, and tobacco. There are many more localities with this name (Turkish, meaning cold stream, or cold spring) in Persia, the most notable, after the above-mentioned Kurdish city, being a district of the province of Tehran, with many villages.

Sault Ste Marie, a city of Michigan, U.S.A., capital of Chippewa county. It is at the rapids of the river St Mary, the outlet of Lake Superior, at the eastern end of the Upper Peninsula. There are three railways, the Canadian Pacific, the Duluth, South Shore, and Atlantic, and the Milwaukee, St Paul, and Sault Ste Marie. The industries of the city are in great part connected with lumber, there being many saw and shingle mills, besides flour-mills, foundries, and machine shops. The river is here crossed at the head of the rapids by a fine railway bridge. The rapids make a descent of 18 feet in half a mile. For the use of commerce these have been avoided by locks; the first, on the American side, having been superseded by a second and larger one, the largest in the world, and capable of holding the largest vessel on the lakes. The Canadians, also, have built a lock on their side of the river. Population (1880), 1947; (1890), 5760; (1900), 10,538, of whom 5329 were foreign-born.

Savage Island. See POLYNESIA.

Sávah, a small province of central Persia, situated north of Irák and south-west of Tehran, comprising the districts of Sávah, Khalejistán (inhabited by the Turkish Khalej tribe), Zerend, and Karaghán. It pays a yearly revenue of about £5000. The capital is the ancient city of Sávah, which has a population of about 7000, and is situated 72 miles south-west of Tehran, at an elevation of 3380 feet, in 35° 4′ N. and 50° 30′ E. The soil is very fertile, is well watered, and produces much wheat, barley, and rice. It is occasionally joined to the province of Tehran in order to facilitate the governor's arrangements for supplying the capital of Persia.

Savannah, a city and seaport of Georgia, U.S.A., capital of Chatham county. It is situated in 32° 05′ N. and 81° 06′ W., on the river Savannah, near its mouth. Its site is in part on low ground, in part on a cliff. It has an excellent water-supply from artesian wells, and is well sewered. The harbour has been deepened by dredging by the United States Government. Formerly one of the chief export ports, especially for cotton, it has lost its relative position, not because of a decrease in business, but because of an increase in that of its rivals, especially New Orleans and Galveston. Its exports, chiefly cotton, fertilizers, and naval stores, had a value in 1898 of $28,937,614. Its imports were trifling. It is at the junction of five railways, the Central of Georgia, the Florida Central and Peninsula, the Georgia and Alabama, the Plant System, and the Southern. In 1900 it contained 155 manufacturing establishments, with a total capital of $5,716,491. They employed 2870 hands, and the product was valued at $6,461,816. The principal item of manufacture was fertilizers. The manufacture of lumber also was of importance, as was the cleaning and polishing of rice. The assessed valuation of real and personal property was, in 1900, $37,108,077, the net debt was $3,196,350, and the rate of taxation was $25·95 per $1000. Population (1890), 43,189, of which 22,978, or 53 per cent., were negro; (1900), 54,244, of whom 3434 were foreign-born, and 28,090, or 52 per cent., were negroes. Of 15,994 males 21 years of age and over, 2628 were illiterate (unable to write), of whom 2435 were negroes.

Savigliano, a town of the province of Cuneo, Piedmont, Italy, 32 miles south of Turin by rail. It has important iron-works and foundries and silk manufactures, as well as sugar factories, printing, and cocoon raising; also a technical school. Population (1881), 10,990; (1899), about 11,250.

Savings Banks.—*The United Kingdom.*—The early history and working of savings banks down to 1884 is given in considerable detail in the ninth edition of this work. It is therefore only necessary to repeat that the idea of receiving small sums on deposit from the comparatively poorer classes, which seems to have been first suggested by Daniel Defoe, gradually developed from the middle of the 19th century in various parts of Europe, and especially in the United Kingdom. Like all sound movements for the welfare of the community, that of the extension of savings banks grew on a solid

basis, and in a great variety of forms. Many Acts of Parliament have been passed for the management of these institutions in Great Britain, culminating in the establishment on a very broad basis of the Post Office savings banks, which are treated in a separate article in this work. It may be said that the promotion of thrift, which was at the end of the 18th century an experiment, commenced and carried on by a few far-seeing individuals, had by the end of the 19th century become to be almost universally adopted, and to be regarded practically as an adjunct to the institutions of every civilized community. Friendly societies, co-operative societies, trade societies, and other agencies, all being based on this same principle of thrift, or the husbanding of small resources for future use, have been brought into existence, and now count their members by hundreds of thousands. The idea has also developed, that in order to render schemes of savings as far-reaching as possible, and to embrace the less thrifty and thoughtful in the community, these institutions should be brought even to the doors of those for whom they are intended, and who might otherwise neglect or overlook the benefits they are intended to afford.

Trustee savings banks.

Many of the old trustee savings banks which were put on a systematic basis in 1817, have been absorbed by the Post Office, but while the total amount of their deposits increases, the number of their depositors remains about the same. In 1863 there were 622 of these banks carrying on operations with 1,558,000 depositors, and deposits amounting to £40,563,000. In 1889 the number of banks had decreased to 380, with 1,500,000 depositors, and £45,000,000 of deposits; while in 1898 they had still further decreased in number to 231, but still had 1,527,000 depositors, and their deposits had increased to £49,500,000. The reason for this is that the smaller trustee savings banks, open often only once a week for a short time, do not and cannot give such facilities as the Post Office, which is open every day and all day. Further than this, owing to the break up of the Cardiff bank in 1886, and other smaller irregularities, a select committee of the House of Commons was appointed to inquire into these banks. By the recommendations of this committee, an independent and permanent inspection committee was appointed, which has carried on its work of inspection ever since, and reports annually to Parliament. This action has rather tended to merge the smaller trustee savings banks in the Post Office. At the same time the large banks continue to do a very great business, and have become in many ways similar to ordinary joint stock banks, affording to persons of smaller means daily facilities for saving.

Those who have studied the habits of thrift among the people have usually come to the conclusion that its development depends largely on the ready facilities which exist for its exercise. To this fact may perhaps be attributed the efforts, already referred to, that have been made in various directions for establishing some means of saving close to the places where wages are paid. To carry out this idea, some of the large railway corporations have obtained powers in special Acts of Parliament to establish savings banks for those in their employment. The success of these banks has been great, though it has varied much, and it is difficult to trace any general rule of progress. Thirteen of such institutions return their operations to the Registrar of Friendly Societies. The total amount held was, by the same return for 1898, £3,016,146 in 38,503 accounts. In these banks the interest paid, as well as the deposits, are really guaranteed by the whole assets of the companies. Further, in order to encourage thrift among their employés, the companies have formally agreed and bound themselves, by the provisions of their special Acts, that the rate of interest paid shall be higher than can be obtained in the open market on the same security. Thus the South-Eastern and Chatham Railway gives 4 per cent., and their 4 per cent. debenture stock, which is not a better security than the savings bank, is considerably above par.

Other efforts have been made to establish savings banks at factories, to be open at the time wages are paid. One great difficulty, however, has been met with, and that is the objection many of those employed have to their employers knowing of their savings, and their fear lest it may affect their rate of pay. To get over this objection the plan has been tried of employing an outside agency to hold the savings bank. This has not been much more successful, as the suspicion that accounts may be looked at by employers is difficult to overcome. It is found that the most successful savings banks are those which are carried on as a business, where the transactions are so numerous that the individual feels that his own private account is not likely to become known.

Penny banks.

Another class of savings bank which of late years has developed considerably, is the penny bank. These banks have a twofold object: one to provide facilities for putting by extremely small sums for those whose means are very limited, and the other to attract children in their earliest years so as to train them to habits of thrift and the realization of the importance and use of even quite small savings. Some form of penny bank now exists in nearly every district, and indeed in nearly every parish. No returns have been collected, but it may be safely said that there are tens of thousands in operation. Many of these penny banks are feeders to the Post Office, which gives them special advantages to invest in that institution. Not only is the gross amount of money thus taken large, but (what is more important) the habit of thrift and of husbanding resources is being taught to the young in all parts of the United Kingdom. This has been one cause of the large extension of the Post Office savings bank itself, and has no doubt led to considerable change in the habits of the people. In a few cases successful efforts have been made to establish permanently these penny banks on a commercial basis, as in the case of the Yorkshire Penny Bank, which has 928 branches, 432,786 depositors, and deposits, £12,500,861; and the National Penny Bank, which has 13 branches in London, most of them open from 9 in the morning till 9 at night, with 129,228 depositors, and £1,811,334 in deposits on the 31st December 1899. The establishment of penny banks in schools has been carried on for many years, and it is difficult to exaggerate the useful work they have done in inculcating habits of thrift in the children, and in adding depositors to the Post Office savings banks when the children start in life. In England and Wales as many as 7393 of these savings banks were held in the 19,937 elementary schools inspected by the Education Department. The number seems to be somewhat diminishing—in 1894, 8668; in 1895, 8410; in 1896, 8065; in 1897, 7489. The reason for this diminution may be the very great amount of clerical labour which the conduct of these institutions imposes on the teachers in addition to their many other duties. The Board schools in London have done much to promote this movement. From the last return of these institutions under the London School Board, it appears that school penny savings banks are held in 231 departments of these Board schools. In these during 1898 there were 41,879 depositors on the books, who deposited £17,428 in the year; of this sum, £16,692 was withdrawn, leaving with previous balance £6161 in hand. This may not be considered a large financial result with over half a million children on the

registers, but its educational effect is considerable. It is also found that many children open accounts at outside penny banks in preference to going to those carried on at their own schools, though it is probable that the idea of so doing is often suggested by the school savings bank.

With a view of bringing the savings bank still nearer the doors of the people, efforts have been made to establish collecting savings banks. In these the collector calls at fixed periods for the deposits. This scheme has grown out of the investigations of a committee of the Charity Organization Society, and is based on the idea, which undoubtedly is the fact, that many people will make contributions when the money is called for, who will not take the trouble to walk a few yards themselves to make the same deposit. That this is so is proved most conclusively by the Post Office life insurance experience, a branch of the Post Office which is scarcely used by the people, while at the same time collecting life insurance companies (which of course must charge a considerable extra premium for collecting) do business to the extent of millions. From the report of these collecting savings banks in 1898, it appears that 49 such institutions were in operation in England, the number of depositors being about 23,000, and the amount deposited in the year about £20,000. In most of these banks no interest is given, but facilities and encouragements are afforded for the transfer of each individual account to the Post Office as soon as it is large enough to earn interest.

Closely allied, though essentially different, are the very numerous sharing-out clubs which may be called temporary savings banks. These nearly all take a weekly subscription from their members, and, should any member die, his representative receives a certain sum, the balance left being divided at Christmas equally among the survivors, in proportion to the weekly subscriptions. Some of these clubs are registered, and a rough estimate in 1899 gave the number as 847, with 115,000 members. The unregistered are, however, much more numerous, though no official information is to be had of them, and it is certain that hundreds of thousands of pounds are divided in this way each Christmas.

The attempt to induce sailors and soldiers to exercise habits of thrift by the establishment of naval savings banks under the Act of 1866, and military savings banks under the Act of 1859, should be mentioned. The amount in the naval savings bank in March 1898 was £262,772. As might be expected the amount does not grow. This is accounted for by the fact that the depositors leave the service and draw out their savings. About £200,000 a year, however, goes in and out of the naval banks, and £80,000 in the army banks. This sum represents a good deal of self denial, when the margin within which it is possible to save among sailors and soldiers is considered.

Closely allied to savings banks are a number of societies which need only be briefly referred to here. The largest of them are building societies under the Act of 1874, which are a very popular form of saving, especially in certain localities. The contributions to the shares of these societies, which are paid by instalments, differ but little from the periodical payments into savings banks; and although the money is not so readily repaid, notice and other forms having to be gone through, large numbers of persons pay in and draw out money, and receive the interest on the shares in much the same way as they do on deposits in savings banks without any idea of building or buying houses. In 1898 the receipts were £38,394,220 in the United Kingdom, and the accumulated capital was more than £57,000,000, with a membership of 619,741. The action of industrial and provident societies regulated under the Act of Parliament of 1893, must also be mentioned with reference to that part of their business which is closely allied to savings banks. These societies are divided into three classes:—(*a*) ordinary co-operative societies with 1,256,666 members; (*b*) societies for carrying on various businesses, including loan and banking, with 42,312 members; (*c*) land and building societies, with 11,144 members. The total, therefore, is 1,310,122 members. Most of these societies, indirectly or directly, act as savings banks, and have had considerable influence in the growth of thrift in the United Kingdom. In the co-operative societies the sales amounted to more than £48,000,000, and the profits to nearly £5,000,000. These profits are divided in different ways among the members, and they form a saving fund of large dimensions. The societies for carrying on various businesses, such as working men's clubs, loan and banking organizations, registered under the 1893 Act, numbered 127 in 1898, with total receipts £1,773,849. These are not rapidly increasing, but they must be included as one exhibition of the savings of the people, and they are practically used as savings banks. The land and building societies under the Act of 1893 are not the same as those above referred to, though their action as regards savings is similar. They are not under the Act of 1874, but carry on a trade or business, including dealings of any kind in land. Their operations are slightly increasing. They received £131,739 from subscriptions and other sources, according to the last return in 1898, and the value of the land and mortgages was £632,790. Two other classes of institutions should be referred to, the friendly and trade societies, which exist for special purposes, namely, to make provision in sickness, for death, for a want of employment, and to a limited extent for old age. They differ essentially from savings banks, as the subscriptions are parted with and cannot be withdrawn. But as the subscriptions are for certain definite needs, almost certain to be required by each member, which but for those societies would have to be provided for by direct savings in banks, they must be mentioned in treating of the subject as a whole. The amount held by the friendly societies is estimated at £37,917,702, subscribed by 11,424,810 members. The income from 630 trade societies in 1898 was £2,856,354, received from 1,219,474 members.

The general conclusions to be drawn from the progress of savings banks of all kinds during the last quarter of the 19th century must certainly be that facilities exist, and are in active operation for the exercise of thrift in many new channels. The gross number of members must form a large proportion of the entire population, even allowing for the fact that many are making use of several of the forms of savings banks that have been referred to. It was once stated, and with truth, that the national debt was held by a very small proportion of the population; but this is not so now. The various agencies which may be described as savings banks in different forms, hold at least £200,000,000, or a third of the National Debt of Great Britain. (x.)

United States.

There are two kinds of savings banks in the United States, *Mutual Savings Banks*, or savings banks proper, and *Stock Banks*, having capital and doing a combined commercial and savings business. To these might be added *School Savings Banks*. There are no postal banks of this kind. All these institutions are organized under the laws of the states where they are located, and are generally under the supervision of an officer appointed by the governor. The distinctive feature of *Mutual Savings*

Banks is that they have no capital, and do a strictly investment business, all their earnings going to the depositors. Their management is vested in a board of trustees, a self-perpetuating body who serve without pay, except for specific service such as appraising property. Executive officers and clerks are paid moderate salaries. The proportion of annual expense to each dollar of assets is sometimes less than ·0025. The rate of interest on deposits usually ranges from 3 to 4 per cent. Depositors have no voice in the management, except as citizens of the state, through their representative in the state legislature. Nearly all the states limit investments carefully, though a few permit considerable latitude: in New York the deposits in savings banks are considered next to Government bonds as safe investments. In eight out of the fifteen states having mutual savings banks, deposits are exempt from taxation; in the others the rate varies from $\frac{1}{4}$ to $\frac{3}{4}$ of 1 per cent. The amount which each person may deposit each year or half-year and the total amount to his credit are usually limited by the by-laws. Deposits are in practice generally payable on demand, though the banks reserve the right to require notice, generally from sixty to ninety days, and sometimes enforce this right in times of panic. The first savings bank incorporated in the United States was the Provident Institution for Savings, incorporated in Boston in 1816. The oldest in New York is the Bank for Savings, of New York City, incorporated in 1819. The largest deposit of any bank of this kind in the United States, $67,735,560, is that of the Bowery Savings Bank of New York. Mutual savings banks are confined chiefly to the New England and Middle states. There is no other kind of savings bank in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. The growth of banks in these states from 1887 to 1897 was as follows:—

	1887.	1897.
Number of banks	593	646
Number of depositors	3,030,094	4,311,972
Amount of deposits	$1,099,313,155	$1,667,486,734
Average to each depositor	362	386

The only mutual banks outside the North-Eastern states are four in Ohio, five in Indiana, four in Minnesota, and one each in West Virginia and Wisconsin.

Though the laws governing mutual banks vary in the different states, the following abstract of the New York Savings Bank Law of 1875, re-enacted in 1892, and subsequently amended, gives the main principles on which they are organized. It is of especial interest in view of the fact that the savings banks of New York are the most important banking institutions chartered by any of the states:—

Thirteen or more persons may incorporate a savings bank, two-thirds of whom shall be residents of the county where the proposed bank is to be situated. When the certificate of organization is filed with the superintendent of banks, who exercises supervision over all banks chartered by the state, he is required to ascertain whether the bank is in fact needed in the community where it is to be organized, and to investigate the character and general fitness of the trustees. The present superintendent of banks requires that the incorporators of a savings bank shall defray personally the expenses of the institution until its earnings are sufficient to meet such expenses, and also return dividends at the rate of 3 per cent. The board of trustees have entire control of the management of the bank. They elect the president and other officers. A trustee who borrows any of the bank's funds, or who becomes a surety for any other borrower, forfeits his office. Trustees are not allowed to have any interest in the profits, or to borrow the deposits or funds of the bank.

The trustees of any savings bank may invest the moneys deposited therein and the income derived therefrom as follows:—1. In the stocks or bonds or interest-bearing notes or obligations of the United States, or those for which the faith of the United States is pledged, including the bonds of the District of Columbia. 2. In the stock or bonds or interest-bearing obligations of this state. 3. In the stocks or bonds or interest-bearing obligations of any of the United States which has not within ten years defaulted in the payment of any part of any debt authorized by its legislature. 4. In the stocks or bonds of any city, county, town, or village, school district bonds, and union free school district bonds, issued for school purposes, or in the interest-bearing obligations of any city or county of this state. 5. In the stocks or bonds of a number of specified cities without the state, subject to the condition that if at any time the indebtedness of any of said cities, less its water debt and sinking fund, shall exceed 7 per cent. of its valuation for purposes of taxation, its bonds and stocks shall cease to be an authorized investment. 6. In bonds and mortgages on unencumbered real property situated in this state, worth at least twice the amount lent thereon. Not more than 65 per cent. of the whole amount of deposits shall be so lent or invested. If the loan is on unimproved and unproductive real property, the amount lent thereon shall not be more than 40 per cent. of its actual value. No investment in any bond and mortgage shall be made by any savings bank, except upon the report of a committee of its trustees. 7. Also, by virtue of a law passed by the legislature of 1898: In the first mortgage bonds of any railway corporation of this state, or in the mortgage bonds of any such railway corporation of an issue to retire all prior mortgage debt of such railway corporation, provided the bonds satisfy certain precautionary conditions. Not more than 20 per cent. of the whole amount of deposits shall be thus lent or invested. Street railway corporations shall not be considered railway corporations within the meaning of this section. An Act passed in 1900 permits the investment of deposits in the bonds of certain railways situated in other states. These investments must conform to conditions assuring safety.

Savings banks in New York are preferred creditors of insolvent state banks and trust companies. In 1901 a law was passed providing for a tax of 1 per cent. on the surplus of savings banks, computed on the par value of their securities. In the year 1900 the resources of the savings banks exceeded those of both the discount and deposit banks and of the trust companies chartered by the state; in 1900 the savings banks held $1,000,209,099; the discount and deposit banks $323,864,743; and the trust companies $672,190,671. The deposits in the savings banks amounted to $887,480,650, distributed amongst 1,981,371 depositors; interest credited for the preceding year amounted to $29,539,688; expenses for the year were $2,629,835, or $2·62 for each $1000 of resources. Loans on real estate, secured by bond and mortgage, amount to $406,210,574, and investments in stocks and bonds, market value, $502,265,621. The gain in resources in 1899 was over $76,000,000, and was the highest ever known. The savings depositors through their banks have purchased $3,733,000 of the state debt, $146,399,233 of the bonds of cities in the state, and $43,420,043 of town, county, village, and school district bonds.

Stock Savings Banks do not as a rule differ from ordinary banks of deposit and discount, except in receiving smaller sums on deposit. They are found in the more purely agricultural parts of the country, the Southern, Mississippi Valley, and Western states, where only a small proportion of people earn wages in manufactures and commerce, suitable investments are not numerous, the benefits of mutual savings banks are not familiar, and the people are unwilling to accept a low rate of interest. In some states having stock banks there are no laws relating to banking, and in others the savings banks carry on their business under the same laws as commercial banks. Several of the states restrict the investments of the stock savings banks. Prior to 1865, when the issue of circulating notes by state banks was suppressed by a prohibitory tax, there was a distinction between state banks and stock savings banks; the former could issue notes, while the latter, as a rule, could not. Stock savings banks are conducted frequently as adjuncts of state and national banks, occupying the same rooms and being under the same management.

The law of the state of Iowa, enacted in 1874, is typical of those states where stock banks are under public supervision. A savings bank may be organized by not less than five persons. In towns of ten thousand inhabitants or less it must have a capital of $10,000, and in towns or cities with more than ten thousand inhabitants $50,000. The usual corporate powers are granted. The amount of deposits is limited to ten times the paid-up capital, and in case

this amount should be exceeded, the capital must be increased in proportion. The usual provisions for repayments of deposits are made, and in addition the savings banks are given the privilege of requiring sixty days' notice for the withdrawal of deposits.

The banks are allowed to invest their funds in the following securities:—(1) Stocks, bonds, or interest-bearing notes of the United States. (2) Stocks, bonds, or evidences of debt bearing interest of the state of Iowa. (3) Stocks, bonds, and warrants of any city, town, village, or school district in the state regularly issued, but the investments of any savings bank should not consist of such bonds or warrants to a greater amount than 25 per cent. of the assets. (4) Mortgages or debts on unencumbered real estate within the state worth at least twice the amount lent. (5) It is lawful for such banks to discount, purchase, sell, and make loans upon personal or public security, except shares of their own capital stock.

Property acquired by foreclosure of mortgages, &c., may not be held more than ten years. The rate of interest to be paid is left to the discretion of the trustees, and the profits, after the payment of such interest and expenses, go to capital stock. Stockholders are liable to the creditors for double their stock, and for such liabilities continued for six months after the transfer of any stock. Directors receive no compensation. Officers and directors of the bank are required to give the same security for loans that is required of others, and such loans can only be made by the board in the absence of the party applying. The savings banks are prohibited from lending to any individual or firm more than 20 per cent. of the capital stock. All savings banks are required to make a quarterly statement to the auditor of the state, giving in detail the statement of condition upon a given day. This statement is made under oath of the officers, and is required to be published. The state auditor is given the power to examine any savings bank at any time, and should the conditions warrant, he is required to report to the attorney-general, who institutes proceedings under the law relating to insolvent corporations. Provision is made for increasing the capital stock by a two-thirds vote of the existing shares. The corporate existence of the banks is placed at fifty years.

Under the above law the number of banks increased from 19 in 1875 to 195 in 1899; their capital from $755,500 to $7,800,000; and the deposits from $2,338,685 to $48,147,860. In 1899 the 287 stock savings banks of the United States held savings deposits amounting to $218,759,168 and deposits subject to check, $2,538,125.

Loans and Investments.—In his annual report dated 31st October 1899, the comptroller of the currency gave data of the loans and investments of 942 out of the 987 savings banks in the United States, of which 655 were mutual and 287 stock banks. As the banks are not under his supervision, being under the control of the respective states, reports are available from only such banks as choose to send them. The loans of the 942 banks aggregate $1,098,598,589, of which $878,126,859 were secured by real estate, $156,359,308 by collateral other than real estate, and $64,112,422 by personal and other security. The investments in United States bonds amount to $136,930,208; state, county, and municipal bonds, $512,777,336; railway bonds and stocks, $167,998,336; bank stocks, $36,637,920; other stocks, bonds, and securities, $230,796,388.

The following are the statistics as to the deposits of the total number of mutual and stock savings banks in the United States:—

Years.	No. of Banks.	No. of Depositors.	Deposits.	Average due each Depositor.	Average per Caput in the U.S.
1896	988	5,065,494	$1,907,156,277	$376.50	$26.68
1897	980	5,201,132	1,939,376,035	372.88	26.56
1898	979	5,385,746	2,065,631,298	383.54	27.67
1899	987	5,687,818	2,230,366,954	392.13	29.24

School Savings Banks were first established in the United States in 1885 by J. H. Thiry, at Long Island City, New York. On 1st January 1900 the system was in use in 526 schools, distributed throughout 97 cities or villages and 15 states. Out of 179,630 pupils registered in these schools, 52,694 have saved $806,0159, of which $525,209 has been withdrawn, leaving a balance of $280,806 due depositors. In those parts of the country where there are no savings banks their place is largely supplied by building and loan associations. For further details see the articles on the several states. (B. R*.)

Savoie, a department of the south-east of France, bordering on Italy, traversed by the chain of the Alps and its ramifications, and watered by the Isère and Arc.

Area, 2389 square miles. The population, 266,438 in 1881, had decreased to 249,460 in 1901. The births in 1899 were 5853, of which 315 were illegitimate; deaths, 5577; marriages, 1670. The schools in 1896 numbered 989, with 47,000 pupils, 2 per cent. of the population being illiterate. The acreage under cultivation in 1896 amounted to 854,620, of which only 219,830 acres were in plough-land and 24,700 acres in vines. The wheat grown in 1899 was valued at £155,000; rye, £98,000; oats, £56,000; maize, £40,000; potatoes, £148,000; natural pastures, £402,000; tobacco, £40,000; walnuts, £78,000. The vintage of 1899 was valued at £248,000. The horses in Savoie (1899) numbered only 3080, the asses, 5200; cattle, 124,840; sheep, 71,630; pigs, 11,980; goats, 15,900. Savoie in 1896 produced 10,582 metric tons of coal, 6217 tons of lignite, 140 tons of peat; 636 tons of iron; and 69 tons of other minerals, of a total value of £5500. The industry in metals registered (1898) 29 metric tons of iron and 162 tons of steel, amounting, with inclusion of the other metals, to the value of £6100. The other industries are in a backward state. Chambéry, the capital, had 22,108 inhabitants in 1901.

Savoie, Haute-, a department of south-east France, bordering on the Lake of Geneva and on Switzerland, and dominated by Mont Blanc.

Area, 1775 square miles. The population, 274,087 in 1881, had decreased to 259,595 in 1901. The births in 1899 were 6010, of which 310 were illegitimate; deaths, 5534; marriages, 1771. There were in 1896 917 schools, with 43,000 pupils, 1 per cent. of the population being illiterate. The land under cultivation in 1896 comprised 827,450 acres, of which 291,460 acres were plough-land and 18,525 acres in vines. The wheat produce of 1899 was valued at £358,000; oats, £113,000. The vintage of the same year was estimated at £234,000; the potato crop, £241,050. In green crops (trefoil and sainfoin) the department reaped in 1898 the value of £256,000, and its natural pastures and grass lands yielded £412,000. Its live stock included 10,040 horses, 1950 mules, 13,090 cattle, 35,580 sheep, 28,210 pigs, and 23,940 goats. Mining in 1898 produced 215 metric tons of coal, 40 tons of peat, and 2660 tons of bitumen, valued altogether at £1510. Metallurgical industry turned out (1898) 2310 metric tons of iron and 440 tons of steel, valued at £21,000. Other industries are silk, tanning, and weaving. Annecy, the capital, had in 1901, 13,611 inhabitants.

Savona, a town and episcopal see of the province of Genoa, Liguria, Italy, on the coast of the west Riviera, 26 miles west by south of Genoa by railway. It is one of the chief seats of the iron industry, having iron-works and foundries, iron shipbuilding, railway workshops, engineering shops, brass foundry, tinplate works, sulphur mills, and glass-works. It is also a considerable seaport, importing commodities to the value of nearly two millions sterling (£1,754,300 in 1899), chiefly coal, with petroleum, iron, cereals, &c. There is a small export trade (£30,000 to £40,000 annually), of which preserved tomatoes, wood, and candied fruits are the chief elements. In 1899 the port (22 to 26 feet deep) was entered by 1139 vessels of 559,200 tons, as compared with 855 vessels of 356,300 tons in 1892. There are a technical institute and a commercial institute. Population (1881), 24,481; (1899), about 28,500.

Savory, Sir William Scovell, Bart. (1826–1895), British surgeon, was born 30th November 1826, in London. He entered St Bartholomew's Hospital in 1844 (M.R.C.S. 1847, F.R.C.S. 1852). From 1849 to 1859 he was demonstrator of anatomy and operative surgery at St Bartholomew's, and for many years curator of the museum, where he devoted himself to pathological and physiological work. In 1859 he succeeded Sir James Paget as lecturer on general anatomy and physiology. In 1861 he became assistant surgeon, and in 1867 surgeon, holding the latter post till 1891; and from 1869

to 1889 he was lecturer on surgery. In the College of Surgeons he was a man of the greatest influence, rising to be president for four successive years, 1885–88. As Hunterian professor of comparative anatomy and physiology (1859–61), he lectured on "General Physiology" and the "Physiology of Food." In 1884 he delivered the Bradshaw Lecture on the "Pathology of Cancer." In 1887 he delivered the Hunterian Oration. In 1879, at Cork, he had declared against "Listerism" at the meeting of the British Medical Association; "the last public expression," it has been said, "by a prominent surgeon against the now accepted methods of modern surgery." In 1887 he became surgeon-extraordinary to Queen Victoria, and in 1890 he was made a baronet. Savory was an able operator, but averse from exhibitions of brilliancy, and was altogether a powerful and authoritative man in his profession; his lucidity of expression being almost as valuable in that respect as his great knowledge of physiology and anatomy. He died in March 1895.

Sawantwari, or SAVANTVADI, a native state of India, in the Konkan division of Bombay. Area, 926 square miles. Population (1891), 192,948; (1901), 217,800; average density, 235 persons per square mile.

The estimated gross revenue is Rs.4,31,867, of which Rs.46,814 was expended on public works in 1897–98; no tribute; military force, 400 men; number of schools, 170, with 6386 pupils in 1897–98, being 3·2 per cent. of the population, compared with 2·4 per cent. for Bombay generally. The chief, whose title is Sir Desai, is a Maratha of the Bhonsle family. The late chief, who had been educated at the Rajkot College, died in December 1899, with no direct heir. It has special manufactures of ornaments carved out of bison-horn, painted and inlaid lacquer-work, and gold and silver embroidery. The town of SAWANTWARI, or Wari, is 17 miles from the seaport of Vengurla. Population (1881), 8584; (1891), 9269; municipal revenue (1897–98), Rs.6348, the incidence of taxation being 9 annas per head. It was founded in 1670, on the edge of an artificial lake amid hills. There is a high school, and Westropp hospital, with an endowment of Rs.10,000, raised to commemorate the Diamond Jubilee.

Saxe, John Godfrey (1816–1887), American poet, was born at Highgate, Vermont, 2nd June 1816. He graduated at Middlebury College in 1839, and became a lawyer, being at one time attorney-general of Vermont. He also engaged in politics as a Democrat, and edited a newspaper in Burlington; but he was best known as a humorous poet and a lecturer. His swiftly-moving lines abounded in puns and witty turns, his travesties and satires found many readers or listeners, and some of his love lyrics or other pieces combined sparkle with real feeling. During a part of his later life he was editor of the *Evening Journal* at Albany, New York, where he died 31st March 1887.

Saxe-Altenburg, a duchy of Germany, one of the Thuringian states, has an area of 511 square miles, and a population (1895), 180,313; (1900), 194,273, of whom 95,442 were males and 98,831 females; the density being 380 inhabitants to the square mile. In 1895 the Protestants numbered 168,549, or 93·5 per cent., and the Roman Catholics 2091. In the same year the duchy contained 16,180 farms, of which 13,589, or 84 per cent., were each less than 25 acres. The live stock in 1900 totalled 69,172 cattle, 66,895 pigs, 12,282 horses, and 9860 sheep. The lignite mines yielded (1900) 1,865,517 tons, valued at £229,300. For the period 1899–1901 the state revenue was fixed at £228,600 annually, and the expenditure at approximately the same. The public debt in 1900 amounted to £44,370, and the contribution to the imperial exchequer in 1901 to £98,550.

Saxe-Coburg-Gotha, a duchy of Germany, one of the Thuringian states, with an area of 755 square miles, and population (1895), 216,603; (1900), 229,567, of whom 110,949 were males and 118,618 females; the density being 304 inhabitants to the square mile. About 98 per cent., or 212,514, of the inhabitants were Protestants, and 2956 Roman Catholics. In 1895 the duchy comprised 29,458 farms, of which 15,230 were each less than 2½ acres in extent and 11,100 between 2½ and 25 acres. The number of persons supported by agriculture was 60,633, or 28 per cent. of the population. In 1900 the live stock numbered 95,988 pigs, 68,780 cattle, 47,718 sheep, and 10,301 horses. The public revenue during the period 1899–1901 was fixed at £135,600 annually, and the expenditure at £165,800; in addition, there was a special revenue for the duchy of Coburg of £70,960 annually, and expenditure of £63,740, and a special revenue of £126,150 annually for the duchy of Gotha and an expenditure of £177,210. The public debt of Coburg amounted in 1900 to £141,560, and of Gotha to £107,330; and in 1901 their joint contribution to the imperial exchequer to £116,350. The duke of Albany, grandson of Queen Victoria, succeeded to the duchy in 1900 on the decease of his uncle, the duke of Edinburgh, who had become duke of Saxe-Coburg-Gotha in 1893.

Saxe-Meiningen, a duchy of Germany, one of the Thuringian states, with an area of 953 square miles, and population (1895), 234,005; (1900), 250,683; of whom 123,027 were males and 127,656 females. Density, 263 inhabitants to the square mile. Of the total population in 1895, 228,969, or 98 per cent., were Evangelical Lutherans, 3188 Roman Catholics, and 1487 Jews. Agriculture supports 67,540, or 29 per cent. of the population. Out of the total number of farms (31,907), in 1895, 15,370 were each under 2½ acres in extent, 13,469 between 2½ and 25 acres. In 1900 the live stock numbered 74,491 cattle, 80,322 pigs, 31,232 sheep, and 7780 horses. For the period 1900–02 the public revenue was fixed at £437,225, and the public expenditure at £394,430. The public debt in 1901 amounted to £415,175, and the contribution to the imperial exchequer to £127,225.

Saxe-Weimar, a grand-duchy of Germany, one of the Thuringian states, with an area of 1388 square miles, and a population (1895), 339,217; of whom 325,315, or 95·9 per cent., were Evangelical Lutherans, 12,112 Roman Catholics, and 1290 Jews. In 1900 the population was 362,018, of whom 176,650 were males and 185,368 females. In 1895 the population was rural to the extent of 60·3 per cent., the rest being urban (39·7 per cent.). During the years 1890–98 inclusive, an average of 119 persons emigrated annually; in 1900 they numbered 86. The university of Jena is common to the four Saxon duchies. The supreme court of Jena serves as a common court of appeal for these duchies, for Schwarzburg-Rudolstadt, for the two Reuss principalities, and for certain parts of Prussia. The number of persons supported by agriculture in 1895 was 123,011, or 36·2 per cent. of the population. The total number of farms in 1895 was 42,227, of which 16,575 were each less than 2½ acres and 19,419 between 2½ and 25 acres. In 1900 the live stock numbered 156,995 pigs, 134,628 cattle, 88,300 sheep, and 22,207 horses. For the financial period, 1899–1901, the state revenue and expenditure were balanced at £523,000. In 1900 the public debt was £97,000, and in 1901 the amount contributed to the imperial exchequer £183,550.

Saxony, a kingdom of the German empire, ranking fifth in area, third in population, and first in density.

Area and Population.—The census returns for 1885, 1895, and 1900, together with the area and density of the

kingdom and its administrative districts, are given in the subjoined table:—

District.	Population, 1885.	Population, 1895.	Population, 1900.	Area in sq. miles.	Density per sq. mile in 1900.
Bautzen .	356,560	385,080	405,092	953	425
Dresden .	860,558	1,067,757	1,216,044	1674	726
Leipzig . .	774,036	945,179	1,059,273	1377	769
Chemnitz .	1,190,849	734,044	791,896	799	991
Zwickau .		655,628	727,453	984	739
Total .	3,182,003	3,787 688	4,199,758	5787	726

The former district of Zwickau has been divided into the two new districts of Chemnitz and Zwickau, and the 1895 population (1,389,672) is duly divided for that year between them. Of the total population in 1900, 2,042,437 were males and 2,157,321 females, or 1056 females to every 1000 males. As will be seen, the density is exceptionally high—in fact, the highest in the empire, with the exception of the Hanseatic towns.

The average density of the entire empire in the year 1900 was 270. Of the total population in 1900, 2,100,475, or 50·01 per cent., lived in towns, the remaining 49·99 per cent. in rural communes. The largest towns of the country in 1900 were Leipzig (455,089), Dresden (395,349), Chemnitz (206,584), Plauen (73,891), Zwickau (55,825), and eight others with above 20,000 inhabitants each. The next table shows the movement of the population for the years 1888 to 1899:—

	Marriages.	Total Births.	Illegitimate.	Total Deaths.	Birth-rate.	Death-rate.	Illegitimacy percentage.	Marriage Rate.
Annual average, 1888–97	..	151,000	..	96,109	41·8	26·6	12·6	9·1
1898	38,611	162,555	21,059	92,785	41	22	12·9	9·1
1899	38,980	164,164	21,148	99,609	40·4	24·5	12·9	9·6

The number of emigrants gradually diminished from 4920 in 1892 to 950 in 1897, and, after an increase to 1128 in 1898, again fell to 876 in 1900; the annual average for the ten years 1889–98 being 2521.

Agriculture.—In 1895 agriculture supported 716,450 persons, or 19 per cent. of the population. The annexed table shows the farms classified according to size:—

Under 2½ acres.	Between 2½ and 25 acres.	Between 25 and 250 acres.	Above 250 acres.	Total Farms.
96,796	67,685	28,392	754	193,627

In 1900 there were 687,587 cattle, 576,825 pigs, 166,713 horses, and 74,518 sheep in the kingdom.

Industry and Mining.—In 1898, 501,677 persons were engaged in these occupations, distributed as follows:—178,571 in the textile industries, 74,234 in the manufacture of machinery and instruments, 92,807 in mining, quarrying, and smelting and founding metals; 34,573 in forestry, saw-milling, &c.; 27,088 in paper manufacture; 22,230 in printing and similar branches; and the rest (72,174) in other branches. In 1900, 120 coal-mines were in active work, 89 being lignite mines; their output was 6,343,213 tons, valued at £3,230,600. There were 13 iron and salt mines at work, and they produced 13,087 tons of ore, valued at £24,000, and 8 mines of cobalt, nickel, and bismuth produced 595 tons of ore valued at £29,650. The iron works, foundries, &c., produced 342,152 tons of iron and steel, valued at £3,507,850; the breweries 107,386,650 gallons of beer, the distilleries 2,965,100 gallons of pure alcohol, and the sugar factories 19,850 tons of sugar. Quarrying is extensively carried on, over 3800 persons being employed in quarrying sandstone near Pirna alone.

Communications.—In 1900, 1880 miles of railway were open for traffic, all except 25 miles belonging to the state. In 1898 the telegraph lines reached a total of 3750 miles, and telegraph wires 17,910 miles; the length of telephone lines was 2685 miles.

Religion and Education.—In 1895, 3,611,670 persons, or 95·3 per cent. of the population, belonged to the Evangelical Lutheran Church, 140,285 were Roman Catholics, 10,538 were "Reformists," 15,059 belonged to other Christian sects, and 9902 were Jews. The university of Leipzig ranks after Berlin and Munich in respect of the number of students attending it (3586 in 1900–01). The remaining educational facilities embrace the technical high school (polytechnic) at Dresden, 2 "provincial" schools, 17 classical, and 10 semi-classical schools, 34 "modern" schools, 22 seminaries, and 3 higher girls' schools. There are also about 4340 elementary and advanced elementary schools in the kingdom, and they are attended by approximately 792,200 children. In 1900 the mining academy at Freiberg had 330 students; the 2 mining schools, about 150 pupils; the academy of forestry at Tharandt, 89 pupils; the 7 schools of navigation (1898), 17 teachers and 157 pupils; the veterinary high school, 212 students: besides which there are 2 art academies, 3 industrial art schools, 2 conservatories of music, a shorthand institute, school of political economy, 4 architects' schools, some 200 schools for training artisans and designers in special industries, 8 agricultural and horticultural schools, 44 commercial schools, 15 music schools, and 1 dramatic school. The military schools are mentioned in the next section.

Army.—In 1900 the peace footing of the Saxon army (12th Army Corps of the imperial forces) numbered 43,288 men of all arms. The cadet school at Dresden has about 250 pupils, and 2 non-commissioned officers' schools at Marienberg are attended by 500 men.

Finances.—For the period 1900–01 the ordinary annual revenue was fixed at £4,609,900, and the ordinary annual expenditure at the same figure; but there were in addition an extraordinary revenue and an extraordinary expenditure, balancing at £4,934,100, this expenditure being for public works. Of the ordinary revenue £2,504,400, or 54½ per cent., was derived from state-owned sources, *e.g.*, forests, domain lands, mines, the porcelain factory of Meissen, and railways (£1,784,100). Direct taxes, chiefly income-tax, yielded £2,105,500. The amount upon which income-tax was levied was £83,326,100 in 1894, and £110,703,670 in 1900. Out of the total number of persons who paid income-tax in 1898, viz., 1,467,070, no less than 1,396,218, or 95 per cent., paid on incomes under £165 per annum, and of these again 319,813 paid on incomes between £20 and £25 a year. In 1900 the amount of the national debt was £41,491,120, and in 1901 the amount contributed to the imperial treasury £2,133,650. See *Kalender und Statistisches Jahrbuch für das Königreich Sachsen auf das Jahr 1900, &c.* (Dresden, 1899).

Saxony, a province of Prussia, with an area of 9750 square miles, and population (1895), 2,698,549; (1900), 2,833,224; of whom 1,389,204 were males and 1,444,020 were females. The mines in 1897 yielded 13,009,653 tons of lignite, valued at £1,583,750 (in 1900, 17,035,074 tons valued at £2,101,200); 273,364 tons of coal, valued at £55,700; 716,348 tons of kainite, valued at £505,900; 640,236 tons of potassium salts, valued at £379,700; and 632,168 tons of copper, valued at £909,700 (in 1900, 671,918 tons valued at £1,108,850); total value in 1897, £3,434,750. The produce of salt-works and furnaces, &c., in 1900 was 108,734 tons of salt, worth £147,600; 163,458 tons of chloride of potassium, worth £1,040,050. The province of Saxony is famous for its high-class farming, and ranks as the first agricultural province of all Germany. Besides the university agricultural college at Halle, there are two agricultural colleges and six agricultural schools, as well as two experimental stations, in the province. The barley and chicory (50 per cent. of that grown in Germany) of Saxony are famous. In 1900 the live stock included 1,259,737 pigs, 833,580 sheep, 778,353 cattle, and 213,040 horses. This province, especially in the neighbourhood of Erfurt, Quedlinburg, and Aschersleben, is far-famed for its gardening and seed farms. The sugar factories in 1900 produced 447,895 tons of sugar; the breweries, 53,700,000 gallons of beer; and the distilleries, 3,897,300 gallons of pure alcohol. For further particulars, see under PRUSSIA. See also "Agriculture in Germany," *Brit. Cons. Rep.*, No. 452 (1898).

Say, Jean Baptiste Léon (1826–1896), French statesman and economist, was born in Paris on 6th June 1826. From his father, Horace Say, and his grandfather, Jean Baptiste, the author of a celebrated *Traité d'économie politique*, founded on Adam Smith, he inherited

an ardent zeal for economic studies, of which he gave a remarkable proof by publishing at the age of twenty-two a brief *Histoire de la Caisse d'escompte*. He was at first destined for the law, next entered a bank, and finally obtained a post in the administration of the Chemin de fer du Nord. Meanwhile he became a regular contributor to the *Journal des Débats*, where he established his reputation by a series of brilliant attacks on the financial administration of the prefect of the Seine, Haussmann. He displayed a remarkable talent for interesting popular audiences in economic questions. His sympathies, like those of his grandfather, were with the British school of economists; he was, indeed, the hereditary defender of free-trade principles in France. He had, moreover, an intimate acquaintance with the English language and institutions, and translated into French Goschen's *Theory of Foreign Exchanges*. He was one of the pioneers of the co-operative movement in France. Elected to the Assembly of 1871 by the departments of Seine and Seine-et-Oise, he adopted the former, and took his seat among the Moderate Liberals, to whose principles he adhered throughout his life. He was immediately chosen as reporter of the commission on the state of the national finances, and in this capacity prepared two elaborate statements. Thiers, though opposing their publication on grounds of public expediency, was much struck by the ability displayed in them, and on 5th June appointed Say prefect of the Seine. The fall of the Empire, the siege of Paris, and the Commune had reduced the administration of the capital to chaos, and the task of reconstruction, amid the urgent problems that called for immediate solution, severely tried the new prefect's power of organization. This was, however, a gift with which he was pre-eminently endowed; and he only quitted his post to assume, in December 1872, the ministry of finance—a remarkable tribute to his abilities from Thiers, who himself held strongly protectionist views. In all other respects Say always regarded himself as the disciple of Thiers, who, in his last public utterance, designated Say as one of the younger men who would carry on his work. He fell from office with Thiers on 24th May 1873, and was elected president of the Left Centre group, as whose candidate he unsuccessfully contested the presidency of the Chamber with Buffet. In spite of their divergence of views, he consented, at the urgent request of President MacMahon, to take office in March 1875 in the Buffet Cabinet; but the strongly reactionary policy of the premier led to a sharp and long-continued dispute between him and Say both in the press and in the constituencies, and brought about Buffet's resignation. Say continued to hold the ministry of finance under Dufaure and Jules Simon, and again in the Dufaure ministry of December 1877, and its successor, the Waddington ministry, till December 1879. During this long period, in which he was practically the autocratic ruler of the French finances, he had first to complete the payment of the war indemnity—an operation which, thanks largely to his consummate knowledge of foreign exchanges, was effected long before the prescribed time. It was at a conference held between Say, Gambetta, and M. de Freycinet in 1878 that the great scheme of public works introduced by the latter was adopted. Say's general financial policy was to ameliorate the incidence of taxation. As a pendant to his free-trade principles, he believed that the surest way of enriching the country, and therefore the Treasury, was to remove all restrictions on internal commerce. He accordingly reduced the rate of postage, repealed the duties on many articles of prime utility, such as paper, and fought strongly, though unsuccessfully, against the system of *octrois*. On 30th April 1880 he accepted the post of ambassador in London for the purpose of negotiating a commercial treaty between France and England, but the presidency of the Senate falling vacant, he was elected, on 25th May, to fill the post, having meanwhile secured a preliminary understanding, the most important feature of which was a reduction of the duty on the cheaper class of French wines. In January 1882 he became minister of finance in the Freycinet Cabinet, which was defeated in the following July on the Egyptian question. Say's influence over the rising generation grew less; his "academic Liberalism" was regarded as old-fashioned; Socialism, which he never ceased to attack, obtained even greater power, and free-trade was discarded in favour of M. Méline's policy of protection, against which Say vainly organized the *Ligue contre le renchérissement du pain*. He had, however, a large share in the successful opposition to the income-tax, which he considered likely to discourage individual effort and thrift. In 1889 he quitted the Senate to enter the Chamber as member for Pau, in the belief that his efforts for Liberalism were more urgently needed in the popular Assembly. Throughout his career he was indefatigable both as a writer and as a lecturer on economics, and in both capacities exerted a far wider influence than in parliament. Special mention must be made of his work, as editor and contributor, on the *Dictionnaire des finances* and *Nouveau dictionnaire d'économie politique*. His style was remarkably easy and lucid, and he was often employed in drawing up important official documents, such as the famous presidential message of December 1877. He was for many years the most prominent member of the Académie des Sciences Morales et Politiques, and in 1886 succeeded to Edmond About's seat in the Académie Française. He died in Paris on 21st April 1896. A selection of his most important writings and speeches has since been published in four volumes under the title of *Les Finances de la France sous la troisième République* (1898–1901). (H. SY.)

Sayre, a borough of Bradford county, Pennsylvania, U.S.A. It is on the North Branch of the river Susquehanna and on several railways, in the north-eastern part of the state. Population (1900), 5243, of whom 337 were foreign-born.

Scarborough, a municipal and parliamentary borough and fashionable watering-place, Yorkshire, England, North Riding, in the Whitby parliamentary division, 40 miles north-east of York by rail. A promontory divides the town into north and south parts. The former was greatly improved by the addition of the promenade and drive, known as the Royal Albert Drive and Clarence Gardens, opened in 1890. In 1891 the corporation purchased Ramsdale Valley bridge, spanning a picturesque ravine which separates the southernmost part of the town from the rest. The People's Park occupies both sides of the valley. Modern public buildings include the church of St James's, two Wesleyan chapels, a Congregational chapel, Constitutional and Liberal clubs, and central fire station. Population of the municipal and parliamentary borough (1881), 30,504; (1901), 38,160.

Schaffhausen, one of the Swiss cantons. Its total area is 113½ square miles. Of this, 108·4 square miles are classed as "productive," forests covering 44·8 square miles, vineyards 4·2 square miles, and arable or pasture land the remaining 59·4 square miles. The population of the canton was 37,783 in 1888, while in 1900 it was 41,514. In 1900 there were 365 inhabitants to each square mile. The people are mostly Protestant—roughly, the Roman Catholics number 10 per cent.—and German-speaking. With the exception of a small portion of the town of Stein, the whole canton lies north of the Rhine.

The cantonal constitution is that of 1876, slightly modified. The legislature is elected as stated in the ninth edition of this work, but only "communes" with over 250 inhabitants form separate electoral circles, the smaller being united electorally to their greater neighbours. The executive of five members is also elected by popular vote for four years. Besides the right of "initiative" of 1000 citizens as to legislative projects, and the revision of the cantonal constitution, there was adopted in 1895 the "obligatory referendum" for all legislative projects, as well as a curious institution (formerly existing in several cantons) by which the legislature can consult the people on certain questions involving principles, and not merely fully drafted legislative projects. In 1897 the state revenue of the canton was 1,647,481 francs (a rise of 42 per cent. since 1885), and the state expenditure, 1,564,118 francs (a rise of 46 per cent.), while in 1898 the surplus was 95,999 francs; the system of accounts in this canton is rather intricate. In 1897 the public debt was *nil*. The taxes are very small, while the state property is the most considerable in Switzerland, so that from a financial point of view it is the most favoured among the Swiss cantons.

AUTHORITIES.—*Beiträge z. vaterländ. Geschichte.* Schaffhausen, 1863-84.—IM THURN. *Der Kant. S.* St Gall and Bern, 1840.—PFAFF. *Das Staatsrecht d. alten Eidgenossenschaft.* Schaffhausen, 1870 (pp. 89-97 contain a history of Schaffhausen). In 1901 there appeared at Schaffhausen two elaborate historical "Festschriften," one for the canton and the other for the town. (W. A. B. C.)

Schaffhausen, the capital of the above canton. There is a railway ($1\frac{1}{4}$ miles) to Feuerthalen (1253 inhabitants), the first station on the line to Constance, which keeps on the Swiss side of the Rhine. There is a fine promenade on the west of the town, called the Fäsenstaub. Population (1880), 11,753; (1900), 15,275.

Schandorph, Sophus. See DANISH LITERATURE.

Scharf, Sir George (1820–1895), director of the British National Portrait Gallery, was born in London on 16th December 1820, the son of George Scharf, a Bavarian miniature painter who settled in England in 1816, and died in 1860. He was educated at University College School, and studied in the schools of the Royal Academy. In 1840 he accompanied Sir Charles Fellows on the second of his archæological visits to Asia Minor, and in 1843 acted as draughtsman to a Government expedition to the same country. After his return he devoted himself with great industry and success to the illustration of books relating to art and antiquity, of which the best known are Macaulay's *Lays of Ancient Rome*, 1847; Milman's *Horace*, 1849; Kugler's *Handbook of Italian Painting*, 1851; and Dr Smith's classical dictionaries. He also engaged largely in lecturing and teaching, and took part in the formation of the Greek, Roman, and Pompeian courts at the Crystal Palace. He acted as art secretary to the great Manchester Art Treasures Exhibition of 1857, and in that year was appointed secretary to the newly founded National Portrait Gallery. The remainder of his life was given to the care of that institution, which during the thirty-seven years of his able and zealous management gradually developed into a collection of first-rate importance. Scharf acquired an unrivalled knowledge of all matters relating to historic portraiture, and was the author of many learned essays on the subject. He was elected a fellow of the Society of Antiquaries in 1852, and a corresponding member of the Archæological Institute of Rome in 1858. In 1885, in recognition of his services to the Portrait Gallery, he was made C.B., and on relinquishing his post, early in 1895, was created K.C.B. and a trustee of the Gallery. He died on the 19th April of the same year. (F. M. O'D.)

Schaumburg-Lippe, a principality of Germany, in the valley of the Weser, between the Prussian provinces of Westphalia and Hanover. Area, 131 square miles. Population (1895), 41,224; (1900), 43,132; of whom 21,449 were males and 21,683 females. The people are almost entirely Evangelical Lutherans. Density, 329 inhabitants to the square mile. Of the total population in 1895, 11,725, or 28·4 per cent., were supported by agriculture. The number of farms was 7218, of which 6585, or 91 per cent., were each less than 25 acres; 625 were between 25 and 250 acres, and only 8 exceeded 250 acres. In 1900 the principality contained 32,243 pigs, 12,434 cattle, 4088 horses, and 1632 sheep. The state revenue and expenditure for 1900 were estimated to balance at £53,530. The public debt amounted in 1900 to £24,100, and in 1901 the contribution to the imperial exchequer to £21,845.

Scheffel, Joseph Victor von (1826–1886), German poet and novelist, was born at Carlsruhe, where his father was an officer in the Baden army, 16th February 1826. His mother, *née* Krederer, was a poet of some distinction. He went to school at Carlsruhe, and afterwards studied law at Munich, Heidelberg, and Berlin. After graduating *doctor juris*, he held a secretaryship for a short time, and subsequently was appointed to various judicial posts. Eventually, in 1854, he retired in order to devote himself entirely to his pen, coming to this determination as a consequence of the great success achieved by his poem *Der Trompeter von Säckingen*, published in 1853. The popularity of this work in Germany has been extraordinary, more than 200 editions of it having been issued. In 1857 he published *Gaudeamus* (a volume of poems) and a historical romance, *Ekkehard*, which also became very popular. In 1864 he married Caroline von Malzen and settled at Carlsruhe, where he lived practically in retirement. He died there on 9th April 1886. His later works never achieved the popularity of those mentioned above, which by themselves were sufficient to procure him enthusiastic eulogiums and various marks of honour on his "jubilee," which was celebrated all over Germany. He was on this occasion granted a patent of hereditary nobility by the grand duke of Baden. His works subsequent to *Ekkehard* were *Frau Aventure* (1863), *Juniperus* (1868), *Waldeinsamkeit* (1880), *Der Heini von Steier* (1883). Volumes of *Reisebilder* (1887), *Gedichte* (1888), *Episteln* (1892), and *Briefe* (1898) were published posthumously. (R. F. S.)

Scheldt, a river flowing through France, Belgium, and Holland. In its Belgian course it is regulated by locks as far as Ghent, below which it flows freely east and north to the estuaries indenting Zeeland, which are, however, really inlets of the sea, being at many places over 3 miles broad from dyke to dyke, and showing no movement but the ebb and flood of the sea. The river water running through these estuaries is, moreover, shrinking in breadth, and the alluvium, especially between the islands, is accumulating. The Dender, a tributary on the right bank, and the Lys, on the left, are both largely canalized. At Antwerp the Scheldt at high water has a breadth of 1706 feet. Sixteen miles north-west of Antwerp the river divides at Fort Bath (Holland) into the Western and the Eastern Scheldt. The Western Scheldt flows, between Dutch Flanders on the south and the islands of South Beveland and Walcheren on the north, into the North Sea at Flushing. Altogether the Scheldt is navigable for 207 miles. On the north side, near Flushing, and along the south coast of South Beveland, as also on the south side near Terneuzen, the Western Scheldt has a depth of 131 feet. Steamers ply between these places and Fort Breskens, on the south bank opposite Flushing. The roadstead of Zierikzee (island of Schouwen) and the navigable water along the northern coast of North Beveland have a depth of 100 to 130 feet. The strait (Mastgat) between the islands of Tholen and North Beveland is

also very deep. The Sloe, an arm of the Western Scheldt between Walcheren and South Beveland, and also both sides of the dyke connecting South Beveland with North Brabant, are silting up; the Braakman, a southern arm of the Western Scheldt, is fast drying up. The difference of level between ebb and flood tide is at Flushing 12, at Antwerp 14, feet.

Schenectady, a city of New York, U.S.A., capital of Schenectady county. It is situated in 42° 47′ N. and 73° 57′ W., in the valley of the river Mohawk, 17 miles north-west of Albany, in the eastern part of the state, at an altitude of 246 feet. It is irregularly laid out, the older and business part of the city being in the valley, while the newer and residential portion is built on higher land in the rear. Its water-supply is pumped and filtered. The city is reached by branches of the Delaware and Hudson and the New York Central and Hudson River railways. The manufacturing interests are very important. There are extensive locomotive, electrical, and agricultural implement works, besides foundries, car works, planing mills, and clothing factories of various kinds. It is the seat of Union College (founded 1795), which had in 1900 a faculty of 24 and was attended by 184 students. Population (1890), 19,902; (1900), 31,682, of whom 7169 were foreign-born and 127 negroes. Of 11,093 males 21 years of age and over, 656 were illiterate (could not write).

Scherer, Edmond Henri Adolphe (1815–1889), French theologian, critic, and politician, was born in Paris, 8th April 1815. After a course of legal studies he found himself strongly attracted to theology, and spent several years in theological study at Strasburg, where he graduated and was ordained. In 1843 he was appointed to a professorship in the École Evangélique at Geneva, but the development of his opinions, which were becoming strongly in favour of the Liberal movement in Protestant theology, led to his resigning the post six years later. Having had already some experience of journalism, he now settled in Paris, where he at once attracted attention by brilliant literary criticisms contributed to the *Revue des Deux Mondes* and other journals. He was elected municipal councillor at Versailles in 1870, deputy to the National Assembly for the department of Seine-et-Oise in 1871, and senator in 1875. As a politician he was a steady supporter of the Republican party. Towards the end of his life he devoted himself mainly to literary and general criticism, and was for many years one of the ablest contributors to *Le Temps*. His critical work is marked by keen insight, individuality, and remarkable lucidity of expression. He was a frequent visitor to England, and took a lively interest in English politics and literature. He died at Versailles, 16th March 1889. His chief works are: *Dogmatique de l'église réformée* (1843), *De l'état actuel de l'église réformée en France* (1844), *Esquisse d'une théorie de l'église chrétienne* (1845), *La Critique et la Foi* (1850), *Alexandre Vinet* (1853), *Lettres à mon Curé* (1853), *Études critiques sur la littérature contemporaine* (1863), *Études critiques de littérature* (1876), *Diderot* (1880), *La Démocratie et la France* (1883), *Études sur la littérature au xviii^e^ siècle* (1891). A memoir of him, by V. C. O. Gréard, appeared in 1890. (R. F. S.)

Scheveningen, a fishing village and fashionable watering-place in the Dutch province of South Holland, 2 miles north-west of The Hague, with which it is connected by the old and the new road, and by horse, steam, and electric tramways. Among modern buildings is the large Kurhaus (1886), with a Kursaal accommodating 2900 guests. Many villas have been built for the requirements of about 20,000 annual visitors, chiefly Dutch and Germans. The fishing fleet comprises about 200 boats, and a new fisher-haven is to be constructed at the mouth of the Hague–Scheveningen Canal. Population (1900), about 20,000.

Schiedam, a manufacturing town and seaport in the Dutch province of South Holland, near the influx of the Schie into the Maas. In 1899 there were 190 grain and 141 other distilleries, producing the "Geneva" or Dutch gin (Hollands). The yeast and the grain refuse of the distilleries form an article of export. Population (1900), 27,081.

Schimmel, Hendrik Jan (1825– ——), Dutch poet and novelist, was born 30th June 1825, at 'S Graveland, in the province of North Holland, where his father was a notary and the burgomaster. From 1836 to 1842 young Schimmel served his apprenticeship in his father's office, and upon his death he was taken into the office of the agent of the Dutch Treasury in Amsterdam, exchanging the work in 1849 for a post with the Dutch Trading Company there. In 1863 he became a director of the Amsterdam Credit Association. His first volume of poems appeared in 1852; but it is as a writer of historical dramas in blank verse, and one of the regenerators of the Dutch stage, that his literary position was made. His finest production is his *Struensee* (1868), which was preceded by *Napoleon Bonaparte* (1851) and *Juffrouw Serklaas* ("Mrs Serklaas," 1857). Among his other dramatic works may be mentioned *Joan Woutersz* (a drama, 1847), *Twee Tudors* ("Two Tudors," 1847), *Gondelbald* (1848), *Schuld en Boete* ("Guilt and Retribution," a drama, 1852), *Het Kind van Staat* ("The State Child," a dramatic fragment, 1859); *Zege na Strijd* ("Struggle and Triumph," a drama, 1878). Schimmel's renderings of Casimir de la Vigne's *Louis XI.*, Geibel's *Sophonisbe*, and Ponsard's *Lucrèce* are also still acted in the Netherlands. His novels are distinguished by their vigorous style and able characterization. The earlier, better-known ones betray the writer's English proclivities. The plots of *Mary Hollis* (1860, 3 vols.; English translation, London 1872, under the title of "Mary Hollis, a Romance of the Days of Charles II. and William, Prince of Orange," 3 vols.) and of *Mylady Carlisle* (1864, 4 vols.) are laid in England, whereas those of his *Sinjeur Semeyns* (1875, 3 vols.), a powerful picture of the terrible year 1672, and of *De Kapitein van de Lijfgarde* (1888, 3 vols.; English adaptation, 1896, under the title of "The Lifeguardsman," 1 vol.), a continuation of "Master Semeyns," are almost entirely centred in the Holland of those stirring days. He had many points of style and manner in common with Madame Bosboom-Toussaint, though both remained highly original in their treatment. Both exhausted their foreign themes and heroes, and finally reverted to essentially national subjects. To the earlier romances of Schimmel belong: *Bonaparte en zyn Tyd* ("Bonaparte and his Time," 1853), *De Eerste Dag eens Nieuwen Levens* ("The First Day of a New Life," 2 vols., 1855), *Sproken en Vertellingen* ("Legends and Tales," 1855), *Een Haagsche Joffer* ("A Hague Damsel," 1857), *De Vooravond der Revolutie* ("The Eve of the Revolution," 1866). Schimmel was an early collaborator of Potgieter on the *Gids* staff. His dramatic works appeared in a collected edition in 1885–86 at Amsterdam (3 vols.), followed by a complete and popular issue of his novels (Schiedam, 1892).

Schizomycetes. See Bacteriology.

Schlan (Czech, *Slaný*), the chief town of a district in Bohemia, Austria, about 40 miles north-west of Prague,

on the railway between the latter town and Brüx. There are extensive coal-fields and important iron, metal, and machine industries, together with the manufacture of chemicals and corn-milling. Population (1890), 9115; (1900), 9494, Czechs.

Schleiz, a town of Germany, second capital of the principality of Reuss the Younger, 20 miles by rail west by north of Plauen (in Saxony). Here are two royal residences, an old church, with the burial vaults of the reigning princes, a deaf and dumb asylum, teachers' seminary, wood-carving school, and various small industries (toys, belts, &c.). Population (1900), 5331.

Schleswig, a town of Prussia, capital of the province of Schleswig-Holstein, 29 miles north-west of Kiel. In 1894 the tower of the cathedral was carried up to 368 ft. The town possesses provincial lunatic and deaf and dumb asylums, and numerous modern monuments to local celebrities. There are tanneries, breweries, flour and saw-mills. Population (1895), 17,253; (1900), 17,909.

Schleswig-Holstein, the most north-westerly province of Prussia, with an area of 7337 square miles, and population (1890), 1,219,523; (1900), 1,387,587, of whom 701,583 were males and 686,004 females; the density being 189 inhabitants to the square mile. The population of the northern circles is still predominantly Danish; the total Danish population of the province being (in 1890) 134,064, as compared with 144,400 at the date of the conquest in 1864. In the circle of Hadersleben 88 per cent. of the population are Danes, in circle Sonderburg 85 per cent., in Apenrade 82 per cent., in Tondern 49 per cent. In these four circles 83·5 per cent. of the children attending school in 1891 spoke Danish as their mother tongue, and only 11·4 per cent. spoke German; whilst 5·1 per cent. spoke both languages. The live stock in 1900 included 897,615 cattle, 611,003 pigs, 235,469 sheep, and 184,658 horses. The sugar factories in 1900 produced 5800 tons of sugar; the breweries, 35,128,200 gallons of beer; and the distilleries, 933,100 gallons of pure alcohol. In 1900 the province owned a mercantile fleet of 770 sea-going vessels of 182,797 tons. The principal ports are Altona, Kiel, Flensburg, Neumühlen, Sonderburg, Wyck, Tönning, and Heligoland. In 1892 Dr Eugen Traeger called attention[1] to the perilous condition of the smaller of the North Frisian Islands, called *halligen;* and in 1896 measures were taken to protect them against the encroachment of the North Sea by warping them (*e.g.*, Oland and Langenes) together, and binding them in the same way to the mainland. For this purpose the Prussian Government voted a sum of £66,000 (see *Globus*, 1896, pp. 290–293). Since 1872 an area of 4000 acres has been reclaimed from the sea in South Dithmarsh, at the south-western extremity of the province, and additional areas were enclosed in 1900 and subsequent years. Altogether 16,000 acres were enclosed between 1785 and 1899.

Schliemann, Heinrich (1822–1890), known to the general world for his archæological discoveries at Hissarlik and Mycenæ, and held in special honour by scholars as the first who let in clear light upon the prehistoric civilization of the Greek lands, was born on 6th January 1822 at Neu Buckow, in Mecklenburg-Schwerin, the son of a poor pastor. He has stated in his autobiography that through all his early years of struggle, when he was successively grocer's apprentice at Fürstenberg, cabin-boy on the *Dorothea* bound for Venezuela, and, after her wreck, office attendant and then book-keeper in Amsterdam, he nourished a passion for the Homeric story and an ambition to become a great linguist. In the end, thanks to an unusually powerful memory and a determined energy, which would have made him remarkable in any line of life, he acquired a knowledge of seven or eight tongues besides his own, including ancient and modern Greek. The foundation of his fortune was laid by the house of B. H. Schröder of Amsterdam, which in 1846 sent him to St Petersburg, where he established a business of his own and embarked in the indigo trade. He made a fortune at the time of the Crimean war, partly as a military contractor. Being accidentally present in California, when made a state of the Union in 1850, he became and remained an American citizen. After travels in Greece, Tunis, India, China, and Japan, and writing a short sketch of the last two countries, he took his large fortune to Greece in 1868, and proceeded to visit Homeric sites. In an ensuing book—*Ithaka, der Peloponnes, und Troja*—he propounded two theories which he was destined eventually to test in practice, viz., that Hissarlik, not Bunarbashi, was the site of Troy, and that the Atreid graves, seen by Pausanias at Mycenæ, lay within the citadel wall. Two years later he took up Mr Calvert's work on the former site, and, convinced that Troy must be on the lowest level, hewed his way down, regardless of the upper strata, wherein lay unseen the remains of which he was really in search. By 1873 he had laid bare considerable fortifications and other remains of a burnt city of very great antiquity, and discovered a treasure of gold jewellery. We now know this city to have belonged to the middle pre-Mycenæan period, long prior to the generation of Homer's Achæans; but Schliemann far and wide proclaimed it "Troy," and was backed by Mr Gladstone and a large part of the European public. Trying to resume his work amid universal attention in February 1874, he found himself inhibited by the Ottoman Government, whose allotted share of the gold treasure had not been satisfactory, and it was not till April 1876 that he obtained a *firman*. During the delay he issued his *Troy and its Remains* (1875), and betook himself to Mycenæ, the other object of his early plans. There in August 1876 he began work in the Dome-tombs and by the Lion Gate, and opened a large pit just within the citadel. The famous double ring of slabs and certain stone reliefs came to light. Schliemann, thinking it was only a platform levelled as a place of Achæan assembly, paused, and did not resume till November. Then, resolved to explore to the rock, he cleared away some three feet more of earth and stones, and lighted on the five shaft graves which have placed him first among fortunate excavators. A sixth grave was found immediately after his departure. The immense treasure of gold, silver, bronze, fine stone and ivory objects, which was buried with the sixteen corpses in this circle, is worth intrinsically more than any treasure trove known to have been found in any land, and it revealed once for all the character of a great civilization preceding the Hellenic. The find was deposited at Athens, and gradually cleaned and arranged in the Polytechnic; and the discoverer, publishing his *Mycenæ* in English in 1877, had his full share of honours and fame. He had now settled in Athens. There he married a Greek lady, and there successively he built two splendid houses, which became centres of Athenian society. In 1878 he dug in Ithaca, but unsuccessfully, and in the same year and the following resumed work at Hissarlik, and summed up his results in a discursive memoir, *Ilios*, upon which a sequel, *Troja*, issued in 1884,

[1] In *Die Halligen der Nordsee* (Stuttgart, 1892), being part of vol. vi. of A. Kirchhoff's *Forschungen zur Deutschen Landes- und Volks-kunde;* also *Globus*, vol. lxxviii. (1900), No. 15; and Christian Jensen, *Vom Dünenstrand der Nordsee und vom Wattenmeer* (Schleswig, 1901).

after Wilhelm Dörpfeld, associated in 1882, had introduced some archæological method into the explorations, was a considerable improvement. In 1880 and 1881 Schliemann cleared out the ruined dome-tomb of Orchomenus, finding little except remains of its beautiful ceiling; and in 1885, with Dörpfeld, he laid bare the upper stratum on the rock of Tiryns, presenting scholars with a complete ground plan of a Mycenæan palace. This was his last fortunate excavation. While Tsountas, for the Greek Archæological Society, picked up his work at Mycenæ in 1886, and gradually cleared the Acropolis, with notable results, Schliemann tried for traces of the Cæsareum at Alexandria, of the Palace of Minos at Knossos, in Crete, and of the Aphrodite temple at Cythera (1888); but he was not successful, meeting in the two former enterprises with a local opposition which his wealth was unable to bear down. In 1889 he entertained at Hissarlik a committee of archæological experts, deputed to examine Bötticher's absurd contention that the ruins represented not a city, but a cremation necropolis; and he was contemplating a new and more extensive campaign on the same site when, in December 1890, he was seized at Naples with an illness which ended fatally on the morning of Christmas Day. His great wealth was left mainly to the two families that he had in Russia and Greece; but a sum was reserved for Hissarlik, where Dörpfeld in 1891 and 1892, by clearing away the débris of the former excavations, exposed the great walls of the sixth stratum which Schliemann had called Lydian, and proved their synchronism with Mycenæ, and identity with Mycenæan remains; that is to say, with Homer's Troy, if Troy ever was.

Schliemann was on several occasions in England, in 1883 to receive honours from the great universities, and in 1886 to confute, at a special gathering of the Hellenic Society, the assertion of Stillman and Penrose that the Tirynthian palace was posterior to the Christian era. Nowhere was he better appreciated, and most of his books were first issued in English. (D. G. H.)

Schlüsselburg, a district town and fortress of Russia, in the government and 40 miles east of the city of St Petersburg, at the issue of the Neva from Lake Ladoga, situated on low ground surrounded by marshes. It was founded in 1323 by the Novgorodians, and though afterwards lost by Russia, was reconquered by Peter the First. It has a fortress, built on an island in the Neva, which is now used as a political prison. Population (1897), 5285.

Schmerling, Anton von (1805–1893), Austrian statesman, was born on 23rd August 1805 at Vienna, where his father held a high position on the judicial side of the civil service. After studying law at the university of Vienna, in 1829 he entered the public service, and during the next eighteen years was constantly occupied, chiefly in Lower Austria. In 1847, as a member of the lesser nobility, he entered the Estates of Lower Austria, with which he had already had some connexion in his official work, and took an active part in the Liberal movement for administrative and constitutional reform of which they were the centre. On the outbreak of the revolution in Vienna in March 1848, when the mob broke into the Assembly, Schmerling was one of the deputation which carried to the palace the demands of the people, and during the next few days he was much occupied in organizing the newly formed National Guard. At the end of the month he was sent by the ministry to Frankfort as one of the men of "public confidence." For the next year he was one of the leading figures in the city which was the centre of the German revolution. He soon succeeded Count Colleredo as president of the Diet, and in this capacity officially transferred to the Archduke John, the "administrator" of the country, the powers of the Diet. For this he was violently attacked in the Assembly by the extreme Radicals; but on this and other occasions (he had himself been elected to the Assembly) he defended moderate and constitutional principles, all the more effectively because he depended not on eloquence but on a recognition of what has been called the "irony of facts"—to which the Assembly as a whole was so blind. He was the first and the most influential member of the ministry which the administrator formed; he held the ministry of the interior and, later, also that of foreign affairs, and it was almost entirely due to him that at least for a short time this phantom government maintained some appearance of power and dignity. A defeat in the Assembly when he defended the armistice of Malmö led to his resignation; but he was immediately called to office again, with practically dictatorial power, in order to quell the revolt which broke out in Frankfort on 18th September. His courage and resolution averted what nearly became a terrible catastrophe. It was his hope to establish in Germany the supremacy of a Liberal and reformed Austria. This brought him into opposition to the party of Prussian supremacy; and when they attained a majority, he resigned, and was succeeded by Gagern. He remained at Frankfort, holding the post of Austrian envoy, and was the leader of the so-called Great German party. This position he resigned when the dissolution of the Austrian Parliament showed that the forces of reaction had conquered at Vienna, and shattered all hopes of Austria attaining the position he had hoped for her. After the abortive election of the king of Prussia to be emperor, he, with the other Austrians, left Frankfort. He was at the time one of the most unpopular men in Germany, but his conduct in the extremely difficult position he had held for the last year caused him to be regarded as the most promising of the younger generation of Austrian officials. On his return to Vienna he became minister of justice, and the reforms which he carried out added to his reputation. His popularity among all Liberals was increased by his resignation in 1851, as a protest against the failure of the Government to establish the constitution they had promised. During the next few years he was judge of the supreme court of appeal. When his forecast was fulfilled and the system of absolutism broke down, it was natural that he should be summoned to power. He became minister in January 1862, and his first act was the publication of the celebrated constitution by which the whole of the empire was to be organized as a single state with a parliamentary government. The experiment failed, chiefly because of the opposition of the Croatians and Magyars, whom he bitterly offended by his celebrated saying that "Hungary could wait." Faults of manner, natural in a man whose life had been spent as an official and a judge, prevented him from keeping together the German Liberals as a strong and united party; he was opposed by a powerful faction at court, and by the Clerical leaders. After the first few months the emperor gave him only a very lukewarm support; and with his retirement in 1865 the attempt to carry out the ideals of Joseph II. to Germanize while he liberalized the whole of the empire, and to compel Hungarians, Poles, Czechs, and Croatians to accept a system in which the government of the whole should be carried on by a German-speaking Parliament and bureaucracy, failed. The constitution of 1862, though suspended on Schmerling's fall, was still regarded as legally valid for the cis-Leithan territories, and is the basis on which the present constitution for half the empire was framed. Schmerling, therefore, not only in

the ideas which he upheld, but in the practical working out of them, was one of the most influential Austrian statesmen of the 19th century. On his retirement he returned to his judicial duties; in 1867 he was made life-member of the Upper House in the Reichsrath, of which he became vice-president, and in 1871 president. This post he laid down in 1879, and came forward as leader of the Liberal German opposition to the administration of Count Taaffe. In 1891 he retired from public life, and died at Vienna on the 23rd of May 1893.

Schmerling married, in 1835, Pauline, daughter of Field-Marshal-Lieutenant Baron von Koudelka. Frau von Schmerling, who was distinguished by literary and artistic abilities, at that time rare in the Austrian capital, died in 1840, leaving two daughters.

AUTHORITIES.—ARNETH, *Anton v. Schemerling.* Prague, 1895. (This contains a full account of Schmerling's life during 1848–49, but does not deal with his later life.)—WURZBACH. *Biographisches Lexicon des Kaiserthums Oesterreich.*—FRIEDJUNG. *Der Kampf um die Vorherrschaft in Deutschland.*—ROGGE. *Geschichte Oesterreichs.* (J. W. HE.)

Schneidemühl, a town of Prussia, province of Posen, 60 miles by rail north of Posen. It has three churches, a synagogue, and a deaf and dumb asylum. Considerable damage was done to the town in 1893 by a violent overflow of water from a deep artesian well. Machinery is made here. Population (1885), 12,406; (1900), 19,656.

Schofield, John McAllister (1831– ——), American soldier, was born in Chautauqua county, N.Y., 29th September 1831, and graduated at the U.S. Military Academy in 1853. He was assistant professor at West Point, 1855–60, and while on leave (1860–61) filled the chair of physics at Washington University, St Louis. When the Civil War broke out he became major in a Missouri volunteer regiment, and served on General Lyon's staff until the death of that brilliant officer; was brigadier-general of volunteers, November 1861, and performed various duties in Missouri (1861–64), rising to major-general, 29th November 1862. In February 1864 he commanded the Missouri department; and, transferred in April to General Sherman, his corps remained with General Thomas when Sherman left Atlanta for the sea. He won the battle of Franklin, 30th November 1864; fought again at Nashville, 15th December 1864, and was promoted to brigadier-general in the regular army. Ordered next to North Carolina, he occupied Wilmington, 22nd February 1865; and joined Sherman at Goldsboro in March for the final capture of Johnston's army. After the war he served in various departments: was secretary of war *ad interim*, June 1868–March 1869; and then appointed major-general. He commanded the United States army, 1888–95; was made lieutenant-general, February 1895, that grade having been revived; and retired in September of that year.

Schönbach, a small town in the government district of Eger, in North Bohemia. It is remarkable from the circumstance that it is almost exclusively devoted to the manufacture of musical instruments. It produces annually nearly 100,000 violins and violoncellos, 14,000 guitars, &c., and 7000 wind instruments, in addition to accordeons, harmonicas, &c. Population (1890), 3639; (1900), 4157.

Schönberg, or MÄHRISCH-SCHÖNBERG (Czech, *Šumperk*), the chief town of a district in Moravia, on the river Tess, a tributary of the March. It has an important textile industry, including linen, silk, and cotton goods. Population (1890), 10,493; (1900), 11,636, almost exclusively German and Catholic.

Schönfeld, Eduard (1828–1891), German astronomer, was born at Hildburghausen, in the duchy of Meiningen, on the 22nd December 1828. He had a distinguished career at the gymnasium of his native town, and on leaving desired to devote himself to astronomy, but abandoned the idea in deference to his father's wishes. He went first to Hanover, and afterwards to Cassel to study architecture, for which he seems to have had but little inclination. In 1849 we find him studying chemistry under Bunsen at Marburg, where his love for astronomy, never quite cooled, was revived by Gerling's lectures. In 1851 he visited the Bonn Observatory, and, expressing to Argelander an earnest wish to study astronomy under him, was received with open arms. In 1853 he was appointed assistant, and in the following year won a distinguished doctor's degree with his treatise *Nova Elementa Thetidis.* At Bonn he took an important part in preparing the *Durchmusterung* of the northern heavens. He was indefatigable as an observer and critical in discussing results, thinking no labour too great in the pursuit of his favourite study. He took up vigorously the investigation of the light-changes in variable stars, devoting to this work nights which, on account of moonlight, were unsuitable for zone observations. The results of these researches are published in the *Sitz. Berich. Wien. Akad.* vol. xlii. For a short time he was a *privat-docent* at Bonn, but in 1859 he was appointed director of the Mannheim Observatory. The instrumental equipment of that observatory was somewhat antiquated, his largest telescope being a small refractor of 73 lines aperture, but he selected a line of work to suit the instruments at his disposal, observing nebulæ and variable stars and keeping a watch on comets and new planets. The results of his observations of nebulæ are contained in two catalogues published in the *Astronomische Beobachtungen der Grossherzoglichen Sternwarte zu Mannheim*, 1st and 2nd parts (1862 and 1875), and those of his variable star obvervations appeared in the *Jahresberichte des Mannheimer Vereins für Naturkunde*, Nos. 32 and 39 (1866 and 1875). On the death of Argelander, which occurred on 17th February 1875, Schönfeld was appointed to succeed him as director of the Bonn Observatory, and soon after his appointment he began his last and greatest piece of work, the extension, on Argelander's plan, of the survey of the heavens down to 23° of south declination. The experience gained on the northern survey under Argelander's direction enabled Schönfeld to introduce some improvements in the methods employed, which increased the accuracy and added considerably to the value of this work, which was practically accomplished in March 1881, some revision only remaining to be done. These zone observations afforded 363,932 separate places of stars, and form the groundwork of the catalogue of 133,659 stars between 2° and 23° south declination, which was published in 1886 as the eighth volume of the Bonn observations.

Schönfeld was a member of the Astronomische Gesellschaft from its foundation in 1863, being a member of Council up to 1869, and in 1875 becoming editor of its publications and secretary in conjunction with Winnecke. In the latter capacity he was brought into friendly relations with many fellow-workers in his own subject. In 1878 he was elected a Foreign Associate of the Royal Astronomical Society. In 1887, as delegate of the Prussian Government, he attended the first Paris Congress for the Photographic Survey of the Heavens. In 1864 he was present at the celebration of the 25th anniversary of the Pulkowa Observatory, and again, in 1889, he was sent, on behalf of the Prussian minister of education, to convey the congratulations of German astronomers on the occasion of the jubilee of that observatory. Illness prevented him from attending the meeting of the Astronomische Gesellschaft in the same year at Brussels, whither the Watson

medal had been sent to him from America. He died, after a long and painful illness, on 1st May 1891. (A. A. R*.)

Schöningen, a town of Germany, duchy of Brunswick, 29 miles by rail west of Magdeburg. It has a salt-mine and brine spring, lignite mines, and chemical and iron-works. The place is mentioned in the year 747, and still possesses remains of a ducal castle, 17th-century wooden houses, and a 15th-century church. Population (1885), 6921; (1900), 8460.

Schools of Art. See ART-TEACHING.

SCHOOLS OF PAINTING.

BRITISH.

At the beginning of the last quarter of the 19th century British art was held to be in a vigorous and authoritative position. During the years immediately preceding, it had been developing with regularity and had displayed a vitality which seemed to be full of promise. It was supported by a large array of capable workers; it had gained the widest recognition from the public; and it was curiously free from those internal conflicts which diminish the strength of an appeal for popular appreciation. There were then few sharp divergences or subdivisions of an important kind. The leadership of the Royal Academy was generally conceded, and its relations with the mass of outside artists were little wanting in cordiality. One of the chief reasons for this understanding was that at this time an almost unprecedented approval was enjoyed by nearly all classes of painters. Picture-collecting had become a general fashion, and even the youngest workers received encouragement directly they gave evidence of a reasonable share of capacity. The demand was equal to the supply; and though the number of men who were adopting the artistic profession was rapidly increasing, there seemed little danger of over-production. Pictorial art had established upon all sorts of people a hold too strong, as it seemed, to be affected by change of fashion. All pointed in the direction of a permanent prosperity.

Subsequent events provided a curious commentary on the anticipations which were reasonable enough in 1875. That year is now seen to have been, not the beginning of an era of unexampled success for British pictorial art, but rather the culminating point of preceding activity. During the period which has succeeded we have witnessed a rapid decline in the popular interest in picture-painting and a marked alteration in the conditions under which artists have had to work. In the place of the former sympathy between the public and the producers, there grew up something which almost approached indifference to their best and sincerest efforts. Simultaneously there developed a great amount of internal dissension and of antagonism between different sections of the art community. As an effect of these two causes, a new set of circumstances came into existence, and the aspect of the British school underwent a radical change. Many art workers found other ways of using their energies. The slackening of the popular demand inclined them to experiment, and to test forms of practice which formerly were not accorded serious attention, and it led to the formation of detached hostile groups of artists always ready to contend over details of technical procedure. Restlessness became the dominant characteristic of the British school, along with some intolerance of the popular lack of sympathy.

The first sign of the coming change appeared very soon after 1875. The right of the Royal Academy to define and direct the policy of the British school was disputed in 1877, when the Grosvenor Gallery was started "with the intention of giving special advantages of exhibition to artists of established reputation, some of whom have previously been imperfectly known to the public." This exhibition gallery was designed not so much as a rival to the Academy, as to provide a place where could be collected the works of those men who did not care to make their appeal to the public through the medium of a large and heterogeneous exhibition. As a rallying place for the few unusual painters, standing apart from their fellows in conviction and method, it had good reason for existence; and that it was not regarded at Burlington House as a rival was proved by the fact that among the contributors to the first exhibition were included Sir Francis Grant, the President of the Royal Academy, and such artists as Leighton, Millais, G. F. Watts, Alma-Tadema, G. D. Leslie, and E. J. Poynter, who were at the time Academicians or Associates. With them, however, appeared such men as Burne-Jones, Holman Hunt, Walter Crane, W. B. Richmond, and J. McN. Whistler, who had not heretofore obtained the publicity to which they were entitled by the exceptional quality and intention of their work. There was doubtless some suggestion that the Academy was not keeping touch with the more important art movements, for shortly after the opening of the Grosvenor Gallery there began that attack upon the official art leaders which has been one of the most noteworthy incidents in recent art history in Great Britain. The initial stage of this conflict ended about 1886, when the vehemence of the attack had been weakened, partly by the withdrawal of some of the more prominent "outsiders," who had meanwhile been elected into the Academy, and partly by the formation of smaller societies, which afforded the more "advanced" of the younger men the opportunities which they desired for the exposition of their views. In a modified form, however, the antagonism between the Academy and the outsiders has continued. The various protesting art associations continue to work in most matters independently of one another, with the common belief that the dominant influence of Burlington House is not exercised entirely as it should be for the promotion of the best interests of British art, and that it maintains tradition against the development of individualism and a "new style."

The Grosvenor Gallery and the Academy.

Meanwhile the policy of the Academy (*q.v.*) has undergone some little change. As things have turned out, there is evidence that the agitation in all branches of art effort has not been entirely without result even inside Burlington House. Some of the older academic views have been modified, and changes seriously discussed, which formerly would have been rejected as opposed to all the traditions of the society. Its calmness under attack, and its ostentatious disregard of the demands made upon it by the younger and more strenuous outsiders, have veiled a great deal of shrewd observation of passing events. It may be said that the Academy has known when to break up an organization in which it recognized a possible source of danger, by selecting the ablest leaders of the opposition to fill vacancies in its own ranks; it has given places on its walls to the works of those reformers who were not unwilling to be represented in the annual exhibitions; and it has, without seeming to yield to clamour, responded

perceptibly to the pressure of professional opinion. In so doing, though it has not checked the progress of the changing fashion by which the popular liking for pictorial art has been diverted into other channels, it has kept its hold upon the public, and has not to any appreciable extent weakened its position of authority.

Changed conditions of British art.

It is doubtful whether a more definite participation by the Academy in the controversies of the period would have been of any use as a means of prolonging the former good relations between artists and the collectors of works of art. The change is the result of something more than the failure of one art society to fulfil its entire mission. The steady falling off in the demand for modern pictures has been due to a combination of causes which have been powerful enough to alter nearly all the conditions under which British painters have to work. For example, the older collectors, who had for some years anterior to 1875 bought up eagerly most of the more important canvases which came within their reach, could find no more room in their galleries for further additions; again, artists, with the idea of profiting to the utmost by the keenness of the competition among the buyers, had forced up their prices to the highest limits. But the most active of all causes was that the younger generation of collectors did not show the same inclination that had swayed their predecessors to limit their attention to modern pictorial art. They turned more and more from pictures to other forms of artistic effort. They built themselves houses in which the possibility of hanging large canvases was not contemplated, and they began to call upon the craftsman and the decorator to supply them with what was necessary for the adornment of their homes. At first this modification in the popular taste was scarcely perceptible, but with every successive year it became more marked in its effect.

Latterly more money has been spent by one class of collectors upon pictures than was available even in the best of the times which have passed away; but this lavish expenditure has been devoted not to the acquisition of works by modern men, but to the purchase of examples of the old masters. Herein may often be recognized the wish to become possessed of objects which have a fictitious value in consequence of their rarity, or which are "sound investments." Evidence of the existence of this spirit among collectors is seen in the prevailing eagerness to acquire works which inadequately represent some famous master, or are even ascribed to him on grounds not always credible. The productions of minor men, such as Henry Morland, who have never been ranked among the masters, receive an amount of attention which is quite out of proportion to what merits they possess, if only they can be proved to be scarce examples, or historically notorious. All this implies in the creed of the art patron a change which has necessarily reacted on living painters and on the conditions of their art production.

Portraiture.

These, then, are the conclusions to which we are led by a comparison of the movements which affected the British school between 1875 and 1902. To a wide appreciation of all types of pictorial art has succeeded a grudging and careless estimate of the value of the bulk of artistic endeavour. Only a few branches of production are still encouraged by anything approaching an efficient demand. Portraiture is the mainstay of the majority of the figure painters; it has never lost its popularity, and may be said to have maintained satisfactorily its hold upon all classes of society, for the desire to possess personal records is very general and is independent of any art fashion. It has persisted through all the changes of view which have been increasingly active in recent years. In 1902 the hope of any marked revival in other branches of picture-painting might well seem somewhat remote. Episodical art, illustrating sentimental motives or incidents with some touch of dramatic action, remained popular, because it had some degree of literary interest; but imaginative works and pictures which had been produced chiefly as expressions of an original regard for nature, or of some unusual conviction about technical details, found comparatively few admirers. The one hopeful sign was that the designers and the workers in the decorative arts were finding opportunities which formerly were denied to them. They had more scope for the display of their ingenuity and more inducement to exercise their powers of invention. It was, indeed, not unreasonable to assume that the first stages were being witnessed in the development of a vigorous and influential school of design which in the near future would evolve work of originality and excellence. Already British designers had gained a hearing abroad, and had earned emphatic approval in countries where a sound decorative tradition had been maintained for centuries; so that there seemed to be the germ of vitality in a movement which had scarcely had time as yet to give more than a hint of its possibilities.

Episodical art.

Decorative art.

Wane of Pre-Raphaelitism and rise of French influence.

Not only in matters affecting the relations between artists and the public has the period been full of change, but also in the convictions of the workers themselves, and in some surprising educational departures. The one dominant influence, that of the Pre-Raphaelite Brotherhood, which in the 'fifties altered the whole complexion of British art, had begun to wane early in the 'seventies, and it was rapidly being replaced by another scarcely less distinctive. The younger generation of artists had wearied, even before 1875, of the Pre-Raphaelite precision, and were impatient of the restrictions imposed upon their freedom of technical expression by a method of practice which required laborious application and unquestioning obedience to a rather formal code of regulations. They yearned for greater freedom and boldness, and for a better chance of asserting their individual capacities. So they gave way to a strong reaction against the creed of their immediate predecessors, and cut themselves deliberately adrift.

With the craving of young artists for new forms of technique came also the idea that the "old-master traditions" were opposed to the exact interpretation of nature, and were based too much upon convention to be adapted for the needs of men who believed that absolute realism was the one thing worth aiming at in picture-production. So Paris became the educational centre instead of Rome. There was to British students, dissatisfied with the half-hearted and imperfect systems of teaching with which they were tantalized at home, a peculiarly exhilarating atmosphere in the French studios—an amount of enthusiasm and a love of art for its own sake without parallel elsewhere. They saw in operation principles which led by the right sequence of stages to sure and certain results. In these circumstances they allowed their sympathies with French methods to become rather exaggerated, and were somewhat reckless in their adoption of both the good and bad qualities of so attractive a school.

At first the results of this breaking-away from all the older educational customs were not wholly satisfactory. British students came back from France better craftsmen, stronger and sounder draughtsmen, more skilful manipulators, and with an infinitely more correct appreciation of refinements of tone-management than they had ever possessed before; but they brought back also a disproportionate amount of French mannerism and a number

of affectations which sat awkwardly upon them. In the first flush of their conversion they went farther than was wise or necessary, for they changed their motives as well as their methods. The quietness of subject and reserve of manner which had been hitherto eminently characteristic of the British school were abandoned for foreign sensationalism and exaggeration of effect. An affectation of extreme vivacity, a liking for theatrical suggestion, even an inclination towards coarse presentation of unpleasant incidents from modern life—all of which could be found in the paintings of the French artists who were then recognized as leaders—must be noted as importations from the Paris studios. They were the source of a distinct degeneration in the artistic taste, and they introduced into British pictorial practice certain unnatural tendencies. Scarcely less evident was the depreciation in the instinctive colour-sense of British painters, which was brought about by the adoption of the French habit of regarding strict accuracy of tone-relation as the one important thing to aim at. Before this there had been a preference for rich and sumptuous harmonies and for chromatic effects which were rather compromises with, than exact renderings of, nature; but as the foreign influence grew more active, these pleasant adaptations, inspired by a sensuous love of colour for its own sake, were abandoned for more scientific statements. The colder and cruder tone-studies of the modern Frenchmen became the models upon which the younger artists based themselves, and the standards against which they measured their own success. "Actuality" was gained, but much of the poetry, the delicacy, and the subtle charm which distinguished British colourists in the 'fifties was lost.

Danger of the French influence.

For some while there was a danger that the art of Great Britain might become hybrid, with the French strain predominating. So many students had succumbed to the fascination of a system of training which seemed to supply them with a perfect equipment on all points, that they were inclined to despise not only the educational methods of their own country, but also the inherent characteristics of British taste. The result was that the exhibitions were full of pictures which presented English people and English landscape in a purely arbitrary and artificial manner, strictly in accordance with a French convention which was out of sympathy with British instincts, and indeed, with British facts. Ultimately a discreet middle course was found between the extreme application of the science of the French art schools and the comparative irresponsibility in technical matters which had so long existed in the British Isles. In the careers of men like Stanhope Forbes, H. S. Tuke, Frank Bramley, and other prominent members of the school, many illustrations are provided of the way in which this readjustment has been effected. Their pictures, if taken in a sufficiently long sequence, summarize instructively the course of the movement which has been so active since 1875. They prove how valuable the interposition of France has been in the matter of artistic education, and how much Englishmen have improved in their understanding of the technique of painting.

Weakening of the French influence.

One noteworthy outcome of the triumph of common sense over fanaticism must be mentioned. Now that the exact relation which French teaching should bear to British thought has been adjusted, an inclination to revive the more typical of the forms of pictorial expression which have had their vogue in the past is becoming increasingly evident. Picturesque domesticity is taking the place of theatrical sensation, the desire to select and represent what is more than ordinarily beautiful is ousting the former preference for what was brutal and ugly, the effort to please is once again stronger than the intention to surprise or shock the art lover. Even the Pre-Raphaelite theories and practices are being reconstructed, and quite a considerable group of young artists is springing up who are avowed believers in the principles which were advocated so strenuously in 1850.

Groups within the British school.

To French intervention can be ascribed the rise and progress of several movements which have had results of more than ordinary moment. There was a few years ago much banding together of men who believed strongly in the importance of asserting plainly their belief in the doctrines to which they had been converted abroad; and as a consequence of this desire for an offensive and defensive association, many detached groups were formed within the boundaries of the British school. Each of these groups had some peculiar tenet which it sought to advocate, and each one had a small orbit of its own in which it revolved, without concerning itself much about what might be going on outside. Roughly, there were three classes into which British artists could then be divided. One included those men who were in the main French in sympathy and manner; another consisted of those who were not insensible to the value of the foreign training, but yet did not wish to surrender entirely their faith in the British tradition; and the third, and smallest, was made up of a few individuals who were independent of all assistance from without, and had sufficient force of character to ignore what was going on in the art world. In this third class there was practically no common point of view: each man chose his own direction and followed it as he thought best, and each one was prepared to stand or fall by the opinion which he had formed as to the true function of the painter. Necessarily, in such a gathering there were several notable personalities who may fairly be reckoned among the best of English modern masters.

The Newlyn school.

Perhaps the most conspicuous of the groups was the collection of painters who established themselves in the Cornish village of Newlyn. This group—"The Newlyn School," as it was called—was afterwards much modified, and many of its most cherished beliefs were considerably altered. In its beginning it was essentially French in atmosphere, and advocated not only strict adherence to realism in choice and treatment of subject, but also the subordination of colour to tone-gradation, and the observance of certain technical details, such as the exclusive use of flat brushes and the laying on of pigments in square touches. The colony was formed, as it were, in stages; and as the school is to be reckoned in the future history of the British school, the order in which the adherents arrived may here be set on record. Edwin Harris came first, and was joined by Walter Langley. Then, in the following order, came Ralph Todd, L. Suthers, Fred Hall, Frank Bramley, and T. C. Gotch, and Percy Craft and Stanhope Forbes together. H. Detmold and Chevallier Tayler next arrived; then Miss Elizabeth Armstrong (Mrs. Stanhope Forbes), F. Bourdillon, W. Fortescue, and Norman Garstin. Ayerst Ingram, H. S. Tuke, H. Martin, and F. Millard were later visitors. The earlier leaders of this school were said to have chosen Newlyn as their working centre because the prevailing greyness in the atmosphere of the place facilitated their interpretation of subleties of tone. Almost the only one of the original set who in 1902 remained at Newlyn was Stanhope Forbes (b. 1857), who was trained at the Lambeth School and at the Royal Academy, and afterwards in Bonnat's studio in Paris. His best known pictures are "A Fish Sale on a Cornish Beach" (1885), "Soldiers and Sailors" (1891), "Forging the Anchor" (1892), and "The Smithy" (1895). He was elected an Associate of the Royal Academy in 1892. Frank Bramley (b. 1857) studied art in the Lincoln School of Art and at Antwerp. He gained much popularity by his pictures "A Hopeless Dawn" (1888), "For of such is the Kingdom of Heaven" (1891), and "After the Storm" (1896), and was elected an Associate in 1894. Of late years he has made a very definite departure from the technical methods which he followed in his earlier period. T. C. Gotch (b. 1854) had a varied art training; for he worked at the Slade School, then at Antwerp, and finally in Paris under Jean Paul Laurens. He did not long remain faithful to the Newlyn creed, but diverged about 1890 into

a kind of decorative symbolism, and subsequently devoted himself entirely to pictures of this type. The other men who must be ranked as supporters of the school adhered closely enough to the principles which were exemplified in the works of the leaders of the movement. They were faithful realists, sincere observers of the facts of the life with which they were brought in contact, and quite earnest in their efforts to paint what they saw, without modification or idealization. Their art was honest, but too material and uninspired to gain a permanent hold upon any but a small section of the public. The Newlyn school has ceased to be an association of artists sharing a common conviction or possessing a united aim. The name continues, but it is used now chiefly as the title of an art colony settled in the village, and including a varied assemblage of workers who have gathered there because the neighbourhood is rich in picturesque material. But Newlyn will always have a place in art history as the headquarters of a movement which proposed to effect a drastic reform in British art.

The Impressionist school. Another group which received its inspiration directly from France was the Impressionist school (see IMPRESSIONISM). This group never had any distinct organization like that of the French Société des Impressionistes, but among the members of it there was a general agreement on points of procedure. They based themselves, more or less, upon prominent French artists like Manet, Renoir, Pissarro, and Claude Monet, and owed not a little to the example of J. McN. Whistler, whose own art may be said to be in a great measure a product of Paris. One of the fundamental principles of their practice is the subdivision of colour masses into their component parts, and the rendering of gradated tints by the juxtaposition of touches of pure colour upon the canvas, rather than by attempting to match them by previously mixing them on the palette. In pictures so painted greater luminosity and more subtlety of aërial effects can be obtained. The works of the British Impressionists have been seen mostly in the exhibitions of the New English Art Club.

The New English Art Club. This society was founded in 1885 by a number of young artists who wished for facilities for exhibition which they felt were denied to them in the other galleries. It drew the greater number of its earlier supporters from the men who had been trained in foreign schools, and a complete list of the contributors to its exhibitions includes the names of many of the best known of the younger painters. It was the meeting-place of numerous groups which advocated one or other of the new creeds, for among its members or exhibitors can be counted P. Wilson Steer, Fred Brown, J. S. Sargent, Solomon J. Solomon, Stanhope Forbes, T. C. Gotch, Frank Bramley, Arthur Hacker, Francis Bate, Moffat Lindner, J. L. Henry, W. W. Russell, George Thomson, Arthur Tomson, Henry Tonks, C. W. Furse, R. Anning Bell, Walter Osborne, Laurence Housman, J. J. Shannon, W. L. Wyllie, H. S. Tuke, Maurice Greiffenhagen, G. P. Jacomb Hood, Alfred Parsons, Alfred East, J. Buxton Knight, C. H. Shannon, Mark Fisher, Walter Sickert, W. Strang, Frank Short, Edward Stott, Mortimer Menpes, Alfred Hartley, William Stott, J. R. Reid, Mouat Loudan, T. B. Kennington, H. Muhrman, A. D. Peppercorn, George Clausen, and J. McN. Whistler, and a number of the Scottish artists, like J. Lavery, J. Guthrie, George Henry, James Paterson, A. Roche, E. A. Walton, J. E. Christie, and E. A. Hornel. A number of the men who have been more or less actively identified with it have been elected members of the Royal Academy, so that it may fairly claim to have exercised a definite influence upon the tendencies of modern art. It has certainly done much to prove the extent of the foreign influence upon the British school, and it has summarized instructively the varieties of artistic practice and point of view which have been so noteworthy during recent years. That there has been latterly a change in the atmosphere of its exhibitions is due to the new conditions which prevail in the art world. It reflects the steadying of conviction and the reaction towards a more national style which are affecting British artists as a mass. It shows less the undiluted influence of France, and much more of that growing, or rather vaguely expressed, desire for individuality which suggests now that British painters recognize the futility of trying to transplant to their country a mode of thought unsuited to their innate convictions and at variance with their mental traditions and with their own temperament.

In its wider sense the Impressionist school may be said to include now all those students of nature who strive for the representation of broad effects rather than minute details, who look at the subject before them largely and comprehensively, and ignore all minor matters which would be likely to interfere with the simplicity of the pictorial rendering. To it can be assigned a number of artists who have never adopted, or have definitely abandoned, the prismatic analysis of colour advocated by the French Impressionists. These men are headed by J. McN. Whistler (*q.v.*), born in America in 1835, and trained in Paris under Gleyre. His pictures have always been remarkable for their beauty of colour combination, and for their sensitive management of subtleties of tone. They have gained for the artist a place among the chief modern executants, and have attracted to him a host of followers. Other notable painters who have places in the school are Mark Fisher, an American landscape painter who studied for a while in Gleyre's studio, one of the ablest interpreters in England of effects of sunlight and breezy atmosphere; A. D. Peppercorn, a pupil of Gérôme, who makes landscapes a medium for the expression of a dignified sense of design and a carefully simplified appreciation of contrasts of tone; and P. Wilson Steer, an artist who began as a follower of Monet, and has based upon his training in the École des Beaux Arts a style of his own, which he displays effectively in both landscapes and figure pictures. In its pure form Impressionism has not gained much hold upon British painters, but in a certain degree some of its principles have affected a great number of men who cannot be strictly considered as avowed believers in the teachings of the school.

Figure painters. Generally speaking, the very large class of artists who fell only to a limited extent under the spell of French teaching includes most of the figure and landscape men and practically the whole of the portrait painters. In all sections of the figure school individual workers of improved technical methods have appeared, but most of them have gradually lost their distinguishing peculiarities of manner, and have year by year assimilated themselves more closely to their less advanced brethren. The section in which their energetic propagandism has been most effective is certainly that of imaginative composition. A definite mark has been made there by men like S. J. Solomon (b. 1860), trained at the Royal Academy Schools, the Munich Academy, and the École des Beaux Arts in Paris, elected an Associate of the Academy in 1896, and widely known by such pictures as "Samson" (1887), "The Judgment of Paris" (1890), and the "Birth of Love" (1895); and Arthur Hacker (b. 1858), educated at the Academy and in Bonnat's studio, elected an Associate in 1894, and the painter of a considerable series of semi-historical and symbolical canvases. They have exercised a considerable influence upon their contemporaries, and have introduced some new elements into the later practice of the school. But at the same time admirably effective work has been done in this section and others by many painters who have kept much more closely in touch with the older type of æsthetic belief, and have not associated themselves openly with any of the newer movements. Among the more prominent of these figure painters there are, or have been, some excellent craftsmen, whose contributions to the record of native British art can be accepted as full of permanent interest. In the school of historical incident good work was done by Sir John Gilbert (1817–1897), a robust and ingenious illustrator of romantic motives, with a never-failing capacity for picturesque invention; John Pettie (1839–1893), a fine colourist and a clever manipulator, whose scenes from the life of past centuries were full of rare vitality; P. H. Calderon (1833–1898), a graceful and sincere artist not wanting in originality; and H. Stacy Marks (1829–1898), who treated mediæval motives with a touch of real humour. Besides these, there are Sir J. D. Linton (b. 1840), who has produced many fine compositions in oil and water colours; Frank Dicksee (b. 1853), elected an Associate of the Royal Academy in 1881 and an Academician in 1891, who has gained wide popularity by pictures in which romance and sentiment are combined in equal proportions; A. C. Gow (b. 1848), a member of the Academy since 1881, whose "Cromwell at Dunbar" (1886), "Flight of James II. after the Battle of the Boyne" (1888), and "Crossing the Bidassoa" (1896) may be noted as typical examples of his performance; J. Seymour Lucas (b. 1849), trained at the Royal Academy Schools, elected an Associate in 1886 and an Academician in 1898, and a brilliant painter of what may be called the by-play of history; W. Dendy Sadler (b. 1854), trained partly in London and partly at Düsseldorf, and well known by his quaintly humorous renderings of the lighter side of life in the olden times; G. H. Boughton (born in England, but educated first in America and afterwards in Paris), elected an Associate in 1879 and an Academician in 1896, and long recognized as a specialist in paintings of old and modern Dutch subjects; the Hon. John Collier (b. 1850), trained at the Slade School, at Munich, and in Paris, and a capable painter both of the nude figure and of costume; and Edwin A. Abbey, an American (b. 1852), educated at the Pennsylvania Academy of the Fine Arts. Abbey came to England in 1876 with a great reputation as an illustrator, but did not begin to exhibit oil pictures until 1890; he was elected an Academician in 1898. Then there are to be noted classicists like Lord Leighton, Sir L. Alma-Tadema, Sir E. J. Poynter, and Edwin Long (1839–1891), a student of the East like Frederick Goodall (*b.* 1822), elected an Associate in 1853 and an Academician in 1863; and an idealist like Sir W. B. Richmond—all of whom have done much to uphold the reputation of the British school for strength of accomplishment and variety of motive.

The painters of sentiment have in the main adhered closely to the tradition which has been handed down through successive generations. They were headed in 1902 by Marcus Stone (b. 1840), elected

an Academician in 1887, an original artist whose dainty fancies are familiar to students of modern art. His pictures have nearly all appeared in the exhibitions of the Royal Academy, to which institution he has been consistently faithful. Another popular artist is G. D. Leslie (b. 1835), elected an Associate in 1868 and an Academician in 1876, who has been responsible for a number of domestic subject pictures remarkable for freshness of treatment and delicacy of feeling. The list may also be held to include Henry Woods (b. 1846), elected Associate of the Royal Academy in 1882 and Academician 1893, and since 1877 a painter of scenes from Venetian life; R. W. Macbeth (b. 1848), elected an Associate in 1883, whose elegant treatment of rustic subjects displays a very attractive individuality; E. Blair Leighton (b. 1853), who has occupied himself chiefly with imaginative motives which combine historical romance with sentiment; and P. R. Morris (1833–1902), elected an Associate 1877, who in his earlier career dealt with modern life poetically and with graceful simplicity. Among the painters of sentiment may perhaps also be included Luke Fildes (b. 1844), educated at the South Kensington and Royal Academy Schools, elected an Academician in 1887, the painter of such famous pictures as "The Casual Ward" (1874), "The Widower" (1876), "The Return of the Penitent" (1879), and "The Doctor" (1892); and Hubert von Herkomer (b. 1849), elected an Associate in 1879 and Academician 1890, famous not only by his many memorable canvases and by his extraordinary versatility in the arts, but also as a teacher and a leader in a number of educational movements.

Painters of sentiment.

Military painting.

Not many military pictures of high merit have been produced during the period. The artists, indeed, who occupy themselves with this class of art are not numerous, and they mostly devote their energies to illustrative pictures rather than large canvases. Lady Butler (*née* Elizabeth Thompson), whose "Roll Call," exhibited in 1874, brought her instantaneous popularity, continued to paint subjects of the same type, among which "Quatre Bras" (1875), "The Defence of Rorke's Drift" (1881), "The Camel Corps" (1891), and "The Dawn of Waterloo" (1895), are perhaps the most worthy of record. Ernest Crofts (b. 1847), trained in London and Düsseldorf, has taken a prominent position by such pictures as "Napoleon at Ligny" (1875), "Napoleon Leaving Moscow" (1887), "The Capture of a French Battery by the 53rd Regiment at Waterloo" (1896), and by many similar representations of historical battles; he was elected an Associate in 1878, an Academician in 1896, and became Keeper of the Royal Academy. Occasional pictures have come also from A. C. Gow (see above), R. Caton Woodville, W. B. Wollen, J. P. Beadle, and a few more men who are better known by their work in other directions; but the sum total of military paintings is inconsiderable.

Portraiture.

The number of artists who have devoted the greater part of their energies to portraiture has been steadily on the increase. Most of the men who have taken definite rank among the figure painters have made reputations by their portraits also, but there are many others who have kept almost exclusively to this branch of practice. Into the first division come such noted artists as Sir John Millais, Sir E. J. Poynter, G. F. Watts, Luke Fildes, Hubert von Herkomer, Sir L. Alma-Tadema, Sir W. B. Richmond, Seymour Lucas, the Hon. John Collier, S. J. Solomon, Arthur Hacker, W. Q. Orchardson, J. M'N. Whistler, Frank Dicksee, Stanhope Forbes, Frank Bramley, H. S. Tuke, T. C. Gotch, P. W. Steer, and Frank Holl. In the second must be reckoned J. S. Sargent, an American (b. 1856), a pupil of Carolus Duran, elected an Associate in 1894 and an Academician 1897, who after 1885 was recognized as one of the most brilliant portrait painters of the day; J. J. Shannon, also an American (b. 1862), trained at the South Kensington School, and elected an Associate in 1897, a graceful and accomplished artist, with a sound technical method and a delightful sense of style; A. S. Cope (b. 1857), trained in Paris, and elected an Associate in 1899, who carries on soundly the better traditions of the British school; James Sant (b. 1820), elected an Academician in 1870, a strong favourite of the public throughout a long career; W. W. Ouless (b. 1848), elected an Associate in 1877 and an Academician in 1881, trained in the Royal Academy Schools, an industrious and prolific worker; H. T. Wells (b. 1828), trained in London and Paris, elected Associate in 1866 and Academician in 1870, who has produced a long series of portraits and portrait groups, and many miniatures; W. Llewellyn (b. 1860), educated at the South Kensington School and in Cormon's studio in Paris, an able draughtsman and a thorough executant; C. W. Furse (b. 1868), trained first in the Slade School under Professor Legros and afterwards in Paris, one of the strongest of the younger men; and others like Walter Osborne, Richard Jack, Ralph Peacock, H. de T. Glazebrook, and J. H. F. Bacon. Generally, the school of Portraiture can be praised for its sturdy vitality. It has thrown aside most of the empty conventions by which it was once hampered; and it has gained from the French influence just enough freshness of idea to increase in the right way its power of initiative and to enhance the value of its effort. The men who belong to it are plainly convinced of the necessity for bringing to bear upon their work a proper spirit of investigation. They observe far more closely than their predecessors of half a century ago, and they analyse and depict character with a much shrewder perception of shades of individuality. But the school as a whole has lost none of its British essentials: it has, indeed, recovered much of the breadth and dignity which made it so remarkable in the 18th century, and has advanced in understanding of technical devices.

Individual figure painters.

In the class of figure painters, who are individual in their work, and owe little or nothing to the suggestions of foreign teachers, a number of artists can be enumerated who have in common little besides a sincere desire to express their personal conviction in their own way. Among them are some of the most distinguished of modern artists, who stand out as the unquestioned chiefs of the school. Sir John Millais occupies a place in this group by virtue of his admirable pictorial work, and with him are W. Holman Hunt, Dante Gabriel Rossetti, G. F. Watts, Sir Edward Burne-Jones, Albert Moore, and Ford Madox Brown, each one of whom may be regarded as a leader. There are also J. M. Strudwick, R. Spencer Stanhope, and Evelyn de Morgan, who are followers of Burne-Jones, and J. W. Waterhouse, elected an Associate of the Royal Academy 1885 and an Academician in 1895, in many ways the most original and inspired of English imaginative painters, and, again, M. Greiffenhagen and Mrs Swynnerton. Into this class come also the decorative painters, Walter Crane (b. 1845), practically self-educated—a prolific illustrator and picture-painter and the producer of an extraordinary amount of work in all branches of decoration; Frank Brangwyn, a young artist whose pictures and designs are marked by fine qualities of execution and by much sumptuousness of colour; W. Reynolds-Stephens, a painter and sculptor of well-deserved repute; and several others, like H. J. Draper, Harold Speed, R. Anning Bell, Gerald Moira, and G. Spencer Watson, who are rapidly coming to the front. As a branch of the decorative school, a small group of artists who are trying to revive the practice of *tempera-painting* must also be noted. It includes Mrs Adrian Stokes, J. D. Batten, J. E. Southall, Arthur Gaskin, and a few others with well-marked decorative tendencies.

Decorative painters.

The new Pre-Raphaelite school.

During the last few years a movement has begun which apparently aims at the revival of Pre-Raphaelitism. It is headed by a few young artists, whose methods show a mingling together of the precision of the 19th century Pre-Raphaelites and a kind of decorative formality. As yet it has not approached the laborious exactness of the earlier school, and has not arrived at that minute realization of crowded detail which was characteristic of the small knot of painters who formed the Pre-Raphaelite Brotherhood, but it has contented itself rather with a suggestion of close and careful observation—a deceptive appearance of finish. Earnest and serious in artistic intention, it may be regarded as a protest against the looser and more audacious technical practice which has resulted from the French influence, and as a reaction from the foreign teaching towards what is more in the nature of a British tradition. The most influential of the artists concerned in the formation of this new school is Byam Shaw, whose originality and quaintness of fancy give to his pictures a more than ordinary degree of persuasiveness. He is a strong colourist and an able draughtsman, and he possesses in a high degree the faculty of imaginative expression, allied with humour that never degenerates into farce. His strongest preference is for symbolical subjects which embody some moral lesson. Another prominent member of the group is Miss Eleanor Fortescue-Brickdale, who is in manner much like Byam Shaw, but yet does not sink her individuality in mere imitative effort; and others are F. Cayley Robinson and Isobel Gloag. It is too early to forecast the future progress of this group, but in 1902 it had already taken a certain position among the more active of the organizations into which the British school was subdivided.

Landscape painters.

The painters of landscapes and sea pictures have for the most part been little affected by the unrest which has caused so many new departures in figure-work. A love of nature has always been one of the best British characteristics, and it has proved itself to be strong enough to keep those artists who seek their inspiration out of doors from falling to any great extent under the control of particular technical fashions. Therefore there is in the school of "open-air" painting little evidence of any change in point of view, or of the growth of any modern feeling at variance with that by which masters of landscape were swayed a century or more ago. Impressionism has gained a few adherents, and the French Barbizon school—itself created in response to suggestion from England—has reacted upon a small section of the younger artists. But, on the whole, in this branch of art the British school has gained in power and confidence, without surrendering that sturdy

independence which in the past produced such momentous results. The absence of any common convention, or of any set pattern of landscape which would lead to uniformity of effort, has left the students of nature free to express themselves in a personal way. The most devout believers in the value of French training, and in the infallibility of the dogmas which emanate from the Paris studios, have not, except in rare instances, demanded any radical remodelling of the British landscape school on French lines, as local conditions affecting the practice of this branch of art make impossible all drastic alterations. What modifications there have been have tended chiefly in the direction of wider choice of subject and increased freedom of executive method; and now most workers in the front rank can claim to be judged on individual merits, and not as a member of a particular coterie. Still, it is convenient to divide the members of the landscape school into such classes as realists, romanticists, and painters of subjective landscape.

Realistic landscape.

Among the most notable of the first class are H. W. B. Davis (b. 1833), elected an Associate in 1873, and an Academician in 1877, the painter of a long series of dainty scenes which suggest happily the charm of rural England; Peter Graham elected an Academician in 1881, who has alternated for the greater part of his working life between Scottish moorland subjects, with cattle wandering on bare hill-sides, and pictures of coast scenery, with sea-gulls perched on dark rocks; David Murray (b. 1849), elected an Associate of the Royal Academy in 1891, an artist whose career has been marked by consistent effort to interpret nature's suggestions with dignity and intelligence; Sir Ernest A. Waterlow (b. 1850), trained in the Royal Academy Schools, elected an Associate in 1890, and afterwards President of the Royal Society of Painters in Water-Colours, a graceful painter, with a tender colour feeling and an excellent technical style; Yeend King (b. 1855), trained partly in England and partly in Paris under Bonnat and Cormon, a sound craftsman who has made a reputation by landscapes in which are introduced groups of figures on a fairly important scale; Alfred Parsons (b. 1847), elected an Associate in 1897, who paints rich river scenery with careful regard for actuality and with much minuteness and exquisiteness of detail, especially in the rendering of flowers; and Frank Walton (b. 1840), who chooses, as a rule, landscape motives which enable him to display unusual powers of accurate draughtsmanship. To the same class of realists belong several deceased painters, like Vicat Cole, Birket Foster, J. W. Oakes, Keeley Halswelle, and perhaps Alfred W. Hunt, though in his case realism was tempered by a delicate poetic imagination.

Romantic and pastoral painters.

The romanticists and pastoral painters have been perceptibly affected by the example of the Barbizon school, but they owe much to such famous Englishmen as Cecil Lawson, John Linnell (both of whom died in 1882), George Mason (d. 1872), and Frederick Walker (d. 1875). In 1902 a large number of very able artists could be included in this section of the landscape school, and this number seemed likely to be greatly increased as years went on. The most prominent member of the group is, perhaps, Alfred East (b. 1849), trained first in the Glasgow School of Art and afterwards in Paris, elected an Associate in 1899, a painter with an exceptional faculty for suggesting the poetry of nature, and endowed with an admirable sense of decorative arrangement; but there are, besides, Leslie Thomson (b. 1851), whose art is especially sound and sincere; J. Aumonier, a pastoral painter with very refined appreciation of subtleties of aërial colour; C. W. Wyllie, a painter of delicate vision and charm of presentation; J. S. Hill, whose sombre landscapes are distinguished in design and impressive in their depth of tone; R. W. Allan (b. 1852), who uses a robust technical method with equal skill in landscapes and coast subjects; J. Buxton Knight, (*b.* 1842), a vigorous manipulator, with a liking for rich harmonies and low tones; Joseph Knight (b. 1838), practically self-taught, whose well-drawn and broadly painted pictures in oil and water-colour have been for many years appreciated by lovers of unaffected nature; Lionel P. Smythe, elected an Associate of the Royal Academy in 1898, a colourist who handles exquisitely the most delicate atmospheric effects and is unusually successful in his rendering of quiet, diffused daylight; J. W. North, elected an Associate in 1893, a painter of fanciful landscapes in which definition of form is subordinated to modulations of decorative colour; Claude Hayes, who studied in the Royal Academy Schools, and has carried on consistently for some years the tradition established by David Cox and his contemporaries; J. L. Pickering, a lover of dramatic light-and-shade contrasts and a student of romantic mountain scenery; A. D. Peppercorn, who gives breadth and dignity, with sombre colour and delicate gradation of tone; Adrian Stokes and M. Ridley Corbet, who died in 1902, only a few months after his election as an Associate of the Royal Academy, a classicist in landscape, in whose pictures can be perceived a definite reflection of the teaching of Professor Costa, the Italian master. There must also be noted, as leaders among the pastoral painters, George Clausen (b. 1852), trained first in the South Kensington School and afterwards in Paris under Bouguereau and Robert-Fleury, and elected an Associate in 1895, who began as a strict realist and has developed since into a rustic idealist; H. H. La Thangue, trained in the Royal Academy Schools and in Paris, elected an Associate in 1898, an artist of amazing technical vigour, and an uncompromising interpreter of rural subjects; Edward Stott, trained in Paris under Carolus-Duran and Cabanel, who paints delicately the more poetic aspects of the life of the fields; and Arnesby Brown, a pupil of Professor von Herkomer, who has taken latterly a very prominent place among the younger artists—his picture "Morning" was bought in 1901 by the Chantrey Fund Trustees, and "River Bank" in 1902 for the Guildhall Art Gallery.

Subjective landscape.

The painters of subjective landscape, who conventionalize nature with the idea of giving to their pictures a kind of sentimental suggestion, are most strikingly represented by B. W. Leader (b. 1831), trained in the Worcester School of Design and in the Royal Academy Schools, and elected an Academician in 1898. He is a strong favourite of the public, and his somewhat formal and precise technical methods are widely admired by the many people who are not satisfied with unaffected transcriptions of natural scenes.

Marine painting.

In marine painting no one has appeared to rival Henry Moore, perhaps the greatest student of wave-forms the world has ever known; but good work was being done in 1902 by the Irish painter, Edwin Hayes, a veteran whose powers showed no sign of failure after some half-century of continuous labour; W. L. Wyllie (b. 1851), trained in the Royal Academy Schools, and elected an Associate in 1889, who paints sea and shipping with intelligent understanding; T. Somerscales, a self-taught artist, with an intimate knowledge of the ocean derived from long actual experience as a sailor; C. Napier Hemy (b. 1841), trained at the Antwerp Academy and in the studio of Baron Leys, elected an Associate in 1898, a powerful manipulator, with a preference for the dramatic aspects of his subject; and J. C. Hook, who retained into old age the subtle qualities which made his pictures notable among the best productions of the British school. Of the men who have fallen out of the ranks, mention must be made of John Brett (1830–1902), the one Pre-Raphaelite sea painter, and Hamilton Macallum (1841–1896), who painted rippling water in bright sunlight with delightful delicacy and charm of manner.

Animal painting.

The school of animal painting is a small one, and includes only a few of marked ability. The chief members include Briton Riviere, one of the most imaginative and inventive of living artists; J. M. Swan, trained first at Lambeth, and afterwards in Paris under Gérôme and Frémiet, elected an Associate of the Royal Academy in 1894, a skilful manipulator and a sensitive draughtsman, and especially remarkable for his intimate understanding of animal character, especially of the *felidæ* (see also SCULPTURE); J. T. Nettleship (1841–1902), trained chiefly in the Slade School, whose studies of the greater beasts of prey are admirably sincere and well painted; Miss Lucy Kemp-Welch (b. 1869), trained in the Herkomer School at Bushey, who paints horses with unusual power; and John Charlton (b. 1849), trained in the South Kensington School, also well known by his pictures of horses.

Scottish schools.

There are some local schools which have a right to attention because of the value of their contributions to the aggregation of British art. One of the most active of these is the Scottish school, with its centres at Glasgow and Edinburgh, which has produced some of the most distinguished British artists. The Royal Academy, indeed, with most of the other leading art societies, has been largely recruited from Scotland. There have been added to its modern roll the names of W. Q. Orchardson, Peter Graham, J. MacWhirter, J. Pettie, Erskine Nichol, T. Faed, David Murray, Colin Hunter, R. W. Macbeth, J. Farquharson, all of them painters of well-established reputation; and outside the Academy there are many well-known Scottish artists, who have made London their headquarters, like Arthur Melville, a portrait and subject painter and a masterly water-colourist; E. A. Walton, who is equally successful with portraits, landscapes, and decorative compositions; J. Coutts-Michie, who alternates between portraiture and landscapes of admirable quality; John Lorimer, who has exhibited a number of excellent subject pictures and many fine portraits; T. Graham, an unaffected painter of sentiment and a good colourist; Grosvenor Thomas, known best by his freely handled and expressive landscapes; T. Austen Brown, who paints semi-decorative pastorals with unusual vigour of statement; John Lavery, who has taken rank among the best of the younger portrait painters; and Robert Brough, another portrait painter of vigour, with a subtle sense of colour. The most notable of the men who still remain in Scotland include Alexander Roche, whose remarkable capacity has brought him many successes in portraiture, figure compositions, and decorative paintings on a large scale; W. Y. MacGregor, a

leader of the school of landscape painters, fine in style and a master of effect; D. Y. Cameron, an admirable oil painter and a famous etcher; George Henry, Harrington Mann, and James Guthrie, well known by their excellent portraits; James Paterson, R. B. Nisbet, Robert Noble, R. Macaulay Stevenson, and David Farquharson, all landscape painters of marked originality and sound technical method; W. McTaggart, an impressionist who is regarded as a leader of the school; E. A. Hornel and W. Hole, decorative painters who have produced many canvases remarkable for robust originality and rare breadth of treatment; W. Mouncey, a landscape painter who united the dignity of the Barbizon school with a typically Scottish freedom of expression; and Sir George Reid, one of the ablest and most distinguished of portrait painters.

The chief characteristics which all these artists have in common are unusual directness and readiness of brushwork, remarkable subtlety of tone-management, and great sensitiveness to modulations of delicate colour. They are brilliant craftsmen, and are eminently sincere in their regard for nature's suggestions; and as a school they show a unanimity of artistic conviction which keeps them closely in touch without leading them into excess of convention.

Water-colour. The water-colour painters can fairly be said to have kept unchanged the essential qualities of their particular form of practice. They have departed scarcely at all from the executive methods which have been recognized as correct for nearly a century, but they have amplified them and have adapted them to a greater range of accomplishment, developing, it may be added, the "blottesque" or accidental manner suggestive of summary decision. Latterly water-colour painting has come to rival oils in its application to all sorts of subjects; and it is used now with absolute freedom by a very large number of skilful artists. Many of the men who have done the best work in this medium are known as oil painters of the highest rank; and among living workers the same capacity to excel in either mode of expression is by no means uncommon. There have been in recent times such masters as Sir John Gilbert, Sir E. Burne-Jones, Ford Madox Brown, Dante Gabriel Rossetti, A. W. Hunt, H. G. Hine, Henry Moore, Albert Moore, C. E. Holloway, and, perhaps, E. M. Wimperis, whose water-colours are at least as worthy of admiration as their oil pictures. As water-colourists, much credit is due to Sir E. J. Poynter for his landscapes, portraits, and figure drawings, Sir L. Alma-Tadema for his minutely detailed classic subjects, Sir J. D. Linton for his historical and romantic compositions, Sir E. A. Waterlow for his delicately expressive landscapes, Hubert von Herkomer for his admirably handled figure subjects, George Clausen for pastorals charming in sentiment and distinguished by fine qualities of colour, J. Aumonier, A. D. Peppercorn, J. S. Hill, J. W. North, Leslie Thomson, Frank Walton, and R. W. Allan for landscapes of special excellence, E. J. Gregory for figure compositions painted with amazing sureness of touch, Alfred Parsons for landscapes and flower studies, J. R. Reid, W. L. Wyllie, E. Hayes, and C. N. Hemy for sea and coast pictures, R. W. Macbeth, Claude Hayes, and Lionel Smythe for rustic scenes with figures in the open air, J. M. Swan for paintings of animals, and G. H. Boughton for costume subjects and delicately poetic fancies. Besides, there is a long list of noteworthy painters whose reputations have been chiefly or entirely made by their successful management of water-colour, and into this list come Birket Foster, the head of the old-fashioned school of dainty rusticity; Carl Haag, a wonderful manipulator, who occupied himself almost exclusively with Eastern subjects; Thomas Collier, A. W. Weedon, H. B. Brabazon, G. A. Fripp, P. J. Naftel, G. P. Boyce, Albert Goodwin, R. Thorne-Waite, F. G. Cotman, Harry Hine, Clarence Whaite, and Bernard Evans, whose landscapes show thorough understanding of nature and distinctive individuality of method; Mrs Allingham, an artist of exquisite refinement, whose idealizations of country life have a more than ordinary degree of merit; Clara Montalba, an able painter of impressions of Venice; Kate Greenaway, unrivalled as an interpreter of the graces of childhood, and endowed with the rarest originality; Mrs Stanhope Forbes, an accomplished executant of well-imagined romantic motives; and J. R. Weguelin, one of the most facile and expressive painters of fantastic figure subjects. By the aid of these artists, and many others of hardly less ability, such as J. Crawhall, J. Paterson, R. Little, and J. Walter West, traditions worthy of all respect are being maintained sincerely and with intelligent discrimination; and to their efforts has been accorded a larger measure of popular support than is bestowed upon any other form of pictorial production.

Books upon the British School of Painting are numerous, and a vast number of biographies and autobiographies of painters have been published, all bearing on the subject. Of the first-named class the following may be enumerated:—

RICHARD MUTHER. *The History of Modern Painting* (English edition, 1895).—R. DE LA SIZERANNE. *English Contemporary Art* (English edition, 1898).—ERNEST CHESNEAU. *The English School of Painting* (2nd English edition, 1885).—CLEMENT and HUTTON. *Artists of the 19th Century* (Boston, U.S.A., 1885).—DAVID MARTIN and F. NEWBERY. *The Glasgow School of Painting* (1897).—E. PINNINGTON. *George Paul Chalmers and the Art of his Time* (1896).—GLEESON WHITE. *The Master Painters of Britain* (1897).—E. T. COOK. *A Popular Handbook to the National Gallery*, vol. ii. (1901).—J. E. HODGSON, R.A. *Fifty Years of British Art* (1887).—A. G. TEMPLE. *Painting in the Queen's Reign* (1897).—COSMO MONKHOUSE. *British Contemporary Artists* (1899).—G. R. REDGRAVE. *History of Water-Colour Painting in England, 1750–1889* (1889).

See also the *Transactions* of the National Association for the Advancement of Art (Liverpool 1888, Edinburgh 1889, and Birmingham 1890); the magazines devoted to the arts—The *Portfolio*, the *Magazine of Art*, the *Art Journal*, and the *Studio*; and the principal reviews, such as "English Art in the Victorian Age" (*Quarterly Review*, January 1898). (M. H. S.)

FRANCE.

The period between 1870 and the end of the 19th century was singularly important in the history of France, and consequently of her art. The internal life of the people developed on new lines with a vigour that left a deep mark on the outcome of mental effort. Literature was foremost in this new movement. The novels of Balzac, Zola, Flaubert, the brothers de Goncourt, Daudet, Guy de Maupassant, and the plays of Alexandre Dumas *fils*, filled as they are with the scientific spirit and social atmosphere of the time, opened the eyes of the young generation to appreciation of the visible beauty and the spiritual poetry of the world around them, and helped them to view it with more attentive eyes, more insight, and more emotion. The aim of art was also to emancipate itself, by the growing efforts of independent artists, from the slavery of tradition, and to devote itself to a more personal contemplation and knowledge of contemporary life under every aspect. Modern French art tends to become more and more the art of the people—a mixture of naturalism and poetry, deriving its inspiration, by preference, from the world of the working man; no longer appealing only to a restricted and more or less fastidious public, but, on the contrary, adapting its æsthetic or moral teaching to popular apprehension. The whole past was not, of course, wiped out. The younger generation had to learn and profit by the lessons taught by their great precursors. To understand the true character of this recent development of French art it is needful, therefore, to glance at the past.

We need not dwell on the individual authorities who constitute the official hierarchy of the contemporary French school; these masters belong for the most part, by the date of their best work, to a former generation. Starting in many cases from very opposite points, but reconciled and united by time, they carried on, during the last quarter of the 19th century, with more or less distinction, the inevitable evolution of their personal gifts. We still see the works of some of the staunch Romanticists: Jean Gigoux (d. 1892), Robert Fleury (d. 1890), Jules Dupré (d. 1889), Lami (d. 1890), Cabat (d. 1893), and Isabey (d. 1886); and with these, though they did not follow quite the same road, may be named Français (d. 1897) and Charles Jacque (d. 1894). Next to them, Meissonier (d. 1891) crowded into the last twenty years of his life a mass of work which, for the most part, enhanced his fame; and Rosa Bonheur (d. 1899), working in retirement up to the age of seventy-seven, went on her accustomed way unmoved by external changes. Hébert, Harpignies, Ziem, and Paul Flandrin survived. Among the generation which grew up under the Second Empire we find men of great intelligence and distinction; some, like Alexandre Cabanel (1824–89), by pictures of historical genre, in a somewhat insipid and conventional style, but more particularly by female portraits, firm in flesh-paint-

ing and aristocratic in feeling; others, like Paul Baudry (1828–86, *q.v.*), whose large decorative works, with their pure and lofty elegance, secured him lasting fame, and whose allegorical compositions were particularly remarkable; not less so his portraits, at first vivid, glowing, and golden, but at the end of his life, under the influence of the new atmosphere, cooler in tone, but more eager, nervous, and restless in feeling. Léon Gérôme (b. 1824, *q.v.*) was the orginator, during the Second Empire, of the Neo-Greek idea, an Orientalist and painter of historic genre, whose somewhat arid instinct for archæological precision and finish developed to better ends in sculpture during later years. William Bouguereau (b. 1825, *q.v.*) painted symbolical and allegorical subjects in a sentimental style. Jules Lefebvre (b. 1836) had a brilliant career as a portrait painter, combined, in his earlier years, with admirable studies of the nude. These were followed by Benjamin Constant (d. 1902), a clever painter of past ages in the East and of modern Oriental life, who latterly directed his powers of vigorous and rapid brushwork to portrait-painting; Fernand Carmon, the inventive chronicler of primeval Gaul, and a solid and learned portrait painter; Aimé Morot, a man of versatile gifts, a painter of portraits full of life and ease. These formed the heart of the Institut. On the other hand, we find a group who betray a close affinity with the realist party—rejecting, like them, tradition at second-hand, though returning for direct teaching to some of the great masters: Léon Bonnat (b. 1833), educated in Spain, and preserving through a long series of official portraits an evident worship of the great realists of that nation; and again, under the same influence, Jean Paul Laurens (b. 1837), who has infused some return of vitality into historical painting by his clear and individual conceptions and realistic treatment. Jean Jacques Henner (b. 1829, *q.v.*), standing even more apart, lived in a Correggio-like dream of pale nude forms in dim landscape scenery. His love of exquisite texture, and his unvarying sense of beauty, with his refined dilettantism, link him on each side to the great groups of realists and idealists.

About the middle of the 19th century, after the vehement disputes between the partisans of line and the votaries of colour, otherwise the Classic and the Romantic schools, when a younger generation was resting from these follies, exhausted, weary, devoid even of any fine technique, two groups slowly formed on the opposite sides of the horizon —seers, or dreamers, both, protesting in different ways against the collapse of the French school, and against the alleged indifference and sceptical eclecticism of the painters who were regarded as the leaders. This was a revolt from the academic and conservative tradition. One was the group of original and nature-loving painters, keen and devoted observers of men and things, the realists, made illustrious by the three great personalities of Corot (*q.v.*), Millet (*q.v.*), and Courbet (*q.v.*), the real originators of French contemporary art. The other was the group of men of imagination, the idealists, who, in the pursuit of perfect beauty and an ideal moral standard, reverted to the dissimilar visions of Delacroix and Ingres, the ideals of rhythm as opposed to harmony, of style *versus* passion, which Théodore Chassériau had endeavoured to combine. Round Puvis de Chavannes (*q.v.*) and Gustave Moreau (*q.v.*) we find a group of artists who, in spite of the fascination exerted on their intelligence by the great works of the old masters, especially the early Florentines and Venetians, would not accept the old technique, but strove to record in splendid imagery the wonders of the spiritual life, or claimed, by studying contemporary individuals, to reveal the psychology of modern minds. Among them were Gustave Ricard (1821–73), whose portraits, suggesting the mystical charm sometimes of Leonardo and sometimes of Rembrandt, are full of deep unuttered vitality; Elie Delaunay (1828–91), serious and expressive in his heroic compositions, keen and striking in his portraits; Eugène Fromentin (1820–76), acute but subtle and silvery, a man of elegant mind, the writer of *Les Maîtres d'Autrefois*, of *Sahel*, and of *Le Sahara*, the discoverer — artistically — of Algeria. And round the loud and showy individuality of Courbet—healthy, nevertheless, and inspiring—a group was gathered of men less judicious, but more stirring, more truculent, thoroughly original, but not less reverent to the old masters than they were defiant of contemporary authorities. They were even more ardent for a strong technique, but the masters who attracted them were the Dutch, the Flemish, the Venetians, who, like themselves, had aimed at recording the life of their day. Among these was François Bonvin (1817–87), who, following Granet, carried on the evolution of a subdivision of genre, the study of domestic interiors. This Drolling, too, had done, early in the 19th century, his predecessors in France being Chardin and Le Nain. This class of subjects has not merely absorbed all genre-painting, but has become a very important factor in the presentment of modern life. Bonvin painted asylums, convent-life, studios, laboratories, and schools. Alphonse Legros (*q.v.*), painter, sculptor, and etcher, who settled in London, was of the same school, though independent in his individuality, celebrating with his brush and etching-needle the life of the poor and humble, and even of the vagabond and beggar. There were also Bracquemond, the reviver of the craft of etching; Fantin-Latour, the painter of highly romantic Wagnerian dreams, figure compositions grouped after the Dutch manner, and flower-pieces not surpassed in his day. Ribot, again, and Vollon, daring and dashing in their handling of the brush; Guillaume Régamey, one of the few military painters gifted with the epic sense; and even Carolus Duran, who, after painting "Murdered" (in the Lille Museum), combined with the professional duties of an official teacher a brilliant career as a portrait painter. A later member of this group, attracted to it by student friendship in the little drawing-school which under Lecoq de Boisbaudran competed in a modest way with the École des Beaux Arts, was J. C. Cazin, well known afterwards as a pronounced idealist. Finally, there was Manet, a connecting link between the realists and the impressionists. These two radiant focuses of imagination and of observation respectively were to be seen still intact during the later period, as represented by the most energetic of the masters who upheld them.

After the catastrophe of 1870, French art appeared to be reawakened by the disasters of the country; and at the great exhibition in Vienna in 1873 Count Andrassy exclaimed to Léon Bonnat, "After such a terrible crisis you are up again, and victorious!" Immense energy prevailed in the studios, and money poured into France in consequence. The output increased rapidly, and at the same time study became more strenuous, and ambition grew bolder and more manly. Renewed activity stirred in the public academies, and a crowd of foreign students came to learn. Two great facts give a characteristic stamp to this new revival of French art: I. In the class of imaginative painting, the renewed impulse towards monumental or decorative work. II. In the class of nature studies, the growth of landscape painting, which developed along two parallel lines—impressionism and the "open-air" school.

I. *Decoration.*—In decorative painting two men were the soul of the movement: Puvis de Chavannes and Philippe de Chennevières Pointel. As we look back on the last years of the Second Empire, we see decorative painting sunk in profound lethargy. After Delacroix,

Chasseriau, and Hippolyte Flandrin, and the completion of the great works in the Palais Bourbon, the Senate House, the Cour des Comptes, and a few churches—St Sulpice, St Vincent de Paul, and St Germain des Prés—no serious attempts had been made in this direction. Excepting in the Hôtel de Ville, where Cabanel was winning his first laurels, and in the Opera House, a work that was progressing in silence, a few chapels only were decorated with paintings in the manner of easel pictures. But two famous exceptions led to a decorative revival: Puvis de Chavannes' splendid scheme of decoration at Amiens (all, with the exception of the last composition, which is dated 1882, executed without break between 1861 and 1867), and his work at Marseilles and at Poitiers; Baudry, with his ceiling in the Opera House, begun in 1866 but not shown to the public till 1874. There was also a movement for reviving French taste in the industrial arts by following the example of systematic teaching set by some foreign countries, more particularly by England. Decorative painting felt the same impulse. Philippe de Chennevières, curator of the Luxembourg Gallery and directeur des Beaux Arts (from 1874 till 1879), determined to encourage it by setting up a great rivalry between the most distinguished painters, like that which had stimulated the zeal of the artists of the Italian Renaissance. Taking up the task already attempted by Chenavard under the Republic of 1848, but abandoned in consequence of political changes, M. de Chennevières commissioned a select number of artists to decorate the walls of the Panthéon. The panels were to record certain events in the history of France, with due regard to the sacred character of the building. Twelve of the most noted painters were named, with a liberal breadth of selection so as to include the most dissimilar styles: Millet and Meissonier, of whom one refused and the other did not carry out the work; Cabanel and Puvis de Chavannes. The last named was the first to begin, in 1878, and he too was the painter who put the crowning end to this great work in 1898. His pictures of the "Childhood of Ste Geneviève" (the patron saint of Paris), simple, full of feeling and of innocent charm, appropriate to a popular legend, with their airy Parisian landscape under a pallid sky, made a deep impression. Thenceforward Puvis de Chavannes had a constantly growing influence over younger men. His magnificent work at Amiens, "Ludus pro Patria" (1881–82), at Lyons, and at Rouen, in the Sorbonne and the Hôtel de Ville, for the Library at Boston, U.S.A., and on to his last composition, "The Old Age of Ste Geneviève," upheld to the end of the 19th century the sense of lofty purpose in decorative painting. Besides the Panthéon, which gave the first impetus to the movement, Philippe de Chennevières found other buildings to be decorated: the Luxembourg, the Palace of the Legion of Honour, and that of the Council of State. The paintings in the Palais de Justice, the Sorbonne, the Hôtel de Ville, the College of Pharmacy, the Natural History Museum, the Opéra Comique, and many more, bear witness to this grand revival of mural painting. Every kind of talent was employed — historical painters, portrait painters, painters of allegory, of fancy scenes, of real life, and of landscape. Among the most important were: J. P. Laurens and Benjamin Constant, Bonnat and Carolus Duran, Cormon and Humbert, Joseph Blanc and L. Olivier Merson, Roll and Gervex, Besnard and Carrière, Harpignies and Pointelin, Raphaël Collin and Henri Martin.

II. *Impressionism.*—In 1874 common cause was made by a group of artists drawn together by sympathetic views and a craving for independence. Various in their tastes, they concentrated from every point of the compass to protest, like their precursors the realists, against the narrow views of academic teaching. Some had romantic proclivities, as the Dutchman Jongkindt, who played an important part in founding this group; others were followers of Daubigny, of Corot, or of Millet; some came from the realistic party, whose influence and effort this new set was to carry on. Among these, Édouard Manet (1833–83) holds a leading place; indeed, his influence, in spite of—or perhaps as a result of—much abuse, extended beyond his circle even so far as to affect academic teaching itself. He was first a pupil of Couture, and then, after Courbet, his real masters were the Spaniards—Velasquez, El Greco, and Goya, all of whom he closely studied at the beginning of his career; but he soon felt the influence of Millet and of Corot. With a keen power of observation, he refined and lightened his style, striving for a subtle rendering of the exact relations of tone and values in light and atmosphere. With him, forming the original group, as represented by the Caillebotte collection in the Luxembourg, we find some landscape painters: Claude Monet, the painter of pure daylight, and the artist who by the title of one of his pictures, "An Impression," gave rise to the designation accepted by the group; Camille Pissarro, who at one time carried to an extreme the principle of dotting with pure tints, known as *pointillisme*, or dot-work; Sisley, Cézanne, and others. Among those who by preference studied the human figure were Edgard Degas (*q.v.*) and Auguste Renoir. After long and violent antagonism, such as had already greeted the earlier innovators, these painters, in spite of many protests, were officially recognized both at the Luxembourg and at the great Exhibition of 1900. Their aims have been various, some painting Man, and some Nature. In the former case they claim to have gone back to the principle of the greatest artists and tried to record the life of their own time. Manet, Degas, and Renoir have shown us aspects of city or vulgar life which had been left to genre-painting or caricature, but which they have represented with the charm of pathos, or with the bitter irony of their own mood, frank transcripts of life with a feeling for style. For those who painted the scenery of nature there was an even wider field. They brought to their work a new visual sense, released from the clinging memories of past art; they endeavoured to fix the transient effects of moving life, changing under the subtlest and most fugitive effects of light and atmosphere, and the play of what may be called the elements of motion—sunshine, air, and clouds—caring less for the exact transcript of motionless objects, which had hitherto been almost exclusively studied, such as the soil, trees, and rocks, the inanimate features of the landscape. They introduced a fresh lightness of key, which had been too subservient to the relations of values; they discovered for their ends a new class of subjects essentially modern: towns, streets, railway stations, factories, coal-mines, iron-works, and smoke, which they represent with an intelligent adaptation of Japanese art, taking new and audacious points of view, constantly varying the position of their horizon. This is indeed the very acme of naturalism, the last possible stage of modern landscape, covering the whole field of observation, doubling back to the starting-point of imagination. Notwithstanding—or because of—the outcry, all these views, peculiarities, and tendencies soon penetrated schools and studios. Three artists in particular became conspicuous among the most individual and most independent spirits: Besnard, who had taken the Grand Prix de Rome, and carried to the highest pitch his inexhaustible and charming fancy in studies of the figure under the most unexpected play of light; Carrière, a pupil of Cabanel, who sought and found in mysterious gloom the

softened spirit of the humble, the warm caress of motherhood; and Raffaëlli, a pupil of Gérôme, who brought to light the unrecognized picturesqueness of the lowest depths of humanity.

III. *The "plein-air," or open-air, school.* The same causes explain the rise of the particular class of work thus commonly designated. Between Millet and Courbet, both redolent of the romantic and naturalistic influences of their time, though apart from them, stands an artist who had some share in establishing the continuity of the line of painters who combined figure-painting with landscape. This is Jules Breton (b. 1827, *q.v.*). More supple than his fellows, less harsh and less wilful, caring more for form and charm, he found it easier to treat "masses," and contributed to diffuse a taste for the artistic presentment and glorification of field labour. He was the chief link between a past style and Jules Bastien-Lepage (1848–84, *q.v.*), who was in fact the founder of the school of open-air painting, a compromise between the academic manner and the new revolutionary ideas, a sort of academic continuation of the naturalistic evolution, which therefore exerted considerable influence on contemporary art. As a pupil of Cabanel and the Academy schools, enamoured of rustic life, he absorbed at an early stage, though not without hesitation, the love of atmospheric effects characteristic of Corot and of Manet. In his open-air heads and rural scenes he is seen as a conscientious nature worshipper, accurate and sincere, and, like Millet, imbued with a touch of mysticism which becomes even more evident in his immediate pupils. Round him there arose a little galaxy of painters, some more faithful to tradition, some followers of the best innovators, who firmly tread this path of light and modern life. Those are Butin, Duez and Renouf, Roll and Gervex, Dagnan-Bouveret, Friant, Adolphe and Victor Binet, and many more.

Immediately after the Exhibition of 1889 an event took place which was not without effect on the progress of French art. This was the schism in the Salon. The audacious work of the Société Nationale des Beaux Arts, which left anything that the Impressionists could do far behind, had accustomed the eyes of the public to the most daring attempts, while the numerous contributions of foreigners, especially from the north, where art aimed solely at a direct presentment of daily life, was a fresh encouragement to the study of modern conditions and of the lower classes. But, at the same time, the encroachment on space at the Exhibition (where no limit of number was imposed) by mere studies, hastened the reaction against the extravagances of the degenerate followers of Courbet, Manet, and Bastien-Lepage. Remonstrances arose against their perverse and narrow-minded devotion to "truth," or rather to minute exactitude, their pedantry and affectation of documentation; sometimes derived from some old colourists who had not renounced their former ideal, sometimes from younger men impelled unconsciously by literature, which had as usual preceded art in the revolt. The protest was seen, too, in a modified treatment of landscape, which took on the warmer colours of sunset, and in a choice of religious subjects, such as a *pardon*, or a funeral, or a ceremonial benediction, and generally of more human and more pathetic scenes.

Bastien-Lepage, like his great precursor Millet, bore within him the germs of a reaction against the movement he had helped to promote. Dagnan-Bouveret, who began by painting "Sitting for a Photograph" (now at Lyons) and "An Accident," after painting "Le Pain bénit," ended with "The Pilgrims to Emmaus" and "The Last Supper." Friant, again, produced scenes of woe, "All Saints' Day" and "Grief"; and their younger successors, Henri Royer, Adler, Duvent, and others, who adhered to this tradition, accommodated it to a more modern ideal, with more vivid colouring and more dramatic composition.

Still, this normal development could have no perceptible effect in modifying the purpose of painting. More was needed. A strong craving for imaginative work was very generally felt, and was revealing itself not merely in France but in Belgium, Scotland, America, and Germany. This tendency ere long resulted in groups forming round certain well-known figures. Thus a group of refined dreamers, of poetic dilettanti and harmonious colourists, assembled under the leading of Henri Martin (a strange but attractive visionary, a pupil of Jean Paul Laurens and direct heir to Puvis de Chavannes, from whom he had much sound teaching) and of Aman-Jean, who had appeared at the same time, starting, but with more reserve, in the same direction. Some of this younger group affected no specific aim; the others, the larger number, leant towards contemporary life, which they endeavoured to depict, especially its aspirations and—according to the modern expression now in France of common usage—its "state of soul," typified by melody of line and the eloquent language of harmonies. Among them should be named, as exhibitors in the Salons and in the great Exhibition of 1900, Ernest Laurent, Ridel, and Hippolyte Fournier, M. and Mrs H. Duhem, Le Sidaner, Paul Steck, &c. On the other hand, a second group had formed of sturdy and fervent naturalistic painters, in some ways resembling the school of 1855 of which mention has been made; young and bold, sometimes over-bold, enthusiastic and emotional, and bent on giving expression to the life of their own day, especially among the people, not merely recording its exterior aspects but epitomizing its meaning by broad and strong synthetical compositions. At their head stood Cottet, who combined in himself the romantic fire and the feeling for orchestrated colour of Delacroix with the incisive realism and bold handling of Courbet; next, and very near to him, but more objective in his treatment, Lucien Simon, a manly painter and rich colourist. Both by preference painted heroic or pathetic scenes from the life of Breton mariners. After them came René Ménard, a more lyrical artist, whose classical themes and landscape carried us back to Poussin, and Dauchez, Prinet, Wéry, &c.

Foreign influences had meanwhile proved stimulating to the new tendencies in art. Sympathy with the populace derived added impulse from the works of the Belgian painters Constantin Meunier, Léon Frédéric, and Struys; a taste for strong and expressive colouring was diffused by certain American artists, pupils of Whistler, and yet more by a busy group of young Scotsmen favourably welcomed in Paris. But the most unforeseen result of this reactionary movement was a sudden reversion to tradition. The cry of the realists of every shade had been for "Nature!" The newcomers raised the opposition cry of "The Old Masters!" And in their name a protest was made against the narrowness of the documentary school of art, a demand for some loftier scheme of conventionality, and for a fuller expression of life, with its complex aspirations and visions. The spirit of English Pre-Raphaelitism made its way in France by the medium of translations from the English poets Shelley, Rossetti, and Swinburne, and the work of their followers Stephane Mallarmé and Le Sâr Peladan; it gave rise to a little artificial impetus, which was furthered by the simultaneous but transient rage for the works of Burne-Jones, which were exhibited with his consent in some of the Salons, and by the importation of William Morris's principles of decoration. The outcome was a few small groups of symbolists, the most famous being that of the Rose ✠ Croix, organized by

Le Sâr Peladan; then there was Henri Martin, and the little coterie of exhibitors attracted by a dealer, the late M. le Bare de Bouttiville, in which Cottet was for a short time entangled. But few interesting names are to be identified: Dulac (d. 1899), who became known chiefly for his mystical lithographs in colour; Maurice Denis and Bonnart, whose decorative compositions, with their refined and harmonious colouring, are not devoid of charm; Vuillard, &c. But it was in the school and studio of Gustave Moreau (1826–1898, *q.v.*) that the fire of idealism burned most hotly. This exceptional man and rare painter, locked up in his solitude, endeavoured, by a thorough and intelligent assimilation of all the traditions of the past, to find and create for himself a new tongue—rich, nervous, eloquent, strong, and resplendent—in which to give utterance to the loftiest dreams that haunt the modern soul. He revived every old myth and rejuvenated every antique symbol, to represent in wonderful imagery all the serene magnificence and all the terrible struggles of the moral side of man, which he had explored to its lowest depths and most heroic heights in man and woman, in poetry and in death. Being appointed, towards the end of his life, to a professorship in the École des Beaux Arts, he regarded his duties as a real apostleship, and his teaching soon spread from his lecture-room and studio to those of the other masters. His own work, though hardly known to his pupils at the time, at first influenced their style; but, especially after his death, they were quickly disgusted with their own detestable imitation of subjects on which the master had set the stamp of his great individuality; they deserted the fabulous world of the Greek Olympus and the wonderful gardens of the Bible, to devote them to a passionate expression of modern life. Desvallières, indeed, remained conspicuous in his original manner; Sabatté, Maxence, Béronneau, Besson, and many more happily worked out their way on other lines.

In trying to draw up the balance-sheet of art in 1902, it were vain to try to enter its work under the old-world headings of History, Genre, Portraits, Landscape. All the streams had burst their channels, all the currents mingled. Historical painting, reinstated for a time by Puvis de Chavannes and J. P. Laurens, in which Benjamin Constant and Cormon also distinguished themselves, had but a few adherents who tried to maintain its dignity, either in combination with landscape, like M. Tattegrain, or with the ineffectual aid of archæology, like M. Rochegrosse. At certain times, especially just after 1870, the memory of the war gave birth to a special genre of military subjects, under the distinguished guidance of Meissonier (*q.v.*), and the peculiar talents of Alphonse de Neuville (*q.v.*), of Detaille (*q.v.*), and Protais. This phase of contemporary history being exhausted, gave way to pictures of military manœuvres, or colonial wars and incidents in recent history; it latterly went through a revival under a demand for subjects from the Empire and the Revolution, in consequence of the publication of many memoirs of those times. Side by side with "history," religious art formerly flourished greatly; indeed, next to mythology, it was always dear to the Academy. Apart from the subjects set for academical competitions, there was only one little revival of any interest in this kind. This was a sort of neo-evangelical offshoot, akin to the literature and stress of religious discussion; and its leader, a man of feeling rather than conviction, was J. C. Cazin (d. 1901). Like Puvis de Chavannes, and under the influence of Corot and Millet, of Hobbema, and yet more of Rembrandt, he attempted to renew the vitality of history and legend by the added charm of landscape and the introduction of more human, more living and more modern, elements into the figures and accessories. Following him, a little group developed this movement to extravagance. The recognized leader at the beginning of the 20th century was Dagnan-Bouveret.

Through mythology and allegory we are brought back to real life. No one now thinks in France of seeking any pretext for displaying the nude beauty of woman. Henner, perhaps, and Fantin-Latour, were the last to cherish a belief in Venus and Artemis, in naiads and nymphs. Painters go direct to the point nowadays; when they paint the nude, it is apart from abstract fancies, and under realistic aspects. They are content with the model. It is the living female. The whole motor force of the time lies in the expression, under various kinds of real life. This it is which has given such a soaring flight to the two most primitive forms of the study of Life, landscape and portraiture. Portraits have in fact adopted every style that can possibly be imagined: homely or fashionable, singly or in groups, by the fire or out of doors, in some familiar attitude and the surroundings of daily life, analytically precise, or synthetically broad, a literal transcript or a bold epitome of facts. As to landscape, no class of painting has been busier, more alive, or more productive. It has overflowed into every other channel of art, giving them new spirit and a new life. It has led the van in every struggle and won every victory. Never was army more numerous or more various than that of the landscape painters, nor more independent. All the traditions find representatives among them, from Paul Flandrin to René Ménard. Naturalists, impressionists, open-air painters, learned in analysis or potent in invention. We need only name Harpignies, broadly decorative; Pointelin, thoughtful and austere; and Cazin, grave and tender, to give a general idea of the strength of the school.

Every quarter of the land has its painters: the North and the South, Provence and Auvergne, Brittany, dear to the young generation of colourists, the East, Algeria, Tunis—all contribute to form a French school of landscape, very living and daring, of which, as successors of Fromentin and Guillaumet, must be named Dinet, Marius Perret, Paul Leroy, and Girardot. But it is more especially in the association of man and nature, in painting simple folk and their struggle for life amid their natural surroundings or by their homely hearth, in the glorification of humble toil, that the latest French art finds its most characteristic ideal life. (L. BE.)

BELGIUM.

Belgium fills a great place in the realm of art; and while its painters show a preference for simple subjects, their technique is broad, rich, and sound, the outcome of a fine tradition. Since 1855 international critics have been struck by the unity of effect produced by the works of the Belgian school, as expressed more especially by similarities of handling and colour. For the things which distinguish all Belgian painters, even in their most unpictorial divagations, are a strong sense of contrast or harmony of colouring, a free, bold style of brushwork, and a preference for rich and solid painting. It is the tradition of the old Flemish school. It would be more correct, indeed, to say traditions; for the modifications of each tendency, inevitably reviving when the success of another has exhausted itself, constantly show a reversion either to the domestic "Primitives" (or, as we might say, Pre-Raphaelites) of the Bruges school, or to the "decorative" painters of the later time at Antwerp, and no veneer of modern taste will ever succeed in masking this traditional perennial groundwork. In this way the prevailing authority of the French painter Louis David may be accounted for; as acknowledged at Brussels at the beginning of the 19th century, it was a reaction in antagonism to the heavy

and flabby work of the late Antwerp school, an unconscious reversion perhaps to the finish and minuteness of the early painters of Bruges. Indeed, in France, Ingres, himself David's most devoted disciple, was reproached with trying to revive the Gothic art of Jean de Bruges. Then, when David's followers produced only cold and feeble work, Wappers arose to restore the methods of another tradition, for which he secured a conspicuous triumph. Classical tinsel made way, indeed, for romantic tinsel. The new art was as conventional as the old, but it had the advantage of being adaptable to the taste for show and splendour which characterizes the nation, and it also admitted the presentment of certain historical personages who survived in the memory of the people. The inevitable reaction from this theatrical art, with its affectation of noble sentiments, was to brutal realism. Baron Henry Leys (1815–1869) initiated it, and the crudity of his style gave rise to a belief in a systematic purpose of supplanting the Latin tradition by Germanic sentimentality. It would be interesting to trace how far the famous Belgian painter was influenced by the English artist Ford Madox Brown, whom he met at Antwerp while both were students. Still, as far as Leys was concerned, this reversion to realism was a matter of will rather than of study. His art is not that of a close observer; he lived in a dream of the period depicted by the masters of the past he delighted in. He himself was a master, a painter by nature, gifted with great powers of draughtsmanship, a firm hand, and a broad, rich sense of colour. As M. Camille Lemonnier has pointed out, it was his hatred of academical conventionality that lured Leys into a sort of wilful barbarism and a sometimes childish artlessness. Modern art was influenced by him to an extraordinary degree. He substituted for the mannered elegance of the so-called classical school, angular attitudes, coarse and common types, and the slow but determined temperament of a people caring little for external beauty and reserving its admiration for mental qualities. But it was soon recognized that there was a Teutonic as well as a Latin *recipe*, and Leys's archaic realism was transformed at Brussels into a realism of observation and modern thought, in the painting of Charles de Groux. The influence of Leys on this artist was merely superficial; for though he, too, affected painful subjects, it was because they appealed to his compassion. The principle represented by de Groux was destined to pioneer the school in a better way; at the same time, from another side the authority of Courbet, the French realist, who had been for some time in Brussels, and that of the great landscape painters of the Fontainebleau school, had suggested to artists a more attentive study of nature and a remarkable reversion in technique to bolder and firmer handling. At this time, among other remarkable men, Alfred Stevens appeared on the scene, the finished artist of whom Camille Lemonnier truly said that he was "of the race of great painters, and, like them, careful of finish"—that in him "the eye, the hand, and the brain all co-operated for the mysterious elaboration" of impasto, colour, and chiaroscuro, and "the least touch was an operation of the mind." A brief period ensued during which the greater number of Belgian artists were carried away by the material charms of brushwork and paint. The striving after brilliant effects of colour which had characterized the painters of the last generation then gave way to a devout study of values; and at the same time it is to be noted that in Belgium, as in France, landscape painters were the first to discover the possibility of giving new life to the interpretation of nature by simplicity and sincerity of expression. They tried to render their exact sensations; and we saw, as has been said, "an increasingly predominant revelation of instinctive feeling in all classes of painting." Artists took an impartial interest in all they saw, and the endeavour to paint well eliminated the hope of expressing a high ideal; they now sought only to utter in a work of art the impression made on them by an external fact; and, too often, the strength of the effort degenerated into brutality.

These new influences, which, in spite of the conservative school, had by degrees modified the aspect of Belgian art in general, led to the formation at Brussels of an association under the name of the Free Society of Fine Arts. This group of painters had a marked influence on the development of the school, and hand in hand with the pupils of Portaels—a teacher of sober methods, caring more for sound practice than for theories—it encouraged not merely the expression of deep and domestic feeling which we find in the works of Leys and de Groux, but also the endeavour to paint nature in the broad light of open air. The example of the Free Society found imitators; various artistic groups were formed to organize exhibitions where new works could be seen and studied irrespective of the influence of dealers, or of the conservatism of the authorities which was increasingly conspicuous in the official galleries; till what had at first been regarded as a mere audacious and fantastic demonstration assumed the dignity of respectable effort. The "Cercle des Vingt" ("The Twenty Club") also exerted a marked influence. By introducing into its exhibitions works by the greatest foreign artists, it released Belgian art from the uniformity which some too patriotic theorists would fain have imposed. The famous "principle of individuality in art" was asserted there in a really remarkable manner; for side by side with the experiments of painters bent on producing certain effects of light, hung the works of men who clung to literary or abstract subjects. Other groups, again, were formed on the same lines; but then came the inevitable reaction from these elaborations of quivering light and subtle expression, pushed, as it seemed, to an extreme. The youngest generation of Brussels painters, in revolt against the lights and ultra-refinements of their immediate predecessors, seem to take pleasure in a return to gums and bitumen, and to seek the violent effects so dear to the romantic painters of a past time.

Brussels is the real centre of art in Belgium. Antwerp, the home of Rubens, is resting on the memory of past glories, after vainly trying to uphold the ideal formerly held in honour by Flemish painters. And yet, so great is the prestige of this ancient reputation, that Antwerp even now attracts artists from every land, and more especially the dealers who go thither to buy pictures as a common form of merchandise. At Ghent the wonderful energy of the authorities who get up the triennial exhibitions makes these the most interesting provincial shows of their kind; other towns, as Liége, Tournay, Namur, Mons, and Spa, also have periodical exhibitions.

From 1830, in the early days of the Belgian school of painting, we may observe a tendency to seek for the fullest qualities of colour, with delicate gradations of light and shade. In this Wappers led the way. At a time when his teachers in the Antwerp Academy would recognize nothing but the heavy brown tones of old paintings, he was already representing the transparent shadows of natural daylight. But heroic and sentimental romanticism was already making way for the serious expression of domestic and popular feeling, and thenceforward the prominence assumed by genre, and yet more by landscape, led to a deeper and more direct study of the various aspects of nature. At the same time a special sense of colour was the leading characteristic of the artists of the time, and it was truly said that "the ambition to be a fine painter was stronger than the desire for scrupulous exactitude." Artists evidently aimed, in the first place, at a solid impasto and glowing colour; an undertone, ruddy and golden, gleamed through the paler and more real hues of the over-painting. In this we may certainly recognize the influence of the French colourists of Courbet's

time; just as we may trace the influence of the grey tone prevalent in Manet's day, in the effort to paint with more simple truth and fewer tricks of recipe, which became evident when the "Free Society" was founded at Brussels, and the pupils from Portaels' studio came to the front.

Among the artists who were then working, the following must be named (with their best works in the Brussels Gallery): Alfred Stevens (*q.v.*), an incomparably charming painter, characterized by exquisite harmony of colour and marvellous dexterity with the brush. In the Brussels Gallery are his "The Lady in Pink," "The Studio," "The Widow," "A Painter and his Model," and "The Lady-Bird." Joseph Stevens, his brother, a master-painter of dogs, broad in his draughtsmanship, and painting in strong touches of colour, is represented by "The Dog-Market," "Brussels—Morning," "A Dog before a Mirror"; Henri de Brækeleer, the nephew and pupil of Leys, a fine painter of interiors, in warm and golden tones, by "The Geographer," "A Farm—Interior," "A Shop"; Lievin de Winne, a portrait painter, sober in style and refined in execution, by "Leopold I., King of the Belgians"; Florent Willems, archaic and elegant, by "The Wedding-Dress"; Eugène Smits, a refined colourist, always working with the thought of Venice in his mind, by "The Procession of the Seasons"; Louis Dubois, a powerful colourist with a full brush, striving to resemble Courbet, by "Storks," "Fish"; Alfred Verwée, a fine animal painter, with special love for a sheeny silkiness of texture, by "The Estuary of the Scheldt," "The Fair Land of Flanders," "A Zeeland Team"; Alfred Verhaeren, a pupil of L. Dubois, by some "Interiors"; Felicien Rops, an extraordinary artist, precise in drawing, sensual, and incisive, by "A Parisienne"; Félix ter Linden, a restless, refined nature, always trying new subtleties of the brush and palette-knife, by "Captives." Amongst other painters may be named Camille van Camp, Gustave de Jonghe, Franz Verhas, and his brother Jan Verhas, the painter of the popular "School Feast" in the Brussels Gallery; and Jan van Beers, the clever and brilliant painter of female coquettishness, by pictures in the Antwerp Gallery.

As landscape painters, the chief are: Hippolyte Boulenger, a refined draughtsman and a delicate colourist, represented in the Brussels Gallery by "View of Dinant," "The Avenue of Old Hornbeams at Tervueren," "The Meuse at Hastière"; Alfred de Knyff, noble and elegant, by "The Marl Pit," "A Heath—Campine"; Joseph Coosemans, by "A Marsh—Campine"; Jules Montigny, by "Wet Weather"; Alph. Asselbergs, by "A Marsh—Campine." There are also Xavier and César de Cock, painters in light gay tones of colour, Gustave Den Duyts, a lover of melancholy twilight, represented in the same gallery by "A Winter Evening"; Mme Marie Collart, a seeker after the more melancholy and concentrated impressions of nature, by "The Old Orchard"; and Baron Jules Gœthals.

Of the *Antwerp school*, François Lamorinière, archaic and minute, has in the Brussels Gallery his "View from Edeghem," and there is also Théodore Verstraete, sentimental, or frenzied.

As marine painters: Paul Jean Clays, who delights in vivid effects of colour, is represented at Brussels by "The Antwerp Roadstead," "Calm on the Scheldt"; Louis Artan, who prefers dark and powerful effects, by "The North Sea," besides, Robert Mols, A. Bouvier, and Lemayeur.

As painters of town scenery may be named F. Stroobant, a draughtsman rather than a painter, who is represented in the Brussels Gallery by "The Grande Place at Brussels," and J. B. Van More, a colourist, chiefly by "The Cathedral at Belem."

The flower painter, Jean Robie, has in the Brussels Gallery "Flowers and Fruit."

Jean Portaels, the painter of "A Box at the Theatre," at Budapest, is represented in the Brussels Gallery by "The Daughter of Sion Insulted"; Émile Wauters, a master of free and solid brushwork, equally skilled in portraiture, historical composition, and decorative portrait painting, by "The Madness of Hugo van der Goes"; Édouard Agneesens, a genuine painter, with breadth of vision and facile execution, by Portraits; André Hennebicq, a painter of historical subjects, by "Labourers in the Campagna, Rome"; Isidore Verheyden, a landscapist and portrait painter, by "Woodcutters"; Eugène Verdyen and Émile Charlet should be mentioned, and the landscape painter Henri van der Hecht, whose "On the Sand-Hills" is in the Brussels Gallery.

The principal landscape painters of what is known as the "neutral tint" school (*l'École du gris*) are: Théodore Baron, faithful to the sterner features of Belgian scenery, represented in the Brussels Gallery by "A Winter Scene—Condroz"; Adrien Joseph Heymans, a careful student of singular effects of light, by "Spring-Time"; Jacques Rosseels, a painter of the cheerful brightness of the Flemish country, by "A Heath," besides Isidore Meyers and Florent Crabeels.

Some figure painters who may be added to this group are: Charles Hermans, whose picture "Dawn" (Brussels Gallery), exhibited in 1875, betrays the ascendancy of the principles upheld by the Free Society of Fine Arts; Jean de la Hoese, who has since made portraits his special line; Émile Sacré; Léon Philippet, represented in the Brussels Gallery by "The Murdered Man"; and Jan Stobbaerts, a masterly painter, powerful but coarse, by "A Farm—Interior."

Three more artists were destined to greater fame: Constantin Meunier, a highly respected artist, equally a painter and a sculptor, known as "the Millet of the Flemish workman," who has depicted with noble feeling his admiration and pity for one contemporary state of the human race, and who is represented in the Brussels Gallery by "The Peasants' War"; Xavier Mellery, who tries to express in works of high artistic merit the inner life of men and things, and personifications of thought, by "A Drawing"; and Alexandre Struys, a strong and clever painter, expressing his sympathy with poverty and misfortune in works of remarkable ability.

Besides these, Charles Verlat, a powerful and skilled artist, painted a vast variety of subjects; his teaching was influential in the Antwerp Academy. In the Brussels Gallery he is represented by "Godfrey de Bouillon at the Siege of Jerusalem," "A Flock of Sheep attacked by an Eagle"; Alfred Cluysenaar, whose aim is to produce decorative work on an enormous scale, by "Canossa"; Albrecht de Vriendt, by "Homage done to Charles V. as a Child"; Juliaan de Vriendt, by "A Christmas Carol"; Victor Lagye, by "The Witch." Franz Vinck, Wilhelm Geets, Karl Ooms, and P. van der Ouderaa, endeavour to perpetuate, while softening down, the style of historical painting so definitely formulated by Leys. Finally, Joseph Stallaert, a painter of classical subjects, is represented in the Brussels Gallery by "The Death of Dido." Eugène Devaux, a remarkable draughtsman, should also be named.

Works by all those artists were to be seen in the Historical Exhibition of Belgian Art at Brussels, 1880. Camille Lemonnier, in his *History of the Fine Arts in Belgium*, discussed this Exhibition very fully, pointing out three distinct periods in the history of the century. The first, romantic, literary, and artificial, extended from 1830 till nearly 1850; the second was a period of transition, domestic in feeling, gradually developing to realism in the course of about 20 years; the third began in the 'seventies, a time of careful study, especially in landscape. This was followed by the beginning of a fourth period, characterized by a freer sense of light and atmosphere.

Apart from the exclusive tendency, inevitable under bureaucratic administration, the mere arrangement, on an antiquated plan, of the great Academic Salons was unsuited to the display of works intended to represent individual feeling or peculiarities of pictorial treatment. Hence it was that a great many painters came to prefer smaller and more eclectic shows, leading to the fashion, which still persists, of exhibitions by clubs or associations. The Fine Arts Club at Brussels had long since afforded opportunities for showing the pictures of the Société Libre, founded in 1868, which were condemned by the authorities as tending to "revolutionize" art. After this, two associations of young painters were formed at Brussels with a view to organizing their own exhibitions.

The "*Chrysalide*" Club was founded in 1875, and the "*Essor*" (the "Soaring") Club, in 1876. In 1882, however, the *Essor* obtained leave to open their exhibition in a room in the Palais des Beaux Arts at Brussels. This tolerance was all the more appreciated by the younger party because a new departure was in course of development, again a modification in the effort to represent light in painting. The "neutral tint" school had given way to the school of "whiteness"; a luminous effect was to be sought by a free use of brilliant colour with a very full brush. But ere long this method proved unsatisfactory, and attention was now turned towards a "sincerer and acuter perception of local values"; and again the influence of certain French painters was brought to bear—those of the group headed by C. Monet, preparing for that of the French painter G. Seurat, the first who carried into practice the systematic decomposition of colour by the process known as *pointillisme* (the intimate juxtaposition of dots of colour). In 1884, in consequence of a division in the *Essor* Club, the "XX" Club was founded, who, though thus limiting their number, reserved the right of "issuing yearly invitations, and thus testifying the sympathy they felt with the most independent artists of Belgium and with those foreign painters with whom they had the most pronounced affinity." For ten years the exhibitions of the "XX," whose careful and artistic arrangements were in themselves admirable, were the fount in Belgium of discussions on art. The limit of its existence to ten years was determined when the club was formed; but as it was desirable that the principle of liberty in art should still be held in honour, M. Octave Maus, the secretary of the "XX" Club, organized the exhibitions of the *Libre Esthétique* in and since 1894. Other clubs had been formed in Brussels: the Fine Art Society in 1891 and "The Furrow" (*le Sillon*) in 1893. In 1894 another breach in the *Essor* Club, which, growing very weak, was soon to disappear, as the "Art Union" and the *Voorwaerts* Club had done, led to the formation of the Society "For Art" ("*pour l'Art*"); and in 1896 a party of that club established a Salon of idealist art which favoured an exaggeration of the intellectual tendency already

begun in the exhibitions of the "XX." Subsequently, in the exhibitions of the *Sillon* and of the *Labeur* Club (founded in 1898) a reaction set in, in favour of heavy brown tones and ponderous composition. At Antwerp the influence of the local societies—the "*Als Ik Kan*," the Independent Art Club, and the "XIII"—was less sensibly felt; it was, however, enough to confirm certain waverers in the direction of purely disinterested effort.

It would be impossible to classify into definite groups those painters whose first distinctive appearance was subsequent to the Historical Exhibition in 1880. Only an approximate grouping can be attempted by assigning each to the association in whose exhibitions he made the best display of what he aimed at expressing. Thus it was chiefly in the rooms of the *Essor* Club that works were shown by the following: L. Frédéric, a remarkable painter, combining wonderful facility of execution with a sincerely simple sentiment of homely pathos, represented at the Brussels Gallery by "Chalk Sellers"; E. Hoeterickx, a painter of crowds in the streets and parks; F. Seghers, a pleasing colourist, who had made flower-painting his speciality; two animal painters, F. van Leemputten, "Return from Work" (Brussels Gallery), and E. van Damme-Sylva, as well as the marine painter, A. Marcette. The landscape painters include J. de Greet, almost brutal in style, "The Pool at Rouge-Cloître" (Brussels Gallery), C. Wolles, and Hamesse. L. Houyoux, F. Halkett, L. Herbo are known for their portraits. And there are E. van Gelder, J. Mayné, A. Crespin, a learned decorative painter, and E. Duyck, a graceful draughtsman, "A Dream" (Brussels Gallery). As designers may be named A. Heins, a clever illustrator, and A. Lynen, of a thoroughly Brussels type, keenly observant and satirical.

At the exhibitions of the "XX" were pictures by the following: Fernand Khnopff ("Memories," a pastel, in Brussels Gallery), an admirer of the refined domesticity of English contemporary art, and of mystical art, as represented by Gustave Moreau; H. van der Velde, a well-known exponent of the new methods in applied art; J. Ensor, a whimsical nature, loving strange combinations of colour and inconsequent fancies (Brussels Gallery: "The Lamp-Man"); Th. van Rysselberghe, a clever painter, especially in the technique of dot painting (*pointillisme*); W. Schlobach, a remarkable colourist of uncertain tendencies; Henry de Groux, son of Ch. de Groux, a seer of visions represented in violent tones and workmanship; G. Vogels, a painter of thaw and rain; G. van Strydonck, R. Wytsman, J. Delvin, F. Charlet, Mlle A. Boch, all of whom have striven to bring light into their pictures; W. Finch and G. Lemmen.

To the Triennial Salons, to the exhibitions of the "Artistic" clubs, to the House of Art (*Maison d'Art*), at Brussels, and to the various Antwerp clubs, the following have contributed: F. Courtens, Rosseels' brilliant pupil, an astonishing painter with a heavy impasto (Brussels Gallery: "Coming Out of Church"); J. de Lalaing, full of lofty aims, but showing in his painting the qualities of a sculptor (Brussels Gallery: "A Prehistoric Hunter"); E. Claus, a lover of bright colour, and a genuine landscape painter (Brussels Gallery: "A Flock on the Road"); A. Baertsoen, who delights in the quiet corners of old Flemish towns; H. Evenepoel, a fine artist whose premature death deprived the Belgian school of a highly distinguished personality (Brussels Gallery: "Child at Play"); G. Vanaise, a painter of huge historical subjects; Ch. Mertens, a refined artist; E. Motte, an interesting painter with a love of archaic methods (Brussels Gallery: "A Girl's Head"); A. Lévêque, an accomplished draughtsman with a distinctive touch; L. Wolles, an admirable draughtsman; J. Leempoels, elaborate and minute; H. Richir, a portrait painter; J. van den Eeckhout, a clever pupil of Verheyden; J. Rosier, a skilful follower of Verlat; L. Abry, a painter of military subjects; E. Carpentier, E. Vanhove, Luyten, and Desmeth.

Essentially of the Antwerp school are F. van Kuyck, P. Verhaert, de Jans, and Brunin of Ghent, Ch. Doudelet, C. Montald, and van Biesbroeck.

There is a group of artists at Liége whose sincerity and high technical qualities have been recognized: A. Donnay, A. Rassenfosse, E. Berchmans, F. Marechal, Dewitte. Of lady painters: Mmes E. Beernaert, L. Héger, and J. Wytsman paint landscape. Mmes B. Art, A. Ronner, G. Meunier, and M. De Bièvre paint flowers. Mmes A. d'Anethan, Lambert de Rothschild, M. Philippson, H. Calais, and M. A. Marcotte paint figures and portraits.

The chief exhibitors at the Society *pour l'Art* are A. Ciamberlani, a painter of large decorative compositions in subdued tones; H. Ottevaere, a painter of night or twilight landscapes; O. Coppens, R. Janssens, and A. Hannotiau, who study old houses, deserted churches, and dead cities; F. Baes, an excellent pupil of Frédéric Fabry, O. and J. Dierickx, painters of decorative figures; H. Meunier, an ingeniously decorative draughtsman; J. Delville, founder of the Salons of Idealist art.

Leading exhibitors at the Voorwaerts Club have been E. Laermans, a strange artist, as it were a Daumier with anchylose joints, but a colourist (Brussels Gallery: "A Flemish Peasant"); V. Gilsoul, a clever pupil of Courtens (Brussels Gallery: "The Kennel"); J. du Jardin, the writer of *L'Art Flamand*, an important critical work illustrated by J. Middeleer.

Contributors to the exhibitions of the *Sillon* Club comprise G. M. Stevens, P. Verdussen, P. Matthieu, J. Gouweloos, Bastien, Blieck, Wagemans, and Smeers; and V. Mignot, ingenious in designing posters.

At the Exhibitions of Water Colours have been seen the works of Huberti, F. Bingé, V. Uytterschaut, Stacquet, and H. Cassiers, who work with light washes or a clever use of body colour; Hagemans, who paints with broad washes; Delaunois, the painter of mysterious interiors; Th. Lybaert, minute in his brushwork; M. Romberg and Titz, correct draughtsmen.

Since 1870 several important works of decorative painting in public buildings have been carried out in Belgium. Guffens, Swerts, and Pauwels have succumbed to the influences of German art, often cold and stiff; A. and J. Devriendt, V. Lagye, W. Geets, and Vander Onderaa have followed more or less in the footsteps of Leys. J. Stallaert has cleverly revived a classic style. Émile Wauters and A. Hennebicq have adopted the traditions of Historical Painting; and so too have L. Gallait, A. Cluysenaar, J. de Lalaing, and A. Bourland, though with a more decorative sense of conception and treatment. But of all these works, certainly the most remarkable in its artistic and intelligent fitness is that of M. Delbeke, in the market hall at Ypres.

See CAMILLE LEMONNIER, *Histoire des Arts en Belgique*; A. J. WAUTERS, *La Peinture Flamande*; J. DU JARDIN, *L'Art Flamand*.

(F. K*.)

HOLLAND.

The entire Impressionist movement of the end of the 19th century failed to exercise the slightest influence upon the Dutch. They are only modern in so far as they again resort to the classics of their Fatherland. For a whole generation Josef Israels was at the head of Dutch art. Born in 1827 at Groningen, the son of a money-changer, he walked every day in his early years, with a linen money-bag under his arm, to the great banking house of Mesdag, a son of which became later the famous marine painter. During his student days in Amsterdam he lived in the Ghetto, in the house of a poor but orthodox Jewish family. He hungered in Paris, and was derided as a Jew in the Delaroche school there. Such were the experiences of life that formed his character. In Zantvoort, the little fishing village close to Haarlem, he made a similar discovery to that which Millet had already made at Barbizon. In the solitude of the remote village he discovered that not only in the pages of history, but also in everyday life, there are tragedies. Having at first only painted historical subjects, he now began to depict the hard struggle of the seafaring man, and the joys and griefs of the poor. He commenced the long series of pictures that for thirty years and more occupied the place of honour in all Dutch exhibitions. They do not contain a story that can be rendered into words; they only tell the tale of everyday life. Old women, with rough, toil-worn hands and good-natured wrinkled faces, sit comfortably at the stove. Weatherbeaten seamen wade through the water, splashed by the waves as they drag along the heavy anchors. A peasant child learns how to walk by the aid of a little cart. Again, the dawning light falls softly upon a peaceful deathbed, on which an old woman has just breathed her last. A sad and resigned melancholy characterizes and pervades all his works. His toilers do not stand up straight; they are broken, without hope, and humble, and accomplish their appointed task without pleasure and without interest. He paints human beings upon whom the oppressions of centuries are resting; eyes that neither gaze on the present nor into the future, but back on to the long, painful past. A Jew, bearing the Ghetto yet in his bosom, is talking to us; and in his painting of the lowly and oppressed, he recounts the story of his own youth and the history of his own race.

The younger painters have divided Israels' subjects among them. Each has his own little field, which he tills and cultivates with industry and good sense; and paints one picture, to be repeated again and again during

his lifetime. Christoph Birschop, born in Friesland, settled as an artist in the land of his birth, where the national costumes are so picturesque, with golden chains, lace caps, and silver embroidered bodices. As in de Hoogh's pictures, the golden light streams through the window upon the floor, upon deep crimson table-covers; and upon a few silent human beings, whose lives are passed in dreamy monotony. Gerk Henkes paints the fogs of the canals, with boats gliding peacefully along. Albert Neuhuys selects simple family scenes, in cosy rooms with the sunlight peeping stealthily through the windows. Adolf Cortz, a pupil of Israels, loves the pale vapour of autumn, grey-green plains, and dusty country roads, with silvery thistles and pale yellow flowers. The landscape painters, also, have more in common with the old Dutch classic masters than with the Parisian Impressionists. There, on the hill, Rembrandt's windmill slowly flaps its wings; there Potter's cows ruminate solemnly as they lie on the grass. There are no coruscation and dazzling brightness, only the grey brownish mellowness that van Goyen affected. Anton Mauve, Jacob and Willem Maris, are the best known of the landscape men. Others are Mesdag, de Haas, Apol, Klinkenberg, Bastert, Blommers, de Kock, Bosboom, Ten Kate, du Chattel, Ter Meulen, Sande-Bakhuyzen. They all paint Dutch coast scenery, Dutch fields, and Dutch cattle, in excellent keeping with the old-master school, and with phlegmatic repose.

A few of the younger masters introduced a certain amount of movement into this distinguished, though somewhat somniferous, excellence. Breitner and Isaak Israels seem to belong rather to Manet's school than to that of Holland. The "suburb" pictures of W. Tholen, the flat landscapes bathed in light by Paul Joseph Gabriel, and Jan Veth's and Havermann's impressionistic portraits prove that, even among the Dutch, there are artists who experiment. Jan Toorop has even attained the proud distinction of being the *enfant terrible* of modern exhibitions, and his works appear to belong rather to the art of the old Assyrians than to the 19th century. But those who will endeavour to enter into their artistic spirit will soon discover that Toorop is deserving of more than a mere shrug of the shoulder; they will find that he is a great painter, who independently pursues original aims. At the present time all criticism of art is determined by the "line." All caprices and whims of the "line" are now ridden as much to death, and with the same enthusiasm, as were formerly those of "light." Toorop occupies one of the first places among those whose only aim consists in allowing the line to talk and make music. His astonishing power of physical expression may be noted. With what simple means, for example, he renders in his picture of the "Sphinx" all phases of hysterical desire; in that of "The Three Brides" nunlike resignation, chaste devotion, and unbridled voluptuousness. If his mastery over gesture, the glance of the eye, be remarked—how each feature, each movement of the hand and head, each raising and closing of the eyelid, exactly expresses what it is intended to express—Toorop's pictures will no more be scoffed at than those of Giotto, but he will be recognized as one of the greatest masters of the "line" that the 19th century has produced.

See MAX ROOSES. *Dutch Painters of the Nineteenth Century.* English Edition. London, 1898–1901. (R. MR.)

GERMANY.

The German school of painting, like that of France, entered on a new phase after the Franco-German war of 1870. An empire had been built up of the agglomeration of separate states. Germany needed no longer to gaze back admiringly at older and greater epochs. The historical painter became neglected. Not the heroic deeds of the past, but the political glories of the new empire were to be immortalized. This transition is particularly noticeable in the work of Adolf von Menzel. At the time of political stagnation he had recorded on his canvas the glories of Prussia in the past. Now that the present had achieved an importance of its own, he painted "The Coronation of King William at Königsberg" and "King William's Departure for the Army"; and ultimately he became the painter of popular subjects. The motley throng in the streets had a special fascination for him, and he loved to draw the crowd pushing its eager way to listen to a band on the promenade, in the market, at the doors of a theatre, or the windows of a café. He discovered the poetry of the builder's yard and the workshop. In the "Moderne Cyklopen" (Ironworks), painted in 1876, he left a monumental mark in the history of German art; for in this picture he depicts a simple incident in daily life, without any attempt at genre; and this was indeed the characteristic of his work for the next few years. Humorous anecdote, as represented by Knaus (b. 1829), Vautier (1829–1898), Defregger (b. 1835), and Grützner (b. 1846), found little acceptance. Serious representations of modern life were required; resort was made to all the expedients of the great painters, and the 'seventies were years of artistic study for Germany. Every great colourist in the past was thoroughly studied and his secrets discovered. In Germany, Wilhelm Leibl (b. 1844), holds the same prominent place that Courbet does in France. Leibl, like Courbet, (*q.v.*), showed that the task of painting is not to narrate, but to depict by the most convincing means at its disposal. He even went farther than Courbet in close scrutiny of nature. With loving patience he strove to translate into colour everything that his keen eye observed: he studied nature with the devotion of the mediæval artist. No feeling, strictly speaking, is discernible in his work. His greatest pictures are only of quiet life, with human accessories, and his painful accuracy divests his pictures of poetry. But when he first appeared, he was necessary. His painting of "Three Peasant Women in Church" is a grand documentary work of that period, whose first aim it was to conquer the picturesque. Leibl taught artists to study detail, to master the secrets of flower, leaf, and stalk.

A great number of pupils were encouraged by him to gain such a thorough mastery of every detail of technique as to be enabled to paint pictures that were thoroughly good in workmanship, irrespective of genre or anecdote. Among these, W. Trübner (b. 1851) stands pre-eminently as a painter. His works during the 'seventies are among the best painting done at Munich during that period; they are full and rich in colour, broad and bold in their treatment of the subject. A contemporary of his was Bruno Piglhein (b. 1848), a German Chaplin in this Courbet group, not heavy and matter-of-fact, but bold and witty. He revived the art of pastel painting and pointed the way to a new style in panoramic and decorative painting, whilst infusing beauty and grace into all his works.

The movement in applied arts which began at this time is also important. The revival of the German empire led to a renaissance in German taste. The "old German dwelling-rooms," which now became the fashion, could only be hung with pictures in keeping with the style of the old masters, and this entailed a closer study and imitation of their works than had hitherto been customary. Wilhelm Diez (b. 1839) is at the head of the group, and as well acquainted with the epoch from Dürer and Holbein to Ostade and Rembrandt as any art historian. In Harburger (b. 1846), Adrian Brouwer lived once more; and in Löfftz (b. 1845), Quintin Massys. Claus Meyer (b. 1846) imitated all the artistic tricks of Pieter de Hooch and Van

der Neer, of Delft. Holbein's costume studies were at first models for Fritz August Kaulbach (b. 1850). Later, he extended his studies to Dolci and Van Dyck, to Watteau and Gainsborough. Adolf Lier (1827–1882) applied the beauty of tone beloved by the old masters to landscape. Von Lenbach's works show the zenith of old-master talent in Germany. He had educated himself as a copyist of classical masterpieces, and passed through a schooling in the study of old masters such as none of his contemporaries had enjoyed. The copies which, as a young man, he made for Count Schach in Italy and Spain are among the best the brush has ever accomplished. Titian and Rubens, Velasquez and Giorgione, were imitated by him with equal success. In like manner he gave to his own works their distinguished old-master charm. More than all other painters of historical subjects, Lenbach enjoys the distinction of having been the historian of his epoch. He gave the great men of the era of the Emperor William I. the form in which they will live in German history, and beauty of colour is blended in all these pictures with their brilliant evidence of thought. The aspirations of a whole generation to restore the technique of the old masters found their realization in Lenbach.

Such was the position of things when there was imported from France the desire to paint light and sun. It was argued that the views which the old masters held concerning colour were in glaring contradiction to what the eye actually saw. The old masters, it was said, paid particular attention to the conditions of light and shade under which they did their work. The golden character of the Italian Renaissance was traceable to the old cathedrals lighted by stained-glass windows. The light and shade of the Netherlanders were in keeping with the light and shadow of the artists' studios lighted by little panes, and due partly to the fact that their pictures were intended to hang in dreamy, brown, panelled chambers. But was this golden or brown light suitable for the 19th century? Were we not illogical, when for the sake of reproducing the tones of the old masters, we darkened our studios and shut out the daylight by coloured glass windows and heavy curtains? Was not light one of the greatest acquisitions of recent times? When the Dutch painted, the world used only little panes of glass. Now the daylight streamed into our rooms through great white sheets of crystal. When our grandfathers lived, there were only candles and oil lamps. Now we had gas and electric light. Instead of imitating the old masters, let us paint the colouristic charms that were unknown to them. Let us do honour to the new marvels of colour. With such arguments as were advanced in France, did artists in Germany adopt the *plein-air* and abandon older methods; and a development like that which took place in France after the days of Manet ensued in Germany also. Daylight, which had so long been kept down, was now to be reproduced as clear and bright. After the art of painting strong effects full of daylight had been grappled with, other and more difficult problems of light effects were attempted. After the full blaze of sunshine had been successfully reproduced, such effects as the haze of early morning, the sultry vaporous atmosphere of the thunderstorm, the mysterious night, the blue-grey dawn, the delicate colours of variegated Chinese lanterns, the scintillation of gas and lamplight, and the dreamy twilight in the interior were dealt with.

Max Liebermann (b. 1849) was the first to join the new departure. In Paris he had learnt technique. Holland, the country of fogs, inspired him with the love for atmospheric effects, and its scenes of simple life, provided him with many subjects. Perhaps the "Net Menders" in the Hamburg Kunsthalle is most typical of Liebermann's art. Franz Skarbina (b. 1849), who was the second to join the new movement in Berlin, proceeded to studies of twilight and artificial light effects.

Hans Herrman (b. 1858), who settled himself on quays and ports; Hugo Vogel, who endeavoured to utilize scenes from contemporary life for decorative pictures; and the two landscape painters, Ludwig Dettmann (b. 1865) and Walther Leistikow (b. 1865), are other representatives of modern Berlin art. Carlsruhe, in the 'eighties, produced some modern pictures of great merit, when Gustav Schönleber (b. 1851) and Herrmann Baisch (b. 1846) showed daintily-conceived pictures of Dutch landscapes. In later years, Count Leopold Kalckreuth (b. 1855), whose powerfully-conceived representations of peasant life belong to the best productions of German realism, and Victor Weishaupt (b. 1848), the animal painter, removed thence to Stuttgart, the residence also of Otto Reiniger (b. 1863), a landscape painter of great originality. At Dresden we find Gotthard Kuehl (b. 1850), long domiciled in Paris, who was one of the first to accept Manet's teaching. In North Germany, Worpswede became a German Barbizon; Ende (b. 1860), Vogeler, and Vinnen (b. 1863) also worked there. In Weimar, two landscape painters of great refinement must be mentioned—Theodor Hagen (b. 1842) and Gleichen-Russwurm (b. 1866). As far back as the 'seventies they rendered ploughed fields, hills enveloped in thin vapour at sunrise, waving fields of corn, and apple trees in full bloom trembling in the rays of the evening glow, with a delicate understanding of natural effects.

But Munich still remains the headquarters of German art, which is there the first of all interests and pervades all circles. Almost all those who are working in other German towns received in that city their inspiration, and have indeed remained its citizens in heart. The International Exhibitions have given a great European tone and impulse to creative work. Among the elders, Albert von Keller (b. 1841) has perhaps the greatest originality. He is one of those who practised the art of the brush as long ago as the 'seventies, and painted, not for the sake of historical subjects or for genre, but for the sole love of his art. He painted everything, never restricted himself to any fixed programme, and never became trivial. He is perhaps in Germany the only painter of female portraits who has caught in his pictures a little of the charm that betrays itself in the expression and movements of the modern woman. In the works of Freiherr von Habermann (b. 1849) this refinement of sentiment, as expressed in colour, is combined with a still more decided shade of eccentricity. Already in his "Child of Sorrow," which hangs in the National Gallery at Berlin, he struck that painful chord that always remained his favourite. However different the subjects he has painted, a morbid note pervades them all.

In Heinrich Zügel (b. 1850), the Munich school possesses an animal painter who rivals the great Frenchmen in original power. Ludwig Dill (b. 1848), whom one must still count as "Dachauer," in spite of his migration to Carlsruhe, had for some time past been famous as a painter of Venice, the lagoons and Chioggia, when the impressionist movement became for him the starting-point of a new development. He strove for still brighter light, tried to realize the most subtle shades of colour, and raised himself from a painter of natural impressions to free and poetical lyricism. Arthur Langhammer (b. 1855), Ludwig Herterich, Leo Samberger (b. 1851), Hans von Bartels (b. 1856), Wilhelm Keller-Reutlinger (b. 1854), Beno Becker, Louis Corinth (b. 1858), Max Slevogt, are others that may be mentioned among the younger Munich artists.

Fritz von Uhde (b. 1848) occupies a peculiar position, as being the first to apply the principles of naturalism to religious art. Immediately before him, Eduard von Gebhardt (b. 1838) had gone back to the angular style of

the old northern masters, that of Roger van der Weyden and Albert Dürer, believing he could draw the old Biblical events closer to present times by relating them in Luther's language and representing them as taking place in the most powerful epoch of German ecclesiastical history. Now that historical paintings had been dispossessed by modern and contemporary subjects, it followed also that scenes from the life of Christ had to be laid in modern times. "I do not assert that only the commonplace occurrences of everyday life can be painted. If the historical past be painted, it should be represented in human garb corresponding to the life we see about us, in the surroundings of our own country, peopled with the people moving before our very eyes, just as if the drama had only been enacted the previous evening." Thus wrote Bastien-Lepage in 1879, when creating his "Jeanne d'Arc," and in this sense did Uhde paint. But besides the charm of feeling expressed in the subtlest hues, there is also the charm of the noble line.

At the time when, in England, Rossetti and Burne-Jones, and, in France, Puvis de Chavannes and Gustave Moreau, stepped into the foreground, in Germany Feuerbach (1829–1880), Marées (1837–1887), Thoma (b. 1839), and Böcklin (1827–1901) were discovered. Feuerbach's life was one series of privations and disappointments. His "Banquet of Plato," "Song of Spring," "Iphigenia" and "Pietà," and his "Medea" and "Battle of the Amazons," met with but scant recognition on their appearance. To some they appeared to lack sentiment, to others they were "not sufficiently German." When he died in Venice in 1880, he had become a stranger to his contemporaries. But posterity accorded him the laurel that his own age had denied him. Just those points in his pictures to which exception had been taken during his lifetime, the great solemn restfulness of his colouring and the calm dignity of his contours, made him appear contemporary.

Hans von Marées fulfilled a similar mission in the sphere of decorative art; his, likewise, was a talent that was not discovered until after his death. He is most in touch with Puvis de Chavannes. But the result was different. Puvis was recognized on his first appearance. Marées never had a chance of revealing his real strength. He was only 28 years of age when he first went to Rome; there, in 1873, he was commissioned to paint some pictures for the walls of the Zoological Station at Naples. After that time, nothing more was heard of him until 1891, when, four years after his death, the works he had left behind him were exhibited and presented to the gallery of Schleissheim. The value of these works of art must not be sought in their technique. The art of Puvis rests on a firm realistic foundation, but Marées had finished his studies of nature too prematurely for the correctness of his drawing. In spite of this defect, they encourage as well as excite, owing to the principle which underlies them, and which they share in equal degree with those of Puvis. Like Puvis, Marées repudiated all illuminating efforts whereby forms might be brought into relief. He only retained what was intrinsically essential, the large lines in nature, as well as those of the human frame.

Next to these artists stands Hans Thoma, like one of the great masters of Dürer's time. In Marées and Feuerbach's works there is the solemn grandeur of the fresco; in those of Thoma there is nothing of Southern loveliness, but something of the homeliness of the old German art of woodcut; nay, something philistine, rustic, patriarchal—the simplicity of heart and childlike innocence that entrance us in German folk-lore, in the paintings of Moritz von Schwind (1804–1871) and Ludwig Richter (1803–1884). He had grown up at Bernau, a small village of the Black Forest. Blossoming fruit-trees and silver brooks, green meadows and solitary peasants' cottages, silent valleys and warm summer evenings, grazing cattle and the cackle of the farmyard, all lived in his memory when he went to Weimar to study the painter's art. This pious faithfulness to the home of his birth and touching affection for the scenes of his childhood pervade all his art and are its leading feature. Even when depicting classical subjects, the mythological marvels of the ocean and centaurs, Thoma still remains the simple-hearted German, who, like Cranach, conceives antiquity as a romantic fairy tale, as the legendary period of chivalry.

Whether it be correct to place Böcklin (*q.v.*) in the same category with these painters, or whether he has a right to a separate place, posterity may decide. The great art of the old masters has weighed heavily upon the development of that of our own age. Even the idealists, who have been mentioned, trace their pedigree back to the old masters. However modern in conception, they are to all intents and purposes "old" as regards the form they employed to express their modern ideas. Böcklin has no ancestor in the history of art; no stroke of his brush reminds us of a leader. No one can think of tracing him back to the Academy of Düsseldorf, to Lessing, or Schorner, as his first teacher. Even less can he be called an imitator of the old masters. His works are the result of nature in her different aspects; they have not their origin in literary or historical suggestion. The catalogue of his conceptions, of landscape in varying moods, is inexhaustible. But landscape does not suffice to express his resources. Knights on the quest for adventure, Saracens storming flaming citadels, Tritons chasing the daughters of Neptune in the billowy waves; such were the subjects which appealed to him. He endowed all fanciful beings that people the atmosphere, that live in the trees, on lonely rocks, or that move and have their being in the slimy bottom of the sea, with body and soul, and placed a second world at the side of the world of actuality. Yet this universe of phantasy was too narrow for the master mind. If it be asked who created on the Continent of Europe the most fervid religious paintings of the 19th century; who alone exhausted the entire scale of sensations, from the placidity of repose to the sublimity of heroism, from the gayest laughter to tragedy; who possessed the most solemn and most serious language of form and, at the same time, the greatest poetry of colour—the name of Böcklin will most probably form the answer.

These masters were for their younger brethren the pioneers into a new world of art. It was momentous for the painter's art that in Germany, no less than in England and France, a new movement at this time set in—the so-called "arts and crafts." Hitherto the various branches of art had followed different courses. The most beautiful paintings were often hung in surroundings grievously lacking in taste. Now arose the ambition to make the room itself a work of art. The picture, as such, now no more stands in the foreground, but the different arts strive together to form a single piece of art. The picture is regarded as merely a decorative accessory.

Among the younger painters still to be mentioned, Max Klinger (b. 1857) is perhaps the most brilliant. He had begun with the etching-needle, and by its aid gave us entire novels, crisp little dramas of everyday life. But this realism was only a preliminary phase enabling him to pass on to a great independent art of form. His great picture, "Christ in Olympus," combines beauty of form with deep philosophical meaning. Ibsen in 1873, in his *Emperor and Galilean*, talked of a "third realm," combining heathen beauty with Christian profundity. Klinger's "Christ in Olympus" strikes the beholder as the realization of this idea. Stuck (b. 1853) shares with him the Hellenic serenity of form, the classical simplicity. Apart from this,

his pictures are thoroughly different. It might almost be said "Klinger is the Nazarene who stepped into Olympus"; the thoughtful, deep son of the North who carries profound physical problems into the beauty-loving Hellenic worship of the senses. Stuck's art is, also, almost classical in its insensibility and petrified coldness. In his first picture (1889), "The Guardian of Paradise," he painted a slim wiry angel, who, like Donatello's "St George," in calm confidence and self-assurance points the sword before him. And similar rigid figures, standing erect in steadiness—always portraits of himself—recur again and again in his works. Even his religious pictures—the "Pietà" and "The Crucifixion"—are, in reality, antique. One would seek in vain in them for the piety of the old masters or the Germanic fervour of Uhde. Grand in style and line, firm, solemn, serious in arrangement, they are yet hard and cold in conception.

Ludwig von Hoffmann (b. 1861) stands next to him, a gentle, dreamy German. In Stuck's work everything is strong and rugged: here all is soft and round. There the massiveness of sculpture and stiff heraldic lines: here all dissolved into variegated fairy tales, glowing harmonies. However classical he may appear, yet it is only the old yearning of the Germani for Hesperia—the song of Mignon—that rings throughout his works; the longing to emerge from the mist and the fog into the light, from the humdrum of everyday life into the remote fabulous world of fairydom, the longing to escape from sin and attain perfect innocence.

There are numerous others deserving of mention besides those already discussed. Josef Sattler, Melchior Lechter (b. 1871), and Otto Greiner (b. 1869), and likewise those who, such as von Berlepsch (b. 1852) and Otto Eckmann (b. 1865), devoted their energies again to "applied art."

See R. MUTHER. *The History of Modern Painting.* London, 1895.—*Deutsches Künstler-Lexikon der Gegenwart in Biographischen Skizzen.* Leipzig, 1898.—Mrs DE LA MAZELIÈRE. *La Peinture Allemande au XIXe Siècle.* Paris, 1900. (R. MR.)

AUSTRIA-HUNGARY.

In Austria the influence of Makart (1840–1884) was predominant in the school of painting during the last quarter of the 19th century. He personified the classical expression of an epoch, when a long period of colour-blindness was followed by an intoxication of colour. Whilst Piloty's ambition stopped short at the presentation of correct historical pictures, his pupil, Makart, felt himself a real painter. He does not interpret either deep thought or historical events, nor does he group his pictures together to suit the views of the art student. His work is essentially that of a colourist. Whatever his subject may be, whether he depicts "The Plague in Florence," "The Nuptials of Caterina Cornaro," "The Triumphal Entry of Charles V.," "The Bark of Cleopatra," or "The Five Senses," "The Chase of Diana," or "The Chase of the Amazons," his pictures are romances of brilliant dresses and human flesh. A few studies of the nude and sketches of colour, in which he merely touched the notes that were to be combined into chords, were the sole preliminaries he required for his historical paintings. Draperies, jewels, and voluptuous female forms, flowers, fruit, fishes, and marble—everything that is full of life and sensuous emotion, and shines and glitters, he heaps together into gorgeous still-life. And because by this picturesque sensuousness he restored to Austrian art a long-lost national peculiarity, his appearance on the scene was as epoch-making as if some strong power had shifted the centre of gravity of all current views and ideas.

In estimating Makart, however, we must not dwell on his pictures alone. He did more than merely paint—he lived them. Almost prematurely he dreamed the beautiful dream which in later days came nearer realization, that no art can exist apart from life—that life itself must be made an art. His studio, not without reason, was called his most beautiful work of art. Whithersoever his travels led him—to Granada, Algiers, or Cairo—he made extensive purchases, and refreshed his eye with the luscious splendour of rich silks and the soft lustrous hues of velvets. He made collections of carved ivory and Egyptian mummies, Gobelins, armour and weapons, old chests, antique sculpture, golden brocades with glittering embroideries, encrusted coverlets and the precious textures of the East, columns, pictures, trophies of all ages and all climes. He scattered money broadcast in striving to realize his dream of beauty—to pass one night, one hour, in the world of Rubens, so bright in colour, so princely in splendour.

Uniting as he did these artistic qualities in his own person—not only because he was a painter, but because in no other besides did the great yearning for æsthetic culture find such powerful utterance—Makart exercised an influence in Austria far transcending the actual sphere of the painter's art. An intense fascination went forth from the little man with the black beard and penetrating glance. At that time Makart dominated not merely Viennese art, but likewise the whole cultured life of the capital. Not only the Makart hat and the Makart bouquet made their pilgrimage through the world, he became also the motive power in all intellectual spheres. When Charlotte Wolter acted Cleopatra or Messalina on the stage, she not only wore dresses specially sketched for her by Makart, but she also spoke in Makart's style, just as Hamerling wrote in it. A veritable Makart fever, had, indeed, taken possession of Vienna. No other painter of the 19th century was so popular, the life of none other was surrounded by such princely sumptuousness. The scene when, during the festivals of 1879, he headed the procession of artists past the imperial box, mounted on a white steed glittering with gold, the Rubens hat with white feathers on his head, amidst the boisterous acclamations of the populace, is unique in the modern history of art. It is the greatest homage that a Philistine century ever offered an artist.

The life of August von Pettenkofen (1821–1889), who should, after Makart, be accounted the greatest Austrian painter of the last quarter of the 19th century, was passed much more modestly and serenely. He had grown up on one of his father's estates in Galicia, and had been a cavalry officer before becoming a painter. His place in Austria is that of Menzel in Germany. With Pettenkofen a new style appeared. The representation of modern subjects now began to take the place of historical painting, which had for so long a time been the ruling taste; not in the sense of the old-fashioned genre picture, but in that of artistic refined painting. Here, again, the distinctive Austrian note can be easily recognized. Pettenkofen's people are lazy, and yawn. All is contemplative and peaceful, full of dreamy, sleepy repose.

But neither Pettenkofen nor Makart has found followers. The great movement which, originating with Manet, took place in other centres of art, passed Austria by without leaving a trace. Hans Canon (b. 1829), who in his pictures transported the characters of the "Gründerzeit" to Venice of bygone days, and reproduced them as Venetian nobles and ladies of quality, is also a painter of note. So likewise is Rudolf Alt (b. 1812), still active with the brush in 1902, a refined painter in water-colours, who reproduces the beauties of Old Vienna in his subtle architectural sketches. Leopold Karl Müller (1834–1892), who had lived in Cairo with Makart, found his sphere of art in the variegated world of the Nile, and his ethnographical exactness, combined with his delicate colouring, made him for a long while much in request as a painter of Oriental

scenes, and a popular illustrator of Egyptological works. Emil Schindler was a great landscape painter, who often rose from faithful interpretation of nature to an almost heroic height. Heinrich von Angeli (b. 1840), again, furnished—as he continued to do—the European Courts with his representative pictures, combining refined conception with smooth elegant technique. These are the only artists who during the 'eighties rose above local mediocrity. After Makart died in 1884, the sun of Austrian art seemed to have set. Stagnation reigned supreme.

Only since the "Secession" from the old Society of Artists (*Künstlergenossenschaft*), which took place in 1896, has the former artistic life recommenced in Vienna. Theodor von Hermann, long domiciled in Paris, was the gifted initiator of the new movement, and succeeded in rousing a storm of discontent among the rising school of Viennese artists. They found a literary champion in their hero's father, who pleaded in eloquent language for a new Austrian culture. In November 1898 the Secessionists opened their first exhibition in a building erected by Josef Olbrück on the Wienerzeil. At first the importance of these exhibitions lay almost exclusively in the fact that the Viennese were thus given an opportunity of making acquaintance with the famous foreign masters, Puvis de Chavannes, Segantini, Besnard, Brangwyn, Meunier, Khnopff, Henri Martin, Vischer, who had until then been practically unknown in Austria, so that the public only then realized the inferiority of their countrymen's artistic work. Thus while acquainting the Viennese public with the strivings of European art, the Secession endeavoured at the same time to produce, in rivalry with foreigners, works of equal artistic merit. Leading foreign masters now joined the movement, and Vienna, which had so long stood aside, through inability to be represented worthily at international exhibitions, became once more a factor in contemporary European art.

Among the painters of the Secession, Gustav Klint possesses, perhaps, the most powerful original talent. Refined portraits, subtle landscapes, and decorative pictures, painted for the Tumba Palace and for the Vienna Hof Museum, first brought his name before the world. But he became famous in consequence of the controversy which arose around his picture, "Philosophy." He had been commissioned to paint the large ceiling piece for the "Aula" of the Vienna University, and instead of selecting a classical subject he essayed an independent work. The heavens open; golden and silvery stars twinkle; sparks of light gleam; masses of green cloud and vapour form clusters; naked human forms float about; a fiery head, crowned with laurel, gazes on the scene with large, serious eyes. Science climbs down to the sources of Truth: yet Truth always remains the inscrutable Sphinx. Klint paid the penalty of his bold originality by his work remaining dark and incomprehensible to most people. It has, notwithstanding, a historical importance for Austria corresponding to that which similar works of Besnard have for France. It embodies the first attempt to place monumental painting upon a purely colouristic basis, and to portray allegorical subjects as pure visions of colour. After Klint, Josef Engelhart (b. 1864) is deserving of notice. He is the true painter of Viennese life. On his first appearance his art was centred in his native place, and was strong in local colour, which was lacking in refinement. To acquire subtlety, he studied the great foreign masters and became a clever juggler with the brush, showing as much dexterity as any of them. Yet this virtuosity meant, in his case, only a good schooling, which should enable him to return with improved means to those subjects best suited to his talent. His works are artistic, but at the same time distinctly local.

Carl Moll (b. 1861) understands how to render with equal skill the play of light in a room and that of the sunbeams upon the fresh green grass. The rural pictures of Rist produce a fresh, cool, and sunny effect upon the eye; like a refreshing draught from a cool mountain spring—a piece of Norway on Austrian soil. Zettel's landscapes are almost too markedly Swiss in colour and conception. Julius von Kollmann worked a long time in Paris and London, and acquired, in intercourse with the great foreign painters—notably Carrière and Watts—an exquisitely refined taste, an almost hyperæsthetical sense for discreetly toned-down colour, and for the music of the line. In Friedrich König, M. von Schwindt's romantic vein is revived. Even the simplest scenes from nature appear under his hand as enchanted groves whispering secrets. Everything is true and, at the same time, dreamy and mysterious. The mythical beings of old German legends—dragons and enchanted princesses—peer through the forest thicket. Ernst Nowak (b. 1851), compared with him, is a sturdy painter, who knows his business well. He sings no delicate lyric. When one stands close by, his pictures appear like masonry—like reliefs. Seen from a distance, the blotches of colour unite into large powerful forms. Bernatzik understands how to interpret with great subtlety twilight moods—moonshine struggling with the light of street lamps, or with the dawn. Ticky followed Henri Martin in painting solemn forest pictures. Ferdinand André leans towards the austere power of Millet. He tells us in his work of labour in the fields, of bronzed faces and hands callous with toil; and especially must his charcoal drawings be mentioned, in which the colour overlays the forms like light vapour, and which, small as they are, have a sculptural effect. Auchentelier—known for his female studies—and Hänisch and Otto Friedrich (b. 1862), refined and subtle as landscape painters, must also be mentioned.

In rivalry with the Secession, the "Künstlergenossenschaft" has taken a fresh upward flight. Among figure painters, Delug, Goltz (b. 1857), Hirschl, and Veith are conspicuous; but still greater fascination is exercised by landscape painters such as Amesadan, Charlemont, &c., whose works show Austrian art in its most amiable aspect. Apart from Austrians proper, there are also representatives of the other nationalities which compose "the monarchy of many tongues." Bohemia takes the lead with a celebrity of European reputation—Gabriel Max (b. 1840), who, although of Piloty's school and residing in Munich, has never repudiated his Bohemian origin. The days of his youth were passed in Prague; and Prague, the mediæval, with its narrow winding alleys, is the most mysterious of all Austrian cities, enveloped in the breath of old memories and bygone legends. From this soil Max drew the mysterious fragrance that characterizes his pictures. His earliest work, the "Female Martyr on the Cross" (1867), struck that sweetly painful, half-tormenting, half-enchanting keynote that has since remained distinctively his. Commonplace historical painting received at Max's hands an entirely new *nuance*. The morbidness of the mortuary and the lunatic asylum, interspersed with spectres—something perverse, unnatural, and heartrending, —this is the true note of his art. His martyrs are never men—only delicate girls and helpless women. His colouring corresponds to his subjects. The sensations his pictures produce are akin to those which the sight of a beautiful girl lying in a mortuary, or the prison scene in *Faust* enacted in real life, might be expected to excite. He even applies the results of hypnotism and spiritualism to Biblical characters. In many of his pictures refinement in the selection of effects is missing. By over-production Max has himself vulgarized his art. Yet, despite his

manner of depicting the mysteries of the realms of shadows, and the intrusion of the spirit-world into realism, he remains a modern master. A new province—the spectral—was opened up by him to art.

Hans Schwaiger is the real *raconteur* of Bohemian legends. He, likewise, passed his youth in a small Bohemian village, over which old memories still brooded. In Hradec, places upon which the gallows had stood were still pointed out. The lonely corridors and passages of the ruined castle were haunted by the shades of its old possessors. This is the mood that led Schwaiger to legend-painting. But underlying his fairy tales there are the gallows or the alchemy of Faust. The landscape with its gloomy skies, the wooden huts, turrets, dwarfed trees—such are ever the accompaniments of his figures.

Of the younger generation of painters, Emil Orlick (b. 1870) seems to be the most versatile. Having acquired technique in Paris and Munich, he practically discovered Old Prague to the world of art. The dark little alleys of the ancient town, swarming with life compressed within their narrow compass, fascinated him. In order to retain and convey all the impressions that crowded in upon him in such superabundant plenitude, he learned how to use the knife of the wood-carver, the needle of the etcher, and the pencil of the lithographer. His studio more resembles the workshop of a printer than the atelier of a painter. In the field of lithography he has attained remarkable results. Orlick has also made his own everything that can be learned from the Japanese. Besides these masters, Albert Hynais, the creator of decorative pictures, almost Parisian in conception, must be mentioned. The landscape painters Wickener, Jansa, Slavicek, and Hudecek relate, in gentle melancholy tones of colour, the atmosphere and solitude of the wide plains of Bohemia.

In Poland, painting has its home at Cracow. Down to the year 1893 Johann Matejko was living there, in the capacity of director of the Academy. His pictures are remarkable for their originality and almost brutal force, and differ very widely from the conventional productions of historical painters. At the close of the 19th century Axentowicz, Olga Hojnanska, Mehoffer, Stanislawski, and Wyotkowski attracted attention. Although apparently laying much less stress on their Polish nationality than their Russian countrymen, their works proclaim the soul of the Polish nation, with its chivalrous gallantry and mute resigned grief, in a much purer form.

Hungary in the spring of 1899 lost him whom it revered as the greatest of its painters—Michael Munkacsy. Long before his death his brush had become idle. To the younger generation, which seeks different aims, his name has become almost synonymous with a wrongly-conceived old-masterly coloration, and with sensation painting and hollowness. "The Last Day of the Condemned Prisoner," his first youthful picture, contained the programme of his art. Then came "The Last Moments of Mozart," and "Milton dictating *Paradise Lost.*" These titles summon up before our eyes a period of all that is false in eclectic art, dominated by Delaroche and Piloty. Even the simple subjects of the Gospel were treated by Munkacsy in Piloty's meretricious style. "Christ before Pilate," "Ecce Homo," "The Crucifixion"—all these are gala representations, costume get-up, and, to that extent, a pious lie. But when we condemn the faults of his period, his personal merit must not be forgotten. When he first came to the fore, ostentation of feeling was the fashion. Munkacsy is, in this respect, the genuine son of the period. He was not one of those who are strong enough to swim against the stream. Instead of raising others to his level, he descended to theirs. But he has the merit of having painted spectacular scenes, such as the period demanded, with genuine artistic power. Like Rahl, Ribot, Roybet, and Makart, he was a *maître-peintre*, a born genius with the brush. Von Uhde and Liebermann were disciples of his school. And if these two painters have left that period behind them, and if independent natural sight has followed upon the imitation of the old masters, it is Munkacsy who enabled them to take the leap. (R. MR)

ITALY.

Modern Italy has produced one artist who towers over all the others, Giovanni Segantini (*q.v.*). Segantini owes as little to his period of study in Milan as Millet did to his sojourn at Delaroche's school. Both derived from their teachers a complete mastery of technique, and as soon as they were in possession of all the aids to art, they discarded them in order to begin afresh. Each painted what he had painted as a youth. They dwelt far from the busy world—Millet in Barbizon, Segantini at Val d'Albola, 5000 feet above the sea-level. They are equally closely allied in art. Millet, who rejected all the artifice of embellishment and perceived only beauty in things as they are, learned to see in the human body a heroic grandeur, in the movements of peasants a majestic rhythm, which none before him had discovered. Although representing peasants, his works resemble sacred pictures, so grand are they in their sublime, solemn simplicity. The same is true of Segantini's works. Like Millet, he found his vocation in observing the life of poor, humble people, and the rough grandeur of nature, at all seasons and all hours. As there is in Millet's, so also is there in Segantini's work a primitive, almost classical, simplicity of execution corresponding to the simplicity of the subjects treated. His pictures, with their cold silvery colouring, remind us of the wax-painting of old times and of the mosaic style of the Middle Ages. They are made up of small scintillating strokes; they are stony and look hard like steel. This technique alone, which touches in principle but not in effect, that of the *pointillistes*, permitted of his rendering what he wished to render, the stony crags of Alpine scenery, the thin scintillating air, the firm steel-like outlines. Finally, he passed from realistic subjects to thoughtful, Biblical, and symbolical works. His "Annunciation," the "Divine Youth," and the "Massacre of the Innocents" were products of an art that had abandoned the firm ground of naturalism and aimed at conquering supernatural worlds. This new aim he was unable to realize. He left the "Panorama of the Engadine," intended for the Paris Exhibition, in an unfinished state behind him. He died in his 42nd year, his head full of plans for the future. Modern Italy lost in him its greatest artist, and the history of art one of the rare geniuses.

Few words will suffice for the other Italian painters. The soil that had yielded down to Tiepolo's days such an abundant harvest was apparently in need of rest during the 19th century. At the Paris Exhibition of 1867 About called Italy "the tomb of art," and indeed until quite recent times Italian painting has had the character of mere pretty saleable goods. Francesco Vinea, Tito Conti, and Frederigo Andreotti painted with tireless activity sleek drapery pictures, with Renaissance lords and smiling Renaissance ladies in them. Apart from such subjects, the comic, genre, or anecdote ruled the fashion—somewhat coarse in colour and of a merrier tendency than is suitable for pictures of good taste. It was not until nearly the end of the 19th century that there was an increase in the number of painters who aim at real achievement. At the Paris Exhibition of 1900 only Detti's "Chest" and Signorini's "Cardinal" pictures reminded one of the comedy subjects formerly in vogue. The younger masters employ neither

"drapery-mummeries" nor spicy anecdote. They paint the Italian country people with refined artistic discernment, though scarcely with the naturalism of Northern nations. Apparently the calm, serious, ascetic, austere art initiated by Millet is foreign to the nature of this volatile, colour-loving people. Southern fire and delight in brilliant hues are especially characteristic of the Neapolitans. A tangle of baldacchinos, priests and choir boys, peasants making obeisance and kneeling during the passing of the Host, weddings, horse-races, and country festivals, everything sparkling with colour and glowing in Neapolitan sunlight—such are the contents of Paolo Michetti's, Vincenzo Capri's, and Edoardo Dalbono's pictures. But Michetti, from being an adherent of this glittering art, has found his way to the monumental style. The Venetians acknowledge and honour as their leader Giacomo Favretto, who died very young. He painted drapery pictures like most artists of the 'eighties, but they were never lackadaisical, never commonplace. The Venice of Canaletto and Goldoni, the magic city surrounded by the glamour of bygone splendour, rose again under Favretto's hands to fairylike radiance.

The older masters, Signorini, Tito Tommasi, Dall 'oca Branca, who depict the Piedmontese landscape, the light on the lagoons, and the colour charm of Venetian streets with so refined a touch, have numerous followers, whose pictures likewise testify to the seriousness that again took possession of Italian painters after a long period of purely commercial artistic industry. Side by side with these native Italians two others must be mentioned, who occupy an important place as interpreters of Parisian elegance and French art-history. Giuseppe de Nittis (born in Naples; died in Paris 1884) was principally known by his representations of French street life. The figures that enlivened his pictures were as full of charm as his rendering of atmospheric effects was refined. Giovanni Boldini, a Ferrarese living in Paris, also painted street scenes, full of throbbing life. But he excelled, besides, as a portrait-painter of ladies and children. He realized the aim of the Parisian Impressionists, which was to render life, and not merely mute repose. He understood in a masterly fashion how to catch the rapid movement of the head, the fleetest expression, the sparkling of the eye, a pretty gesture. From his pictures posterity will learn as much about the sensuous life of the 19th century as Greuze has told us about that of the 18th.

Among those who have been the leaders of modern Italian art, not already mentioned, are Domenico Morelli, Giovanni Costa, landscape painter; Sartorio, an Italian Pre-Raphaelite; Pasini, painter of the East; Muzzioli, a follower of Alma-Tadema; Barabino, historical painter; and most striking and original of all, Monticelli, whose glow of colours was often obtained, not only by palette-knife painting, but by squeezing the colour straight from the tubes on to the canvas.

See ASHTON R. WILLARD. *History of Modern Italian Art.* London, 1898. (R. MR.)

SPAIN AND PORTUGAL.

Modern Spanish painting began with Mariano Fortuny (*q.v.*), who, dying as long ago as 1874, nevertheless left his mark even on the following generation of artists. During his residence in Paris in 1866 he had been strongly influenced by Meissonier, and subsequently selected similar subjects—scenes in 18th-century costume. In Fortuny, however, the French painter's elaborate finish is associated with something more intense and vivid, indicative of the southern Latin temperament. He collected in his studio in Rome the most artistic examples of mediæval industry. The objects among which he lived he also painted with incisive spirit as a setting for elegant figures from the world of Watteau and of Goya, which are thrown into his pictures with amazing dash and sparkle; and this love of dazzling kaleidoscopic variety has animated his successors. Academic teaching tries to encourage historical painting. Hence, since the 'seventies, the chief paintings produced in Spain have been huge historical works, which have made the round of European exhibitions and then been collected in the Gallery of Modern Art at Madrid. There may be seen "The Mad Queen Juana," by Pradilla; "The Conversion of the Duke of Gandia," by Moreno Carbonero; "The Bell of Huesca," by Casado; "The Last Day of Numantia," by Vera; "Ines de Castro," by Cabello.

It is possible, of course, to discern in the love of the horrible displayed in these pictures an element of the national character, for in the land of bull-fights even painting turns to murder and sudden death, poison and the rope. However, at least we must admit the great power revealed, and recognize the audacious colouring. But in point of fact these works are only variants on those executed in France from the time of Delaroche to Jean Paul Laurens, and tell their story in the style that was current in Parisian studios in the 'sixties. What is called the national garb of Spain is mainly the cast-off fashion of Paris. After all this magniloquent work Fortuny's rococo became the rage. The same painters who had produced the great historical pictures were now content to take up a brilliant and dazzling miniature style; either, like Fortuny himself, using small and motley figures in baroque subjects, or adapting the modern national life of Spain to the rococo style.

Here again we observe the acrobatic dexterity with which the painters, Pradilla especially, use the brush. But here again there is nothing essentially new—only a repetition of what Fortuny had already done twenty years before. The Spanish school, therefore, presented a very old-fashioned aspect at the Paris Exhibition of 1900. The pictures shown there were mostly wild or emotional. Bedouins fighting, an antique quadriga flying past, the inhabitants of Pompeii hastily endeavouring to escape from the lava torrent, Don Quixote's Rosinante hanging to the sail of the windmill, and the terrors of the Day of Judgment were the subjects; Alvarez Dumont, Benlliure y Gil, Ulpiano Checa, Manuel Ramirez Ibañez, and Morena Carbonero were the painters. Among the huge canvases, a number of small pictures, things of no importance, were scattered, which showed only a genre-like wit. Spain is a somewhat barren land in modern art. There painting, although active, is blind to life and to the treasures of art which lie unheeded in the road. Only one artist, Agrasot, during the 'seventies painted pictures of Spanish low life of great sincerity; and much later two young painters appeared who energetically threw themselves into the modern movement. One was Sorolla y Bastida, by whom there is a large fishing picture in the Luxembourg, which in its stern gravity might be the work of a Northern painter; the other was Ignacio Zuloaga, in whom Goya seems to live again. Old women, girls of the people, and *cocottes* especially, he has painted with admirable spirit and with breadth. Spain, which has taken so little part in the great movement since Manet's time, only repeating in old-fashioned guise things which are falsely regarded as national, seems at last to possess in Zuloaga an artist at once modern and genuinely national.

Portugal took an almost lower place in the Paris Exhibition. For whereas the historical Spanish school has endeavoured to be modern to some extent, at least in colour, the Portuguese cling to the blue-plush and red-velvet splendours of Delaroche in all their crudity. Weak pictures of monks and of visions are produced in numbers, together with genre pictures depicting the popular life

of Portugal, spiced to the taste of the tourist. There are the younger men who aim at availing themselves of the efforts of the open-air painters; but even as followers of the Parisians they only say now what the French were saying long years ago through Bastien-Lepage, Puvis de Chavannes, and Adrien Dumont. There is always a Frenchman behind the Portuguese, who guides his brush and sets his model. The only painter formed in the school is Carlos Reis, whose vast canvas "Sunset" has much in common with the first huge peasant pictures painted in Germany by Count Kalckreuth. One painter there is, however, who is quite independent and wholly Portuguese, a worthy successor of the great old masters of his native land, and this is Columbano, whose portraits of actors have a spark of the genius which inspired the works of Velasquez and Goya. (R. MR.)

Denmark.

Denmark resembles Holland in this: that in both, nature presents little luxury of emphasized colour or accentuated majesty of form. Broad flats are everywhere to be seen—vague, almost indefinable, in outline. Danish art is as demure and staid as the Danish landscape. As in Holland, the painters make no bold experiments, attempt no pretentious subjects, no rich colouring, nothing sportive or light. Like the Dutch, the Danes are somewhat sluggishly tranquil, loving dim twilight and the swirling mist. But Denmark is a leaner land than Holland, less moist and more thinly inhabited, so that its art lacks the comfortable self-satisfied character of Dutch art. It betrays rather a tremulous longing, a pleasing melancholy and delight in dreams, a trembling dread of contact with coarse and stern reality. It was only for a time, early in the 'seventies, that a touch of cosmopolitanism affected Danish art. The phase of grandiose historical painting and anecdotic genre was experienced there, as in every other country. In Karl Bloch (b. 1834), Denmark had a historical painter in some respects parallel with the German Piloty; in Axel Helsted (b. 1847), a genre painter reminding us of Ludwig Knaus. The two artists Laurits Tuxen (b. 1853) and Peter Kröyer (b. 1851), who are most nearly allied to Manet and Bastien-Lepage, have a sort of elegance that is almost Parisian. Kröyer, especially, has bold inventiveness and amazing skill. Open-air effects and twilight moods, the glare of sunshine and artificial light, he has painted with equal mastery. In portraiture, too, he stands alone. The two large pictures in which he recorded a "Meeting of the Committee of the Copenhagen Exhibition, 1887," and a "Meeting of the Copenhagen Academy of Sciences," are modern works which in power of expression may almost compare with those of Frans Hals. Such versatility and facile elegance are to be found in no other Danish painter. At the period of historic painting it was significant that next to Bloch, the cosmopolitan, came Kristian Zahrtmann (b. 1843), who painted scenes from the life of Eleonora Christina, a Danish heroine (daughter of Christian IV.), with the utmost simplicity, and without any emotional or theatrical pathos. This touching feeling for home and country is the keynote of Danish art. The Dane has now no sentiment but that of home; his country, once so powerful, has become but a small one, and has lost its political importance. Hence he clings to the little that is left to him with melancholy tenderness. Viggo Johansen (b. 1851), with his gentle dreaminess, is the best representative of modern Danish home-life. He shows us dark sitting-rooms, where a quiet party has met around the tea-table. "An Evening at Home," "The Christmas Tree," "Grandmother's Birthday," are typical subjects, and all have the same fresh and fragrant charm. He is also one of the best Danish landscape painters. The silvery atmosphere and sad, mysterious stillness of the island-realm rest on Johansen's pictures. Not less satisfactory in their little world are the rest: Holsöe (b. 1866), Lauritz Ring (b. 1854), Haslund, Syberg (b. 1862), Irminger (b. 1850), and Ilsted paint the pleasant life of Copenhagen. In Skagen, a fishing town at the extreme end of Jutland, we find painters of sea life: Michael Ancher (b. 1849), Anna Ancher (b. 1859), and C. Locher (b. 1851). The landscape painters Viggo Pedersen (b. 1854), Philipsen (b. 1840), Julius Paulsen (b. 1860), Johan Rohde (b. 1856) have made their home in the villages round Copenhagen. Each has his own individuality and sees nature with his own eyes, and yet in all we find the same sober tone, the same gentle, tearful melancholy. The new Idealism has, however, been discernible in Denmark. Joakim Skovgaard (b. 1856), with his "Christ among the Dead" and "Pool of Bethesda," is trying to endow Denmark with a monumental type of art. Harald Slott-Möller (b. 1864) and J. F. Willumsen (b. 1863) affect a highly symbolical style. But even more than these painters, who aim at reproducing ancient folk-tales through the medium of modern mysticism, two others claim our attention, by the infusion into the old tradition of a very modern view of beauty approaching that of Whistler and of Carrière: one is Ejnar Nielsen, whose portraits have a peculiar, refined strain of gentle Danish melancholy; the other, V. Hammershöj, who has an exquisite sense of tone, and paints the magical effect of light in half-darkened rooms. Among the more noteworthy portrait painters, Aug. Jerndorff and Otto Bache should be included; and among the more decorative artists, L. Frölich. Hans Tegner is the greatest illustrator of the day. (R. MR.)

Sweden.

There is as great a difference between Danish and Swedish art as between Copenhagen and Stockholm. Copenhagen is a homely provincial town, and life is confined to home circles. In Stockholm we find the whirl of life and all the elegance of a capital. It has been styled the Paris of the North, and its art also wears this cosmopolitan aspect. Düsseldorf, where in the 'sixties most painters studied their art, appeared to latter-day artists too provincial. Munich and, to a still greater extent, Paris became their "Alma Mater." Salmson (1843–1894) and Hagborg (b. 1852), who were first initiated into naturalism in Paris, adopted this city for a domicile. They paint the fishermen of Brittany and the peasants of Picardy; and even when apparently interpreting Sweden, they only clothe their Parisian models in a Swedish garb. Those who returned to Stockholm turned their Parisian art into a Swedish art, but they have remained cosmopolitan until this day. Whilst there is something prosy and homely about Danish art, that of Sweden displays nervous elegance and cosmopolitan polish. Simplicity is in her eyes humdrum; she prefers light and brilliant notes. There, a naturalness and simplicity allow us to forget the difficulties of the brush: here, we chiefly receive the impression of a cleverly solved problem. There, the greatest moderation in colour, a soft all-pervading grey: here, a cunning play with delicate tones and gradations—a striving to render the most difficult effects of light with obedient hand. This tendency is particularly marked in the case of the landscape painters: Per Ekström (b. 1844), Niels Kreuger (b. 1858), Karl Nordström (b. 1865), Prince Eugen (of Sweden, b. 1865), Axel Sjöberg Wallander (b. 1862), and Wahlberg (b. 1864). Nature in Sweden has not the idyllic softness, the veiled elegiac character, it displays in Denmark. It is more coquettish, southern, and French, and the painters regard it also with French eyes.

As a painter of animals, Bruno Liljefors (b. 1860) created a sensation by his surprising pictures. Whatever his subjects—quails, capercailzies, dogs, hares, magpies, or thrushes—he has caught the fleetest motions and the most transitory effects of light with the cleverness of a Japanese. With this exception, the Swedish painters cannot be classified according to "subjects." They are "virtuosi," calling every technical aspect of art their own—as well in fresco as in portrait painting. Oscar Bjórek (b. 1860), Ernst Josephson (b. 1851), Georg Pauli (b. 1855), Richard Bergh (b. 1858), Hanna Hirsch (now Pauli, b. 1864), are the best-known names. Carl Larsson's (b. 1853) decorative *panneaux* fascinate by their easy lightness and coquettish grace of execution. Ander Zorn (b. 1860), with his dazzling virtuosity, is as typical of Swedish as the prosaic simplicity of Johansen is of Danish art. His marine pictures, with their undulating waves and naked forms bathed in light, belong to the most surprising examples of the cleverness with which modern art can stereotype quivering motions; and the same boldness in handling his subjects, which triumphs over difficulties, makes his "interiors," his portraits and etchings, objects of admiration to every painter's eye. In his "Dance before the Window" all is vivacity and motion. His portrait of a "Peasant Woman" is a powerful harmony of sparkling yellow-red tones of colour. Besides these older masters who cleave to the most dazzling light effects, there are the younger artists of the school of Carl Larsson, who aspire more to decorative effects on a grander scale. Gustav Fjälstad (b. 1868) exhibited a picture in the Paris Exhibition of 1900 that stood out like mosaic among its surroundings. And great similarity in method has Hermann Normann, who, as a landscape painter, also imitates the classic style. (R. MR.)

NORWAY.

We enter a new world when in picture galleries we pass to the Norwegian from the Swedish section. From the great city we are transported to nature, solemn and solitary, into a land of silence, where a rude, sparse population, a race of fishermen, snatches a scanty sustenance from the sea. The Norwegians also contributed for a time to the international market in works of art. They sent mainly genre pictures telling of the manners and customs of their country, or landscapes depicting the phenomena of Northern scenery. Adolf Tidemand (1814–1876) introduced his countrymen—the peasants and fishermen of the Northern coast—to the European public. We are introduced to Norwegian Christmas customs, accompany the Norseman on his nocturnal fishing expeditions, join the "Brudefærd" across the Hardanger fjord, sit as disciples at the feet of the Norwegian sacristan. Ferdinand Fagerlin (b. 1825) and Hans Dahl are two other painters who, educated at Düsseldorf and settled in Germany, introduced the style of Knaus and Vautier to Norwegian art circles. Knud Badde (1808–1879), Hans Gude (b. 1825), Niels Bjórnsen Möller, Morten-Müller (b. 1828), Ludvig Munthe (1843–1896), and Adelsten Normann (b. 1848) are known as excellent landscape painters, who have faithfully portrayed the majestic mountain scenery and black pine forests of their native land, the cliffs that enclose the fjords, and the sparkling snowfields of the land of the midnight sun. But the time when actuality had to be well seasoned, and every picture was bound to have a spice of genre or the attraction of something out of the common to make it palatable, is past and gone. As early as the 'sixties Björnson was president of a Norwegian society which made it its chief business to wage war against the shallow conventionalities of the Düsseldorf school. Ibsen was vice-president. In the works of the more modern artists there is not a single trace of Düsseldorf influence. Especially in the 'eighties, when naturalism was at its zenith, we find the Norwegians its boldest devotees. They portrayed life as they found it, without embellishment; they did not trouble about plastic elegance, but painted the land of their home and its people in a direct, rough-hewn style. Like the people we meet in the North, giants with stalwart iron frames, callous hands, and sunburnt faces, with their sou'-westers and blue blouses, who resemble sons of a bygone heroic age, have the painters themselves—notably Niels Gustav Wentzel (b. 1859), Svend Jórgensen (b. 1861), Kolstœ (b. 1860), Christian Krohg—something primitive in the directness, in, one might almost say, the barbarous brutality with which they approach their subjects. They preferred the most glaring effects of *plein-air*; they revelled in all the hues of the rainbow.

But these very uncouth fellows, who treated the figures in their pictures with such rough directness, painted even in those days landscapes with great refinement; not the midnight sun and the precipitous cliffs of the fjords, by which foreigners were sought to be impressed, but austere, simple nature, as it lies in deathlike and spectral repose—lonely meres, whose surface is unruffled by the keel of any boat, where no human being is visible, where no sound is audible; the hour of twilight, when the sun has disappeared behind the mountains, and all is chill and drear; the winter, when an icy blast sweeps over the crisp snowfields; the spring, almost like winter, with its bare branches and its thin young shoots. Such were their themes, and painters like Amaldus Nilsen (b. 1838), Eilif Petersen (b. 1852), Christian Skredsvig (b. 1854), Fritz Thaulow (b. 1848), and Gerhard Munthe (b. 1849) arrested public attention by their exhibition of pictures of this character.

Latterly these painters have become more civilized, and have emancipated themselves from their early uncouthness. Jörgensen, Krohg, Kolstœ, Soot, Gustav Wentzel, no longer paint those herculean sailors and fishermen, those pictures of giants that formerly gave to Norwegian exhibitions their peculiar character. Elegance has taken possession of the Norwegian palette. This transformation began with Fritz Thaulow, and indeed his art threatened to relapse somewhat into routine, and even the ripples of his waters to sparkle somewhat coquettishly. Borgen (b. 1852), Hennig (b. 1871), Hjerlów (b. 1863), and Stenersen (b. 1862) were gifted recruits of the ranks of Norwegian painters, whilst Halfdan Strom (b. 1863), who depicts rays of light issuing from silent windows and streaming and quivering over solitary landscapes, dark blue streams and ponds, nocturnal skies, variegated female dresses, contrasting as spots of colour with dark green meadows, has a delicacy in colouring that recalls Cazin. Gerhard Munthe, who, as we have seen, first made a name by his delicate vernal scenery, has turned his attention to the classical side of art; and, finally, Erik Werenskjold (b. 1855), who was also first known by his landscapes and scenes of country life, afterwards gained success as an illustrator of Norwegian folk-lore. (R. MR.)

RUSSIA.

Until late in the 19th century modern Russian painting was unknown to western Europe. What had been seen of it in international exhibitions showed the traditions of primitive European art, with a distinct vein of barbarism. In the early 'fifties, painters were less bent on art than on political agitation; they used the brush as a means of propaganda in favour of some political idea. Peroff showed us the miserable condition of the serfs, the wastefulness and profligacy of the nobility. Vereschagin made himself the advocate of the soldier, painting the horrors of war long before the Tsar's manifesto preached universal disarmament. Art suffered from this praiseworthy

misapplication; many pictures were painted, but very few rose to the level of modern achievement in point of technique. It was only by the St Petersburg art journal *Mir Iskustwa*, and by a small exhibition arranged at Munich in 1892 by a group of Russian landscape painters, that it was realized that a younger Russian school had arisen, fully equipped with the methods of modern technique, and depicting Russian life with the stamp of individuality. At the Paris Exhibition of 1900 the productions of this young Russian school were seen with surprise. A florescence similar to that which literature displayed in Pushkin, Dostoiefsky, and Tolstoy seemed to be beginning for Russian painting. Some of these young painters rushed into art with unbridled zest, painting with primitive force and boldness. They produced historical pictures, almost barbaric but of striking force; representations of the life of the people full of deep and hopeless gloom; the poor driven by the police and huddled together in dull indifference; the popes tramping across the lonely steppes, prayer-book in hand; peasants muttering prayers before a crucifix. There is great pathos in "The Karamasow Brothers," or "The Power of Darkness." At the same time we feel that a long-inherited tradition pervades all Russia. We find a characteristic ecclesiastical art, far removed from the productions of the *fin de siècle*, in which the rigid tradition of the Byzantines of the 3rd century still survives. And, finally, there are landscapes almost Danish in their bloodless, dreamy tenderness. Among the historical painters Elias Repin is the most impressive. In his pictures, "Ivan the Cruel," "The Cossacks' Reply to the Sultan," and "The Miracle of Saint Nicholas," may be seen—what is so rare in historical painting—genuine purpose and style. Terror is rendered with Shakespearean power; the boldness with which he has reconstituted the past, and the power of pictorial psychology which has enabled him to give new life to his figures, are equally striking in "Sowing on the Volga" and "The Village Procession." He was the first to paint subjects of contemporary life, and the work, while thoroughly Russian, has high technical qualities—the sense of oppression, subjection, and gloom is all-pervading. But he does not "point the moral," as Peroff did; he paints simply but sympathetically what he sees, and this lends his pictures something of the resigned melancholy of Russian songs. Even more impressive than Repin is Philippe Maliavine. He has rendered peasants, stalwart figures of powerful build and, in a picture called "Laughter," Macbeth-like women, wrapped in rags of fiery red, are thrown on the canvas with astonishing power. Among religious painters Victor Vasnezoff, the powerful decorator of the dome in the church of St Vladimir at Kieff, is the most distinguished figure. These paintings seem to have been executed in the very spirit of the Russian Church; blazing with gold, they depend for much of their effect upon barbaric splendour. But Vasnezoff has painted other things: "The Scythians," fighting with lance and battle-axe; horsemen making their way across the pathless steppe; and woods and landscapes pervaded by romantic charm, the home of the spirits of Russian legend. Next to Vasnezoff is Michael Nesteroff, a painter also of monks and saints, but as different from him as Zurbaran from the mosaic workers of Venice; and Valentin Seroff, powerful in portraiture and fascinating in his landscape. It is to be remarked that although these artists are austere and unpolished in their figure-painting, they paint landscape with delicate refinement.

Schischkin and Vassilieff were the first to paint their native land in all simplicity, and it is in landscape that Russian art at the present time still shows its most pleasing work. Savrassoff depicts tender spring effects; Kuindshi light birch-copses full of quivering light; Sudkovski interprets the solemn majesty of the sea; Albert Benois paints in water-colour delicate Finnish scenery; Apollinaris Vasnezoff has recorded the dismal wastes of Siberia, its dark plains and endless primeval forest, with powerful simplicity.

A special province in Russian art must be assigned to the Poles. It is difficult indeed to share to the full the admiration felt in Warsaw for the Polish painters. It is there firmly believed that Poland has a school of its own, owing nothing to Russia, Austria, or Germany; an art which embodies all the chivalry and all the suffering of that land. The accessories are Polish, and so are the costumes. Jan Chelminski, Wojcliech Gerson, Constantine Gorski, Apolonius Kendzrierski, Joseph Ryszkievicz, and Roman Szvoinicki are the principal artists. We see in their pictures a great deal of fighting, a great deal of weeping; but what there is peculiar to the Poles in the expression or technique of their works it is hard to discover.

Finland, on the other hand, is thoroughly modern. Belonging by descent to Sweden rather than to Russia, its painters' views of art also resemble those of the "Parisians of the North." They display no ungoverned power, but rather supple elegance. The play of light and the caprice of sunshine are rendered with much subtlety. Albert Edelfeldt is the most versatile artist of the group; Axel Gallen, at first naturalistic, developed into a decorative artist of fine style; Eero Jaernefelt charms with his airy studies and brilliant landscapes. Magnus Enckell, Pekka Halonen, and Victor Vesterholm sustain the school with work remarkable for sober and tasteful feeling. (R. MR.)

BALKAN STATES.

Until quite recent times the Balkan States had no part at all in the history of art. But at the Paris Exhibition of 1900 it was noted with surprise that even in south-eastern Europe there was a certain pulsation of new life. And there were also signs that painting in the Balkans, which thitherto had appeared only as a reflex of Paris and Munich art, would ere long assume a definite national character. At this Exhibition Bulgaria seemed to be the most backward of all, its painters still representing the manners and customs of their country in the style of the illustrated papers. Market-places are seen, where women with golden chains, half-nude boys, and old Jews are moving about; or cemeteries, with orthodox clergy praying and women sobbing; military pageants, wine harvests, and horse fairs, old men performing the national dance, and topers jesting with brown-eyed girls. Such are the subjects that Anton Mittoff, Raymund Ulrich, and Jaroslav Vesin paint. More original is Mvkuicka. In his most important work he represented the late princess of Bulgaria sitting on a throne, solemn and stately, in the background mosaics rich in gold, tall slim lilies at her side. In his other pictures he painted Biblical landscapes, battlefields wrapped in sulphurous smoke, and old Rabbis—all with a certain uncouth barbaric power. The Bulgarian painters have not as yet arrived at the æsthetic phase. One of the best among them, who paints delicate pale green landscapes, is Charalampi Ilieff; and Nicholas Michailoff, who lives at Munich, has executed pictures, representing nymphs, that arrest attention by their delicate tone and their beautiful colouring.

Quite modern was the effect of the small Croatian-Slavonic Gallery in the Exhibition. Looking at the pictures there, the visitor might imagine himself on the banks of the Seine rather than in the East. The French saying, "*Faire des Whistler, faire des Dagnan, faire des Carrière*," is eminently applicable to their work. Vlaho

Bukovak, Nicola Masic, Csiks, and Medovic all paint very modern pictures, and in excellent taste, only it is surprising to find upon them Croatian and not Parisian signatures.

Precisely the same judgment must be passed with regard to Rumania. Most of the painters live in Paris or Munich, have sought their inspiration at the feet of the advanced masters there, and paint, as pupils of these masters, pictures just as good in taste, just as cosmopolitan and equally devoid of character. Irène Deschly, a pupil of Carrière, illustrates the songs of François Coppée; Verona Gargouromin is devoted to the pale symbolism of Dagnan-Bouveret. Nicolas Grant paints bright landscapes, with apple trees with their pink blossoms, like Darnoye. Nicolas Gropeano appears as the double of Aman-Jean, with his female heads and pictures from fairy tales. Olga Koruca studied under Puvis de Chavannes, and painted Cleopatra quite in the tone of her master. A landscape by A. Segall was the only work that appeared to be really Rumanian, representing thatched huts.

Servia is in striking contrast to Rumania. No trace of modern influence has penetrated to her. There historical painting, such as was in vogue in France and Germany a generation ago, is the order of the day. Risto Voucanovitch paints his scenes from Servian history in brown; Paul Ivanovitch his in greyish *plein-air*. But in spite of this *paté* painting, the latter's works have no modern effect —as little as the sharply-drawn small landscapes of his brother Svatislav Ivanovitch. (R. MR.)

UNITED STATES.

The history of painting in the United States is almost entirely a 19th-century record. The earlier years of the nation were devoted to establishing government, subduing the land and the aborigines, building a commonwealth out of primeval nature; and naturally enough the æsthetic things of life received not too much consideration. In Colonial times the graphic arts existed, to be sure, but in a feeble way. Painting was made up of portraits of prominent people; only an occasional artist was disposed towards historical pictures; but the total result added little to the sum of art or to the tale of history. The first artist of importance was J. S. Copley (1737–1815), with whom painting in America really began. Benjamin West (1738–1820) belongs in the same period, though he spent most of his life in England, and finally became President of the Royal Academy. As a painter he is not to be ranked so high as Copley. In the early part of the 19th century two men, John Trumbull (1756–1843), a historical painter of importance, and Gilbert Stuart (1755–1828), a pre-eminent portrait painter, were the leaders; and after them came John Vanderlyn (1776–1852), Washington Allston (1779–1843), Rembrandt Peale (1787–1860), J. W. Jarvis (1780–1834), Thomas Sully (born in England, 1783–1872)—men of importance in their day. The style of all this early art was modelled upon that of the British school, and indeed most of the men had studied in England under the mastership of West, Lawrence, and others. The middle or second period of painting in the United States began with the landscape work of Thomas Doughty (1793–1856) and Thomas Cole (1801–1848). It was not a refined or cultivated work, for the men were in great measure self-taught, but at least it was original and distinctly American. In subject and in spirit it was perhaps too panoramic and pompous; but in the hands of A. B. Durand (1796–1886), J. F. Kensett (1818–1872), and F. E. Church (1826–1900), it was modified in scale and improved in technique.

A group of painters called the Hudson River school finally emerged. To this school some of the strongest landscape painters in the United States owe their inspiration, though in almost every case there has been the modifying influence of foreign study. Contemporary with Cole came the portrait painters Chester Harding (1792–1866), C. L. Elliott (1812–1868), Henry Inman (1801–1846), William Page (1811–1885), G. P. A. Healy (1813–1894), Daniel Huntington, and W. S. Mount (1807–1868), one of the earliest genre painters. Foreign art had been followed to good advantage by most of these painters, and as a result some excellent portraits were produced. The excellence of the work was not, however, appreciated by the public generally, because art knowledge was not at that time a public possession. Little was required of the portrait painter beyond a recognizable likeness. A little later the teachings of the Düsseldorf school began to have an influence upon American art through Leutze (1816–1868), who was a German pupil of Lessing, and went to America to paint historical scenes from the Revolutionary War. But the foreign influence of the time to make the most impression came from France in 1855 with two American pupils of Couture—W. M. Hunt (1824–1879) and Thomas Hicks (1823–1890). Hunt had also been a pupil of Millet at Barbizon, and was the real introducer of the Barbizon painters to the American people. After his return to Boston his teaching and example had much weight in moulding artistic opinion. He, more than any other, turned the rising generation of painters towards the Paris schools. Contemporary with Hunt and following him were a number of painters, some self-taught and some schooled in Europe, who brought American art to a high standard of excellence. George Fuller (1822–84), Eastman Johnson, Elihu Vedder, produced work of much merit; and John La Farge and Winslow Homer were unquestionably in 1902 the foremost painters in the United States. In landscape the three strongest men have passed away — A. H. Wyant, George Inness, and Homer Martin. Swain Gifford, Edward Gay, Thomas Moran, Jervis McEntee, Albert Bierstadt, are other landscape painters of note who belonged to the middle period and reflected the traditions of the Hudson River school to some extent. With the Centennial Exhibition at Philadelphia in 1876 a widespread and momentous movement in American art began to shape itself. The display of pictures at Philadelphia, the national prosperity, and the sudden development of the wealth of the United States had doubtless much to do with it. Many young men from all parts of the country took up the study of art and began going abroad for instruction in the schools at Munich, and, later, at Paris. Before 1880 some of them had returned to the United States and founded schools and societies of art, like the Art Students' League and the Society of American Artists. The movement spread to the Western cities, and in a few years museums and art schools began to appear in all the prominent towns, and a national interest in art was awakened. After 1870 the predominant influence, as regards technical training, was French. Many students still go to Paris to complete their studies, though there is a large body of accomplished painters teaching in the home schools, with satisfactory results as regards the work of their pupils. From their French training, many of the American artists have been charged with echoing Parisian art; and the charge is partly true. They have accepted French methods because they think them the best, but their subjects and motives are sufficiently original.

Among the "younger element" in American art are W. M. Chase, for many years President of the Society of American Artists, Walter Shirlaw, T. W. Dewing, Kenyon Cox, Abbott Thayer, Robert Blum, J. C. Beckwith, G. W. Maynard, E. E. Simmons, W. H. Low, Robert Reid, Wilton Lockwood, C. Y. Turner, H. S. Mowbray, J. W. Alexander, Irving Wiles, E. R. Blashfield, J. McClure Hamilton—

painters who have done very good work in portraiture, in easel pictures, and in wall paintings. The most completely indigenous art yet produced in America has been in the field of landscape painting. In spite of the example of the famous Fontainebleau painters, the Americans have chosen the material of their own country and pictured it with fine atmospheric and colour effects, and no little sentiment. Men like D. W. Tryon, C. A. Platt, Alden Weir, J. H. Twachtman, Theodore Robinson, Childe Hassam, Horatio Walker, have received some inspiration from such French painters as Daubigny, Bastien-Lepage, and Monet, but no more than every painter receives from his master. Besides the painters who reside in the United States, there is a large contingent of Americans resident abroad which perhaps belongs to the American school as much as to any other. These painters do not, however, represent the land or the people to the extent usually assumed by Europeans. Indeed, it is questionable if they represent America in any way. James McNeill Whistler, though American-born, is an example of the modern man without a country. No nation can claim him as an artist, because he seems to have no nationality. E. A. Abbey, John S. Sargent, Mark Fisher, and J. J. Shannon are American only by birth. They are resident in London and are cosmopolitan in their methods and themes. This may be said with equal truth of many painters resident in Paris and elsewhere on the Continent. However good as art it may be, there is nothing distinctively American about the work of W. T. Dannat, Alexander Harrison, George Hitchcock, Gari Melchers, C. S. Pearce, E. L. Weeks, J. L. Stewart, and Walter Gay. If they owe allegiance to any centre or city, it is to Paris rather than to New York.

During the last quarter of the 19th century much effort and money were devoted to the establishment of institutions like the Metropolitan Museum in New York, the Carnegie Museum at Pittsburg, and the Art Institute in Chicago. Every city of importance in the United States has its gallery of paintings. Schools of technical training and societies of artists likewise exist wherever there are important galleries. Exhibitions during the winter season and at great national expositions, like the World's Fair at Chicago and the Pan-American Exhibition at Buffalo, give abundant opportunity for rising talent to display itself; and, in addition, there is a growing public patronage of painting, as shown by the extensive mural decorations in the Congressional Library building at Washington, in the Boston Public Library, in many colleges and churches, in courts of justice, in the reception-rooms of large hotels, in theatres and elsewhere. All these educational influences are being felt by the people, and there is an increasing appreciation of painting that augurs well for the future. (J. C. VAN D.)

Schorlau, or TCHORLAU, chief town of a sanjak in the vilayet of Rodosto, European Turkey, situated on an eminence on the right bank of a small tributary of the Erghĕnĕ, and about 2 miles from the station on the Constantinople-Adrianople Railway, 20 miles north-east of Rodosto. It possesses three mosques and several Christian churches. It has manufactures of woollen cloth (*chayak*) and native carpets, and exports cereals, oil-cloth, carpets, cattle, poultry, fresh meat, game, fruits, wine, alcohol, hides, and bones. Population, 11,500, of whom about one-half are Greeks, one-third Turks, and the remainder Armenians and Jews.

Schouvaloff. See SHUVALOV.

Schulze-Delitzsch, Franz Hermann (1808–1883), German economist, was born at Delitzsch, 29th August 1808. The place-name Delitzsch was added in 1848 to distinguish him from other Schulzes in the National Assembly. At the age of thirteen he was sent to the Nikolaischule at Leipzig; he proceeded to that university in 1827, and to Halle in 1829. Devoting himself to the study of law, he became at thirty years of age an assessor in the court of justice at Berlin, and three years later was appointed *patrimonialrichter* at Delitzsch. Entering the Parliament of 1848, he joined the Left Centre, and, acting as president of the Commission of Inquiry into the Condition of the Labourers and Artisans, became impressed with the necessity of co-operation to enable the smaller tradespeople to hold their own against the capitalists. He was a member of the Second Chamber in 1848–49; but as matters ceased to run smoothly between himself and the high legal officials, he threw up his public appointments in October 1851, and withdrew to Delitzsch. Here he devoted all his efforts to the organization and development of co-operation in Germany, and to the foundation of Vorschuss-vereine (people's banks), of which he had established the first at Delitzsch in 1850. These developed so rapidly that Schulze-Delitzsch in 1858, in *Die Arbeitenden Klassen und das Assoziationswesen in Deutschland*, enumerated twenty-five as already in existence. In 1859 he promoted the first *Genossenschaftstag*, or co-operative meeting, in Weimar, and founded a central bureau of co-operative societies. In 1861 he again entered the Prussian Chamber, and became a prominent member of the Progressist party. In 1863 he devoted the chief portion of a testimonial, amounting to 150,000 marks, to the maintenance of his co-operative institutions and offices. This, however, was only to meet an exceptional outlay, for he always insisted that they must be self-supporting, and refused repeated offers of pecuniary aid. The next three or four years were given to the formation of local centres, and the establishment of the Deutsche Genossenschafts-Bank, 1865.

The spread of these organizations naturally led to legislation on the subject, and this too was chiefly the work of Schulze-Delitzsch. As a member of the Chamber in 1867 he was mainly instrumental in passing the Prussian law of association, which was extended to the North German Confederation in 1868, and later to the Empire. Schulze-Delitzsch also contributed to uniformity of legislation throughout the states of Germany, in 1869, by the publication of *Die Gesetzgebung über die privatrechtliche Stellung des Erwerbs- und Wirthschaftsgenossenschaften, &c.* His life-work was now complete; and following the central idea of the *monts de piété*, he had placed the advantages of capital and co-operation within the reach of struggling tradesmen throughout Germany. His remaining years were spent in consolidating this work. Both as a writer and a member of the Reichstag, his industry was incessant, and he died in harness on the 29th April 1883 at Potsdam, leaving the reputation of a benefactor to the smaller tradesmen and artisans, in which light he must be regarded rather than as the founder of true co-operative principles in Germany. (G. F. B.)

Schumann, Clara Josephine (1819–1896), German pianist, daughter of the distinguished pianoforte teacher Friedrich Wieck, was born at Leipzig, 13th September 1819. She was taught the piano by her father from her fifth year, and first appeared in public in 1828, obtaining the honour of an appearance at the famous Gewandhaus Concerts as early as 1832, when she played a concerto by Moscheles. Before this she had made a tour to Weimar, Cassel, Frankfort, and Paris, making a great success wherever she was heard. Her powers as a composer were already dawning, and a theme and variations of her own appeared in some of her earliest programmes. A performance of Bach's triple concerto with Mendelssohn and Rakemann in November 1832 marked her definite entry into the world of the highest music, and thenceforward she devoted herself to the interpretation of

the classical composers. In 1836 she visited Vienna, and it was about this time that she aroused the admiration of Robert Schumann, to whom, after many delays and troubles of all kinds, arising from the opposition of her parents to the match, she was married on 12th September 1840. From this time forth she undertook the difficult task of compelling the public to understand Schumann's music, and she succeeded in winning for it the admiration of all cultivated musicians in the various countries where she played. Her first visit to England took place in 1856, two years after her husband's insanity had declared itself in an attempt at suicide. The leading critics of the day set themselves in violent opposition to Schumann's music, and although they accepted her as a great pianist, her reception was so far from enthusiastic that she did not pay London a second visit until 1865; but after that time her visits were annual until 1882, with the exception of some four seasons. From 1885 to 1888 she regularly appeared each year in London, arousing more and more enthusiasm. In 1878 she was appointed teacher of the piano at the Hoch Conservatorium at Frankfort, and held the post until 1892, when she was compelled to retire owing to a distressing affection of the auditory nerve, but from this she recovered almost completely, and her death on 20th May 1896 was almost unexpected. Her most prominent qualities as a pianist were the wonderful sympathy with which she interpreted nearly all schools of music, her mastery of tone-gradation, and her entire concealment of all manual effort. As a composer her work is worthy to be remembered, quite apart from her playing. Her compositions are mainly for the piano, and have individuality and charm, while her few songs are exquisitely expressive. She edited her husband's works for Breitkopf and Haertel, and wrote cadenzas to two of Beethoven's concertos, in addition to her original compositions. (J. A. F. M.)

Schurz, Carl (1829-——), American statesman and reformer, was born in Liblar, near Cologne, Germany, on 2nd March 1829. At the age of twenty he left the university of Bonn to join the revolutionary movement in South Germany, and in consequence was obliged to flee the country. After a short stay in England he went to the United States in 1852. Engaging in the practice of law and journalism in Wisconsin, he soon attained prominence as a Republican politician. In 1861 he was appointed minister to Spain, but soon resigned to join the Union army, in which he rose to the rank of major-general of volunteers. After the war he resumed editorial work at St Louis, and became United States senator from Missouri 1869–75. In 1872 he was conspicuous in the Liberal Republican (anti-Grant) movement, presiding at the National Convention. During the Hayes administration he was secretary of the interior (1877–81), and at its close removed to New York City, where he ever afterwards resided. As editorial writer on the New York *Evening Post* (1881–84) and *Harper's Weekly* (1892–98), and in other literary enterprises, he vigorously promoted the ideas through which Mr Cleveland was twice elected to the Presidency. With the cause of administrative reform he was peculiarly identified, serving continuously as president of the Civil Service Reform Association since 1893. Mr Schurz's books on *Henry Clay* and *Abraham Lincoln* are of considerable merit.

Schwabach, a town of Bavaria, district of Middle Franconia, Germany, 9 miles by rail south of Nuremberg. It possesses an interesting parish church (1469–95), with an altar-piece (1506) by Veit Stoss, and paintings and carved work by Wohlgemut, Martin Schön, and others, and a lofty pyx by Adam Krafft; also a fountain (1716), a Jewish theological school, and a teachers' seminary. It is a chief seat of the needle manufacture in Bavaria. Gold and silver wire work, haberdashery, and brewing are the principal industries. The Schwabacher Articles of 1529, drawn up by Luther, formed the foundation of the Augsburg Confession. Population (1900), 9385.

Schwarzburg-Rudolstadt, a principality of Germany, one of the Thuringian states, with an area of 363 square miles, and a population (1885), 83,836; (1900), 92,657; giving a density of 255 inhabitants to the square mile. In 1900, 45,082 of the inhabitants were males and 47,575 females; and nearly the whole were Evangelical Lutherans. Agriculture supports 27,195 persons, or 30·6 per cent. of the population. The number of farms in 1895 was 13,264, of which 12,258 were each less than 25 acres in extent, 986 were between 25 and 250 acres each, and 20 exceeded 250 acres. In 1900 the number of pigs was 31,877; of sheep, 23,562; of cattle, 22,152; and of horses, 3505. For the period 1900–02 the annual state revenue and expenditure were estimated to balance at £104,840; nearly one-half of the revenue is derived from domains and state property. There is a public debt of £201,530 (1900), and in 1901 the state contribution to the imperial exchequer was fixed at £46,920.

Schwarzburg-Sondershausen, a principality of Germany, one of the Thuringian states, with an area of 333 square miles, and population (1885), 73,606; (1900), 80,678; giving a density of 242 inhabitants to the square mile. In 1900, 39,401 of the inhabitants were males and 41,277 females. The people belong almost entirely to the Evangelical Lutheran Church. In 1895 agriculture supported 25,064 persons, or 32 per cent. of the population. The number of farms was 11,787, of which 10,622, or 90·1 per cent., were each less than 25 acres in extent, 1128 were between 25 and 250 acres, and 37 exceeded 250 acres. In 1900 the live stock consisted of 37,888 sheep, 40,863 pigs, 25,036 cattle, and 4948 horses. In 1900–02 the state revenue and expenditure were each estimated at £167,000 annually. The public debt amounted in 1899 to £162,400, and the state contribution in 1901 to the imperial exchequer to £40,825.

Schwaz, a market-place in Tirol, Austria, on the river Inn, 18½ miles north-east of Innsbruck, on the Austrian State Railway. It is dominated by the old château of Freundsburg, and on an adjoining hill is a Benedictine abbey, which was restored after a fire in 1868. There are some old silver, copper, and iron mines in the vicinity, and tobacco, stoneware, hosiery, woollen yarn, and wire are manufactured. Population (1890), 5888; (1900), 6545.

Schwechat, a market-place in Lower Austria, about 5 miles south-east of Vienna. It has the largest brewery of the monarchy (with an annual production of about 600,000 hectolitres), together with important smelting and iron works, cotton-spinning, factories of electrical plant, &c. The meeting at Schwechat of the Emperor Leopold I. with Sobieski in 1683 is commemorated by an obelisk. The imperial troops defeated the Hungarian insurgents in a battle fought here in October 1848. Population (1890), 6031; (1900), 8241.

Schweidnitz, a town of Prussia, province of Silesia, 35 miles by rail south-east of Liegnitz. It is the seat of a provincial industrial school, and manufactures woollens and linens, stoves, hosiery, carpets, and millstones in addition to the industries already named in the 9th edition. Population (1885), 23,669; (1900), 28,432.

Schweinfurt, a town of Bavaria, district of Lower Franconia, Germany, on the left bank of the Main, 27 miles by rail north-north-east of Würzburg. A new classical school was built in 1881 to replace the one founded by Gustavus Adolphus of Sweden in 1631. There are

monuments to Rückert (1890) and in commemoration of the war of 1870–71, a commercial institute, and a technical school. The industries remain as stated in the 9th edition, except that factories for steel shot and bicycle bearings have been added. Population (1885), 12,502; (1900), 15,295.

Schweinfurth, Georg August (1836– ——), explorer, was born at Riga, 29th December 1836, and educated at the universities of Heidelberg, Munich, and Berlin (1856–62), where he particularly devoted himself to botany and palæontology. Commissioned to arrange the collections brought from the Sudan by von Barnim and Hartmann, his attention was directed to that region; and he proceeded thither himself in 1863, when he travelled round the shores of the Red Sea, passed on to Khartum, and returned to Europe in 1866. His researches attracted so much attention that in 1868 the Humboldt-Stiftung of Berlin entrusted him with an important scientific mission to the interior of East Africa. Starting from Khartum in January 1869, he went up the White Nile to Bahr-el-Ghazal and Dyoor, and then, with a party of ivory dealers, through Dinka, Bongo, and Niam-Niam; but unfortunately nearly all his collections, sketches, and other belongings were lost in a fire in the camp. He returned in 1871 and published an account of the expedition, under the title of *Im Herzen von Afrika*, Leipzig, 1874, which also contains interesting notices of the pygmies of Akka. In 1873–74 he accompanied Rohlfs in his attempt to penetrate into the desert of Libya. Settling at Cairo in 1875, he founded a geographical society, under the auspices of the Khedive, and devoted himself exclusively to African studies, historical and ethnographical. In the following year he penetrated into the desert of Arabia with Güssfeldt, and continued the exploration at intervals until 1888, and during the same period made geological and botanical investigations in the neighbourhood of Cairo, in the valley of the Nile, &c. Since 1889 he has resided in Berlin; but he visited the Italian colony of Erithrea in 1891, 1892, and 1894. The accounts of all his travels and researches have appeared either in book form or in periodicals, such as *Petermanns Mitteilungen*, the *Zeitschrift für Erdkunde*, &c.

Schwerin, a town of Germany, capital of grand-duchy of Mecklenburg-Schwerin, 129 miles by rail north-west of Berlin and 20 miles south of the Baltic. The town has a fine equestrian statue of the grand-duke Frederick Francis II. (1893), a post office, a ducal library of about 180,000 volumes, a veterinary school, lunatic asylum, military and technical schools, and a "school of pages." Population (1885), 31,528; (1900), 38,667.

Schwerin, a town of Prussia, province of Posen, at the confluence of the Obra and the Warthe, 28 miles by rail east of Küstrin. There are tobacco and other factories. Population (1900), 7316.

Schwerte, a town of Prussia, province of Westphalia, 9 miles by rail north-east of Hagen. There are iron and nickel works, and it has a Romanesque church, with carved altar of 1523 and 14th and 15th century stained-glass. Population (1895), 9892; (1900), 12,261.

Schwetz, a town of Prussia, province of West Prussia, 29 miles by rail north-east of Bromberg, on the left bank of the Vistula. There are remains of a castle (1335–41) of the Teutonic Order, three churches, a provincial lunatic asylum, and some tanning and damask weaving. There is also a trade in wool and corn. Population (1900), 7010.

Schwetzingen, a town of Germany, grand-duchy of Baden, 9 miles by rail south-east of Mannheim. It has a grand-ducal castle (1656, destroyed by the French in 1689, subsequently rebuilt) and gardens laid out in the middle of the 18th century in imitation of those of Versailles. There is a technical school. Cigars, yeast, &c., are manufactured, and there is a trade in hops and tobacco. Population (1900), 6417.

Schwiebus, a town of Prussia, province of Brandenburg, 47 miles east of Frankfort-on-the-Oder by rail. It is still in part surrounded by its mediæval wall, and has an ancient market-place, a couple of churches, a castle, and an orphanage. Cloth, machinery, and stearine candles are manufactured, and there are flour-mills, breweries, distilleries, and lignite mines. Population (1900), 8659.

Schwyz, one of the Swiss cantons. Its total area is 350·6 square miles. Of this, 254·8 square miles are reckoned as "productive," forests, covering 62·4 square miles, and vineyards 1·1 square mile. The population in 1880 was 51,109, and in 1900, 55,385, or 158 inhabitants to each square mile. The population is almost wholly Roman Catholic, and also mostly German-speaking, the numbers of Italian-speaking and French-speaking inhabitants being quite inconsiderable. The capital is Schwyz, which in 1888 had 6616 inhabitants (in 1900, 7398); its port on the Lake of Lucerne is Brunnen. The largest town in the canton is Einsiedeln, which in 1900 had 8496 inhabitants. There are 6 administrative districts in the canton, comprising 30 "communes." In 1897 the state revenue was 534,467 francs (a rise of 47½ per cent. since 1885), and the state expenditure 510,210 francs (a rise of 46 per cent. since 1885). The cantonal financial management is very defective. In 1897 the public debt was 2,960,000 francs. In 1899 there were 417 mountain pastures, or "alps," in the canton, supporting 17,492 cows. There is a railway from Arth-Goldau to the Lake of Zürich, with a branch from Biberbrücke up to Einsiedeln. The cantonal constitution of 1876 was further revised in 1898. The legislature is elected for 4 years by the "Gemeinden" in the proportion of one member for each 600 (or fraction over 300) inhabitants. The 7 members of the executive are chosen for 4 years by popular vote in the whole canton. In case of elections to the legislature, it is provided that in each "Gemeinde" that is entitled to elect 3 or more members, the election shall take place according to the principles of proportional representation, the same system as in Zug. The "obligatory referendum" obtains in the case of all laws, and the "facultative referendum" at the demand of 2000 citizens as regards resolutions and decrees of the legislature. It must also be noted that 2000 citizens have the right of "initiative" as to the revision of the cantonal constitution, or as to legislative projects.

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(W. A. B. C.)

Sciacca, a seaport town and bishop's see of Italy, Sicily, province of Girgenti, 30 miles west-north-west of Girgenti. It is the Sicilian headquarters of Mediterranean coral fishing. Down to 1888 such large quantities of coral were taken that in the year named fishing was suspended by Government order. It was resumed in 1893, during which and the year following 193 and 183 boats, manned by 2172 and 2205 men respectively, were engaged; and they brought up 613 and 633 tons of coral, valued at £78,325 and £88,390 respectively. Of these Sciacca sent 73 and 72 boats. The town has manufactures of bricks and pottery, barrels, baskets, and olive oil, and cures fish. In 1897 its port was cleared by 489 vessels of 74,690 tons. Population (1881), 20,709; (1899), 23,000.

Scilla, a seaport town of Italy, Calabria, province of Reggio, 14 miles by rail north by east of Reggio. It stands on a steep cliff overlooking the Strait of Messina, and has a citadel which withstood the French in 1806–08. It was

in great part rebuilt after the earthquake of 1783, and is famous for its silk and wine, and carries on fishing for tunny and sword-fish. It is the ancient *Scylla*. Population, about 7000.

Scillitan Martyrs.—The recovery in their original form of the Acts of the Scillitan Martyrs has given us the earliest documents of the Church of Africa and, it would seem, the earliest specimen of Christian Latin. The martyrs take their name from Scilla (or Scillium), a town in Numidia. Their trial and execution took place in Carthage under the Pro-consul Vigellius Saturninus, whom Tertullian declares to have been the first persecutor of the Christians in Africa. The date of their martyrdom is 17th July 180 A.D. It is thus the concluding scene of the persecution under Marcus Aurelius, which is best known from the sufferings of the churches of Vienna and Lyons. The great emperor died on 17th March of the year in question, and persecution ceased almost immediately upon the accession of Commodus. A group of sufferers called the Madaurian martyrs seems to belong to the same period: for in the correspondence of St Augustine, Namphamo, one of their number, is spoken of as "archimartyr," which appears to mean protomartyr of Africa. We have in this martyrdom an excellent example of "Acts of Martyrs" properly so called. The document is in brief legal form, beginning with the date and the names of the accused, and giving the actual dialogue between them and their judge. It closes with the sentence, based on "obstinate" persistency in an illicit cult, and with the proclamation by the herald of the names of the offenders and the penalty. All this may quite well be a transcript of the *acta*, or official report of the proceedings. A Christian appends the words: "And so they all together were crowned with martyrdom; and they reign with the Father and the Son and the Holy Ghost, for ever and ever. Amen."

The Scillitan sufferers were twelve in all—seven men and five women. Two of these bear Punic names (Nartzalus, Cintinus), but the rest Latin names. Six had already been tried: of the remainder, to whom these *acta* primarily relate, Speratus is the principal spokesman. He claims for himself and his companions that they have lived a quiet and moral life, paying their dues and doing no wrong to their neighbours. But when called upon to swear by the genius of the emperor, he replies: "I recognize not the empire of this world; but rather do I serve that God whom no man hath seen, nor with these eyes can see." Here he uses the language of 1 Tim. vi. 16; and it is interesting also to note that in reply to the question, "What are the things in your chest?" he says, "Books and letters of Paul, a just man." The martyrs are offered a delay of thirty days to reconsider their decision, but this they all alike refuse. These Acts have been long known in an expanded form, or rather in a variety of later recensions. The fame of the martyrs led to the building of a basilica in their honour at Carthage; and their annual commemoration required that the brevity and obscurity of their Acts should be supplemented and explained, to make them suitable for public recitation.

The historical questions connected with these martyrs are treated by Lightfoot, *Ignatius* (1889, ed. 2), i. 524 ff. The Latin text, together with later recensions and a Greek version, is published in *Texts and Studies*, i. 2 (Passion of Perpetua, 1890). The original Latin was published independently about the same time in the *Analecta Bollandiana*, viii. p. 5. (J. A. R.)

Scilly Islands, a group belonging to the county of Cornwall, England, 40 miles due west of Lizard Point, and reached by a service of steamers from Penzance. The government of the islands is vested in a county council, distinct from that of Cornwall, formed in 1892, consisting of a president, vice-president, 4 aldermen, and 18 councillors. Telephone and telegraph communication connects with the mainland. The early potato industry has given place largely to the raising of early asparagus and other vegetables, and spring flowers. This trade has increased so considerably that from 200 tons in 1889 it had risen to 515 tons in 1896. There is a coasting trade of about 20,000 tons clearances annually. The area of the principal islands is as follows:—St Mary's, 1613 acres; Tresco, 917 acres; St Martin's, 650 acres; St Agnes, 444 acres; and Bryher, about 350 acres. The population of the whole islands (area, 3980 acres) was in 1881, 2320; in 1891, 1911; in 1901, 1974. The population of St Mary's Island was in 1891, 1201; in 1901, 1275. Hugh Town, the capital of the islands, is on St Mary's. Its pier was extended in 1889 at a cost of £4000, and new public buildings were erected in the same year. In 1882 a new church to St Nicholas was erected on Tresco.

Scio, the classical *Chios*, an island on the west coast of Asia Minor, forming, with the islands of Ipsara, Nicaria, Leros, Calymnos, and Cos, a sanjak of the Archipelago vilayet. In 1881 Scio was visited by a very severe earthquake. Over 5600 persons lost their lives, the villages in the Kampos were destroyed, the monastery built by Constantine Monomachus was overthrown, and more than half the villages were seriously damaged. The island has now recovered its prosperity. A harbour has been made at Castro, and steam flour-mills, foundries, and tanneries have been established. Rich antimony and calamine mines are worked by a French undertaking, and good marble is quarried by an Italian company. In 1899 the exports—gum mastic, fruit, and leather—amounted to £247,400, and the imports to £265,000. The population of the island is 64,000 (Moslem 1000, Greeks 62,750, Jews 250), and of the town 16,000.

Scotland.—The population at the census of 1891 was 4,025,647 (1,942,717 males and 2,082,930 females), and at the census of 1901, 4,472,000 (2,173,151 males and 2,298,849 females). The net increase between 1881 and 1891 was 290,074 (143,242 males and 146,832 females), or at a rate of 7·8 per cent., and between 1891 and 1901, 446,353, or at the rate of 11·09 per cent. The areas (old and amended) and populations of the counties are given under the several headings which deal with them:—

Population, vital and social statistics.

TABLE I.—*Showing Grouping of Population in 1871, 1881, and 1891.*

	Total Population.			Increase or Decrease.				Percentage to Total Population.		
	1871.	1881.	1891.	1871 to 1881.		1881 to 1891.		1871.	1881.	1891.
				Actual.	Per cent.	Actual.	Per cent.			
Towns	1,951,704	2,306,852	2,631,298	+355,148	+18·20	+324,446	+14·06	58·09	61·75	65·37 [1]
Villages	386,993	447,884	465,836	+60,891	+15·73	+17,952	+4·01	11·52	11·99	11·57
Rural districts	1,021,321	980,837	928,513	−40,484	−3·96	−52,324	−5·33	30·39	26·26	23·06
Scotland	3,360,018	3,735,573	4,025,647	+375,555	+11·18	+290,074	+7·77	100	100	1000

[1] The incomplete returns show that in 1901 the town population was 75 per cent. of the whole.

Calculated according to the corrected area of 1891, the population of 1881 gave about 121 persons to the square

TABLE II.—*Showing Population of Chief Towns, 1881, 1891, and 1901.*

	1881.	1891.	1901.
Glasgow . .	551,415	565,839 (of enlarged area, 658,198)	780,423
Edinburgh .	226,357	261,225 (of enlarged area)	316,479
Dundee . .	140,239	153,330	160,871
Aberdeen . .	105,189	121,623	143,722
Paisley . .	55,638	66,425	79,355
Leith . .	59,485	67,700	76,667
Govan . .	50,492	63,625	76,351
Greenock . .	66,704	63,423	67,645
Partick . .	27,410	36,538	54,274
Coatbridge .	24,812	30,034	36,981
Kilmarnock .	23,901	28,447	34,161
Perth . .	28,980	29,899	32,872
Hamilton . .	18,517	24,859	32,775
Motherwell .	12,904	18,736	30,423

mile, instead of 125, as stated in the 9th edition of this work. In 1891 the density worked out at 131 persons to the square mile, and in 1901 at 149. Dumbarton, with 25·44, showed the largest rise between 1881 and 1891, owing to the development of its shipbuilding, engineering, and dyeing industries; Linlithgow, with 24·4, the largest between 1891 and 1901. Decreasing counties were purely agricultural in character; but Selkirk, owing to contraction of the woollen industry, showed the greatest loss—15·8. Table II. shows the population of the principal towns in Scotland in 1881, 1891, and 1901.

Of the four large towns, Aberdeen, with 22·9 per cent., increased most rapidly between 1891 and 1901; Dundee, with 4·5 per cent., most slowly. The iron town of Motherwell, with 62·5, shows the most phenomenal growth. Table III. shows the increase of population that should have taken place between 1871 and 1881 and between 1881 and 1891, compared with the actual increase, the grouping being into towns of over 25,000, towns with less than 25,000 and more than 10,000, towns between 10,000 and 2000, and rural districts. Comparison with Table IV. will show to what an extent the actual increase in large towns was due to immigration of Irish and English, in addition to immigration from Scottish rural districts:—

TABLE III.—*Showing Increase or Decrease of Population in 1871, 1881, and 1891.*

Groups.	Population according to Grouping in 1871.		Population according to Grouping in 1881.		Births.	Deaths.	Births.	Deaths.	Increase or Decrease, 1871–81.		Increase or Decrease, 1881–91.	
	1871.	1881.	1881.	1891.	1871–80.	1871–80.	1881–90.	1881–90.	Actual.	Excess of Births over Deaths.	Actual.	Excess of Births over Deaths.
Principal towns . . .	1,193,940	1,411,536	1,409,260	1,590,310	429,679	296,285	517,454	330,010	+217,596	+133,394	+181,050	+187,444
Large towns . . .	327,734	388,797	404,302	467,642	150,005	94,408	146,367	83,966	+61,063	+55,597	+63,570	+62,401
Small towns . . .	696,958	790,796	784,654	840,339	293,220	171,485	266,277	149,843	+93,838	+121,735	+55,685	+116,434
Rural districts . . .	1,141,386	1,144,444	1,137,357	1,127,356	361,367	203,200	321,832	179,763	+3,058	+158,157	−10,231	+142,069
	3,360,018	3,735,573	3,735,573	4,025,647	1,234,351	765,468	1,251,930	743,582	+375,555	+408,883	+290 074	+508,848

The novel facts to be noted in connexion with the distribution of the population in 1891 are:—The rural population, having previously all but ceased to rise, had actually begun to fall. The actual increase and the excess of births over deaths almost balanced one another in the large towns. In the principal towns the tide of immigration would seem to have turned by 1891, the actual increase of the population being 6394 less than the natural increase; whereas in 1881, owing to immigration, the actual increase over 1871 was 84,202 more than the natural increase. Table IV. shows the nationalities of the people of Scotland in 1881 and 1891, with the nationalities in burghs with a population of 10,000 and upwards:—

TABLE IV.—*Illustrating Nationalities in 1881 and 1891.*

Nationalities.	Scotland, 1881.		Scotland, 1891.		Burghs, 1891.	
	Number.	Percentage of Pop.	Number.	Percentage of Pop.	Number.	Percentage of Pop.
Scots .	3,397,759	90·96	3,698,700	91·63	1,770,028	88·70
Irish .	218,745	5·86	184,807	4·84	135,826	6·81
English .	90,017	2·41	108,736	2·70	67,949	3·40
British Colonials	12,874	0·34	13,607	0·39	8,671	0·44
British b. abroad or at sea .	7,024	0·19	8,051	0·20	5,028	0·25
Foreigners	6,399	0·17	8,510	0·21	6,078	0·30
Welsh .	1,806	0·05	2,309	0·06	1,362	0·07
Channel Islanders	949	0·02	927	0·02	567	0·03
	3,735,573	100	4,025,647	100	1,995,511	100

In contradistinction to that of 1881, the census of 1891 showed both an actual and a proportional decrease of non-natives in the population of Scotland. There were 337,814 in 1881 and 336,947 in 1891, the proportions to population being 9·043 and 8·370 respectively, the decline of Irish immigration being the cause of the falling off. Non-natives, however, continued to increase between 1881 and 1891, the percentage of increase being 1·584.

The number of persons of Scottish birth in England in 1891 was 282,271 and in Ireland 27,323—total 309,594. On the other hand, the natives of these two countries in Scotland in 1891 numbered together 303,543. Table V. shows how the population was affected by emigration and immigration in four decades:—

TABLE V.—*Illustrating Emigration and Immigration.*

	1861–70.	1871–80.	1881–90.	1891–1901.
Excess of births over deaths . . .	414,594	468,363	508,348	498,135
Actual increase . .	297,385	375,555	290,074	446,310
Balance	117,209	92,808	218,274	51,825

The male population in 1891 was 1,942,717, an increase over 1881 of 7·9 per cent., the female population 2,082,930, an increase of 7·7 per cent. In 1901 the males numbered 2,173,151 and the females 2,298,849, showing increases of 11·8 and 10·4 per cent. respectively. The proportion of 105·8 females to 100 males was the lowest ratio experienced since 1801. The highest was 118·5 in 1811, and since then the decline has been almost regular from census to census. In Scotland the ratio in 1891 was greater than in England, where it was 106·8 to 100; or in Ireland, where it was 102·8 to 100. The percentage of illegitimate births, after falling almost continuously during the century, rose from 7·04 in 1871–80 to 8·16 in 1881–90, but fell again to 7·11 in 1891–1900, 6·73 in the large towns, 7·88 in the small town districts, 10·33 in the mainland rural, and 6·02 in the insular-rural districts. Wigtown and Ross and Cromarty exhibited the two extremes, the former—a lowland rural district—having an illegitimacy percentage of 16·51, and the former—a highland rural district—having only 4·92 per cent. Table VI. shows the percentages to population of births, deaths, and marriages registered in the four decades specified:—

TABLE VI.—*Showing Birth, Death, and Marriage Ratio.*

	1861–71.	1871–81.	1881–91.	1891–1901.
Birth-rate	3·48	3·47	3·22	3·01
Death-rate	2·19	2·15	1·91	1·84
Marriage-rate . . .	0·69	0·71	0·66	0·70

The marriage-rate in decade 1881–91 was higher than that for Scotland in six counties—Forfar, Renfrew, Ayr, Lanark, Linlithgow, and Edinburgh—and below in all the others. Renfrew had the highest rate—73·11 per ten thousand—and Sutherland the lowest—31·91. Five counties had a higher death-rate than Scotland—Forfar, Edinburgh, Bute, Renfrew, Lanark; of the others, which were below the mean, Peebles was lowest with 14·028. The mortality rate at ages under five years to the population alive at the same age varies from 1·7 in Orkney to 6·8 in Lanark. Table VII. gives the percentage of single, married, and widowed to the total of each sex in Scotland, England and Wales, and Ireland respectively in 1891:—

TABLE VII.—*Showing Percentage of Single, Married, and Widowed in the United Kingdom (1891).*

Sexes.	Scotland.			England and Wales.			Ireland.		
	Sing.	Mar.	Wid.	Sing.	Mar.	Wid.	Sing.	Mar.	Wid.
Males	66·3	30·3	3·2	62·0	34·5	3·5	69·5	24·4	3·9
Females	63·1	28·9	7·8	59·6	32·9	7·5	64·0	26·2	9·7

Blind, &c.—The number of blind persons in Scotland in 1891 was 2797 (1417 males and 1380 females), the proportion to the total population being 1 to 1439, as against 1 to 1182 in 1881. The deaf and dumb numbered 2125 (1195 males and 930 females), the proportion to the population being 1 to 1894, compared with 1 to 1744 in 1881. The number of lunatics was 10,455 (4918 males and 5527 females), equal to 1 to 385 of the population; in 1881 the number was 8406, or 1 in 444. In addition, there were 5017 imbeciles (2506 males and 2511 females), being 1 to 802 of the population, compared with 5991, or 1 in 623, in 1881.

Occupations.—Table VIII. exhibits the classification of the people in 1881 and 1891. The proportions of the professional, commercial, and industrial classes maintained the increase which they had shown in the preceding decade; and while the agricultural class continued to diminish, there was no cessation of the diminution of the unproductive class, whose falling away in 1881 was put down to a change in classification since the previous census:—

TABLE VIII.—*Classifying Population in Professions and Trades.*

Classes of Occupation.	1881.	1891.	Per cent. of Total Population.	
			1881.	1891.
Professional	96,103	111,319	2·57	2·76
Domestic	176,565	203,153	4·73	5·05
Commercial	132,126	180,952	3·54	4·49
Agricultural and fishing	269,537	249,124	7·21	6·19
Industrial	932,653	1,032,404	24·97	25·65
Unproductive	2,128,589	2,248,695	56·98	55·86

Pauperism.—In Scotland pauperism showed an almost continuous decline from 1868 to 1891, the ratio of ordinary poor per thousand of estimated population being 40 in the former year and 20 in the latter. The average in the decade 1881–90 was 22·5; it fell from 21 in 1890 to 20 in 1891, and stood at that figure till the end of the ensuing decade, except in 1897 and 1898, when it was 21. On the other hand, the ratio of lunatic poor per thousand of estimated population has risen from 1·8 in 1868 to 3·1 in 1900, the increase being undoubtedly due, in part at least, to the fact that greater care has been taken to segregate this class of the population, coupled with a growing disinclination of the working classes to be burdened with the mentally weak in the home.

Crime.—Although the prison accommodation in the large centres of population is more and more taxed every year, crime continues to decline steadily, as is shown by Table IX., albeit the figures for 1898 indicate a set back from 1897:—

TABLE IX.—*Classifying Crimes.*

Offences.	Average.					1900.		
	1884–88.	1888–92.	1893–97.	1891–95.	1896–1900.	Males.	Females.	Total.
Against person	789	685	656	663	643	565	66	631
Against property, with violence	565	547	601	581	594	610	33	643
Against property, without violence	895	906	831	862	840	627	170	797
Against property, malicious	82	42	31	30	24	14	2	16
Forgery, &c.	42	33	23	31	24	18	4	22
Other offences	104	123	82	107	61	52	6	58
Total	2477	2336	2224	2283	2186	1886	281	2107

Communications.—By the Local Government Act of 1889 the oversight of the roads in Scotland was transferred from the Road Trustees to county councils, and the management is in practice in the hands of district committees, composed of representatives of the county council and the parish councils of the district. Table X. shows the development of railway communication in Scotland. The total capital of all the railway companies in 1888 was £114,120,119; in 1898 it had been raised to £158,982,782—paid up and raised by loans and debenture stock.

TABLE X.—*Illustrating Growth of Railway Communications.*

Year.	Miles.	Passengers.				Receipts.		
	Open.	First Class.	Second Class.	Third Class.	Total.	Passenger.	Goods.	Total.
1884	2909	4,711,500	2,715,932	46,877,042	54,305,074	£2,931,737	£4,426,023	£7,357,760
1888	3097	4,026,971	1,043,992	62,142,386	68,413,319	3,103,105	4,504,627	7,094,427
1898	3476	4,718,024	..	109,389,421	114,107,445	4,350,182	6,105,581	10,873,318
1900	3485	5,875,084	..	116,825,118	122,201,102	4,715,592	6,431,693	11,003,010

The total disappearance of the second-class passenger from Scotland during the decade ended in 1898 will be noted, together with the almost constant number and real decrease of the first-class passengers. From the passing of the Light Railways Act of 1896 down to the end of 1898, the Board of Trade had sanctioned the construction of nine light railways in Scotland, with a total mileage of 66¾.

Agriculture.—The distribution of land in respect of ownership has not suffered an appreciable change since 1875. Table XI. is a comparative statement of the number and acreage of holdings in each class above five acres in the years 1885 and 1895:—

TABLE XI.—*Illustrating Distribution of Holdings above Five Acres.*

Years.	5 to 20 Acres.		20 to 50 Acres.		50 to 100 Acres.		100 to 300 Acres.		300 to 500 Acres.		500 to 1000 Acres.		Above 1000 Acres.		Total.	
	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.
1885	22,132	236,995	10,677	361,675	9778	725,499	12,549	2,139,138	2034	768,823	632	409,641	90	137,104	57,892	4,778,870
1895	23,104	245,664	10,817	363,266	9834	731,977	12,968	2,203,207	2070	782,369	620	397,682	76	104,410	59,489	4,828,575

The table contains striking evidence of the reversal of the tendency, long prevalent, to abolish the lowland crofting class, and of the natural reversion to the division of land into farms of manageable size. There were altogether 54,071 holdings in 1895 under 50 acres (including 20,150 under 5 acres), or 67·89 of all the holdings in Scotland.

Since the passing of the Crofters Act of 1885, and the amending statutes of succeeding years, which added to the Commissioners' powers of fixing fair rents and cancelling arrears, the power of enlarging crofts and common grazings, political agitation among the Highland crofters has practically died out. The material condition of the class has not very markedly improved, except where, by Government assistance, crofter fishermen have been enabled to buy better boats; but in some districts, even in the Lewis, superior houses have been built. The Crofters' Commission has been continuously at work since 1886, and had up to the end of 1898 dealt with 19,862 applications to fix fair rents, covering 192,283 acres held in individual occupancy, and 1,243,328, acres of grazings or common hill pasture. The total amount of the fair rents fixed was £59,420, and the total amount of reduction on the old rents £21,446.

Of £183,930 of arrears of rent, £123,651 was cancelled; and 41,452 acres was assigned in enlargement of existing holdings. Under a Congested Districts (Scotland) Act of 1897, a Board expends £35,000 a year of public moneys, within certain districts of Argyll, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney and Shetland, in assisting migration, improving the breeds of live stock, building piers and boatslips, making roads and bridges, developing home industries, &c. Deer forests in 1899 covered 2,287,297 acres—an increase of 575,405 acres since 1883.

The epoch of agricultural depression which set in prior to 1885 was surmounted in Scotland with comparatively little trouble. A large amount of capital was lost by tenants, and a few farms were thrown here and there upon the landlords' hands, but in no district was rent extinguished or were holdings abandoned. The sub-commissioners who reported to the Royal Commission on Agriculture in 1895, found nearly everywhere a demand, sometimes competition, for farms, persisting throughout the crisis. In Banff, Nairn, Elgin, and the seven counties south of the Firth of Forth rent reductions varied from 25 to 30 per cent. In Perth, Fife, Forfar, and Aberdeen the average was 30 per cent.; but in all the counties of both groups, towards the end at least of the period of depression, the coexistent demand and competition for farms were observable. In some districts of the western division of the country rents fell very little; in others, especially sheep-farming districts, the fall was very severe. In Ayrshire the figure varied from 5 to 20 per cent.; for Dumfriesshire 16 per cent. was given as a fair average, but here too the distressed farmer was compelled to admit that if he gave up his holding there were others ready to take it. Now, owing to the increased attention given to stock-fattening, dairying, &c., and to a rise in prices all round, farming has reached a condition of equilibrium, and the most noticeable residuum of the period of depression is the large intrusion of the butcher and grazier class into the farmer class proper. Caithness-shire was declared to be the greatest sufferer by the period of depression; rents fell in that county by 30 to 50 per cent. on large farms, 20 to 30 per cent. on medium, and 10 to 60 per cent. on small farms. Table XII. shows the total area, the cultivated area, and the area under each kind of crops in 1888 and 1901: —

TABLE XII.—*Illustrating Acreage under Cultivation.*

Total Area (Foreshore excluded), 19,455,788 Acres.	1888.	1901.
Cultivated acreage	4,878,514	4,900,131
Permanent pasture	1,191,648	1,428,224
Arable land	3,686,866	3,471,907
Corn crops:		
Wheat	68,735	36,225
Barley or bere	223,468	235,115
Oats	1,015,395	956,389
Rye	9,690	5,541
Beans	15 738	13,037
Peas	1,423	1,349
Total corn crops	1,336,338	1,247,656
Green crops:		
Potatoes	157,605	130,176
Turnips	480,626	458,556
Mangolds	1,345	2,950
Cabbage, kohl-rabi, and rape	6,884	14,404
Vetches or tares	13,851	9,016
Other green crops	2,848	2,384
Total green crops	663,159	617,486
Grasses under rotation	1,668,453	1,593,461
Flax	327	4
Small fruit	3,416	6,079
Bare fallow	15,083	7,221

The most notable movement in corn crops, if we except the revival in a limited area of wheat-growing, has been in barley, the acreage of which responded to the rapid development of distilling in Scotland up to 1899. In regard to green crops, the figures relating to cabbage, &c., and to small fruit reflect the development of market-gardening in the neighbourhood of the large towns. The area under orchards rose from 1562 in 1880 to 2149 in 1898. Woods and plantations covered 811,703 acres in 1880 and 878,765 acres in 1895, of which 54,956 acres had been planted between 1881 and 1895.

Table XIII. shows the yield of the principal crops per acre in 1888 and 1899, with the average yield per acre in 1899:—

TABLE XIII.—*Showing Yield of Chief Crops per Acre.*

		1888.	1899.	Average per Acre. 1899.
Wheat	Bushels	2,139,282	1,768,320	37·42
Barley	,,	7.630,661	8,222,891	34·19
Oats	,,	34,986,742	33,313,304	34·73
Beans	,,	409,535	439,613	33·66
Peas	,,	26,740	26,515	24·04
Potatoes	Tons	767,271	649,428	5·11
Turnips	,,	6,218,905	5,751,738	12·23

Table XIV. shows the number of live stock in 1888 and 1901:—

TABLE XIV.—*Illustrating Increase of Live Stock.*

	1888.	1901.
Horses used for agriculture	146,913	153,918
Unbroken horses and breeding mares	42,874	40,975
Total	189,787	194,893
Cattle:		
Cows or heifers in milk or calf	410,256	433,981
Other cattle, 2 years and above	249,156	274,016
Under 2 years	450,878	521,284
Total cattle	1,110,290	1,229,281
Sheep:		
One year and above	4,431,535	4,627,066
Under one	2,299,032	2,774,343
Total	6,730,567	7,401,409
Pigs	154,599	124,821

The table shows, when collated with Table XIII., the extent to which Scottish farmers have turned their attention to stock-raising in preference to crop-raising. The cow stock of the country has risen steadily, and the regular increase of the number of cattle under one year points to the breeding industry being in a healthy state. Horse-breeding, as indicated by the numbers of unbroken horses and breeding mares, is a declining industry; it reached its maximum of prosperity in 1894, when the number of horses in the class named was 51,740.

Fisheries.—The development of the Scottish fisheries during the past decade is exhibited in Table XV.:—

TABLE XV.—*Showing Growth of Fisheries.*

	Total taken by Net and Line.			Total taken by Trawl.			Total Quantity and Value of Fish landed.		
	Cwt.	£	Price per Cwt.	Cwt.	£	Price per Cwt.	Cwt.	£	Price per Cwt.
1890	5,380,715	1,205,809	4/10	201,812	203,620	13/11	5,864,488	1,623,340	5/6
1898	5,774,331	1,420,033	4/11	783,436	453,233	11/7	6,657,708	1,879,866	5/8
1900	4,202,183	1,622,567	7/7	1,077,082	703,127	13/1	5,309,265	2,325,904	8/8

While net-fishing has not been at a standstill, the great progress of the fisheries has been due to the multiplication of beam-trawling vessels, in which a large amount of capital has been invested, and whose operations have scarcely been checked by the closing of the Moray Firth and other inshore waters to all but line boats. Line-fishing has suffered a decided set-back. For instance, while 1,420,789 cwt. of round fish were caught by line in 1890, only 650,000 cwt. were caught by line in 1900; trawlers landed 171,593 cwt. in 1890, and 892,000 cwt. in 1900. Trawlers have to go farther and farther afield for their fishing-grounds, and the line fishermen on the east coast are to some extent adapting themselves to changed conditions by employing larger boats, and in some cases having them propelled by steam; on the west coast, on the other hand, the tendency is towards the employment of smaller boats. In 1900, 82,809 persons were employed in connexion with the various branches of the sea fisheries; the fleet of fishing vessels numbered 11,275, manned by 40,192 fishermen; and total value of the fish landed on Scottish coasts was £2,401,900 (as against £2,270,484 in 1899 and £1,957,000 in 1898), made up of: herring, £1,248,407; sprats, £1876; sparling, £1086; mackerel, £5025; cod, £205,994; ling, £51,210; tusk, £2295; saithe, £12,208; haddocks, £512,660; whiting, £35,444; conger eel, £7765; turbot, £18,325; halibut, £40,801; sole, £41,688; flounder, plaice, and brill, £109,829; skate, £20,659: other white fish, £25,658; shell-fish, £75,906.

Mining Industries.—Table XVI. exhibits the development of the mineral industry of Scotland since 1885 so far as statistics are available:—

TABLE XVI.—*Illustrating Development of Mining Industry.*

	1885.		1895.		1900.	
	Tons.	£	Tons.	£	Tons.	£
Coal .	21,288,586	4,746,423	28,792,693	7,672,747	33,112,204	13,055,968
Fire clay	455,246	53,112	687,658	101,663	1,061,836	160,220
Iron ore .	1,835,159	776,160	824,673	311,303	849,031	408,713
Oil, shale	1,741,750	437,339	2,236,224	559,056	2,279,879	626,966
Lead ore	4,316	38,774	4,111	30,832	1,839	24,067
Granite .	...	...	351,268	190,506	1,182,067	381,244
Limestone	...	...	493,347	120,411	504,730	90,547
Slate .	19,238	27,814	44,235	75,742	36,277	72,513
Imports of Iron Ore.						
	2,832,598	1,957,199	4,450,311	2,977,952	1,371,684	1,171,026

Pig-Iron Production.

	1885.	1895.	1900.
Furnaces in blast	92	76	85
Output in tons	1,003,562	1,048,774	1,156,885

Coal is found in 15 Scottish counties. Of the total output since 1876, Lanark contributed 55·90, Ayr 14·35, Fife and Kinross 11·95, Stirling 6·05, Edinburgh 3·75, Linlithgow 2·80, Dumbarton and Clackmannan each 1·40, Haddington 1·20, Renfrew 0·35, and Argyll, Dumfries, Perth, and Sutherland together 0·85. The total quantity worked up to the end of 1898 was 1,514,062,000 tons, and the quantity then remaining to work was estimated at 4,634,785,000 tons. The export of coal from the principal Scottish ports rose from 5,800,000 tons in 1889 to 9,000,000 tons in 1899. Lanark produces about 46 per cent. of the fire-clay production, and Ayr comes next with about 16 per cent.; Edinburgh, Renfrew, and Stirling are the other counties in which the mineral is found in quantity. Ayrshire, with an output of 36 per cent. of the whole, is the principal iron-mining county; Renfrew follows with 20 per cent., and Lanark with 18 per cent.; iron ore is worked also in Edinburgh, Linlithgow, and Dumbarton on a considerable scale. Oil shale is found in Linlithgow, Ayr, Lanark, Stirling, and Renfrew; but more than half the total output is credited to Linlithgow, where the principal refining works are situated. Argyllshire furnishes the bulk of the slate production. Limestone is found mainly in Lanark, Renfrew, Banff, Ayr, Stirling, and Haddington, in the order stated. Granite occurs in Aberdeen, Kirkcudbright, Argyll, Kincardine, the Aberdeen production being 69 per cent., of Kirkcudbright 15 per cent., and of Argyll 10 per cent., of the whole.

There are 25 iron-works in Scotland, and all were in active operation in 1900. They are owned by 22 firms and employ about 7000 operatives. The product consists of all classes of malleable iron—bars, angles, tees, hoops, strips, sheets, and plates, and amounts to some 350,000 tons per annum. There were working in the West of Scotland in 1900 about 115 open-hearth Siemens-Martin steel furnaces, ranging in capacity from 50 down to 20 tons per furnace. The average output per furnace is 210 tons a week—total, 24,150 tons; and the total produce of the year of 48 working weeks, 1,149,200 tons of ingot steel. There are also 2 Bessemer converters, which produce about 1000 tons weekly, so that the output of ingot steel in West Scotland is nearly 1¼ million tons.

Manufactures.—The detailed statistics for 1890 about the manufactures exhibit the following facts:—The woollen industry has the widest spread of all the textiles. There were in that year 2 wool-spinning factories in the northern district, 2 in the north-western, 8 in the north-eastern, 23 in the east midland, 8 in the west midland, 14 in the south-western, 14 in the south-eastern, and 14 in the southern. In 1900 there were 256 worsted and woollen factories, and 91 hosiers' and wool workshops. Weaving has its principal seats in Hawick, Galashiels, Dumfries, Elgin, Aberdeen, Inverness. Table XVII. shows the progress made in the previous decade:—

TABLE XVII.—*Illustrating Growth of Woollen Industry.*

	Factories.	Spindles.		Power Looms.	Persons employed.		
		Spinning.	Doubling.		Male.	Female.	Total.
1878	246	559,021	62,013	6284	10,083	12,584	22,667
1890	282	565,146	73,978	9836	12,915	18,162	31,077

The employés in this industry numbered 29,218 in 1897.

The linen industry is confined mainly to the counties of Forfar, Fife, Aberdeen, Perth, and the speciality of thread-spinning to Paisley. Table XVIII. offers a comparison between its condition in 1878 and 1890, and it may be said generally that the persistence of hostile tariff legislation in the United States has prevented a recurrence of its former activity:—

TABLE XVIII.—*Illustrating Growth of Linen Industry.*

	Factories.	Spindles.		Power Looms.	Persons employed.
		Spinning.	Doubling.		
1878	155	265,263	18,495	16,756	36,476
1890	136	187,755	20,599	18,687	34,222

There were in 1890, 27 hemp factories, with 14,450 spinning and 1735 doubling spindles and 3216 employés; and 103 jute factories, with 242,205 spinning and 10,868 doubling spindles, 12,897 power looms, and 13,007 male and 26,878 female employés. In 1900 factories engaged in flax, jute, hemp, and tow numbered 243.

Cotton manufacture has stagnated in Scotland as compared with England, and it is certain that there has been no development of the industry since the publication of the last official statistics. Table XIX. gives particulars for 1875, 1885, and 1890. The most important factories are still confined to Glasgow and neighbourhood:—

TABLE XIX.—*Illustrating Growth of Cotton Industry.*

	Factories.	Spindles.	Power Looms.	Persons employed.
1875 .	96	1,711,214	29,171	35,652
1885 .	147	1,149,514	19,684	37,167
1890 .	124	1,204,113	28,093	34,878

The employés numbered 29,540 in 1897. In 1900 there were 92 cotton factories and 18 textile workshops engaged in cotton.

The textile industry that has made most marked progress in Scotland is the weaving of lace curtains, which is carried on chiefly in a number of Ayrshire towns and in Glasgow. In 1878 there was only one lace factory, employing 45 hands; in 1890 there were 19 factories, with 2087 hands; and the number has increased since. There were 11 silk factories in the south-western district in 1890, with 7917 spindles and 734 power looms, employing 1334 hands (2244 in 1897). Table XX. shows particulars of all textile factories in Scotland subject to the Factories and Workshops Acts for a series of years:—

TABLE XX.—*Illustrating Position of all Textile Factories.*

Years.	Factories.					Number of Spindles.		Number of Power Looms.
	Spinning.	Weaving.	Spinning and Weaving.	Other.	Total.	Spinning.	Doubling.	
1875	229	195	211	45	680	2,436,947	446,429	74,195
1885	251	221	190	114	776	1,725,173	643,931	72,279
1890	220	227	184	116	747	1,713,899	699,836	71,471
1900	...	...	...	...	725	...	...	...

The Scottish industries that have made decided progress are the manufacture of iron and steel, of which statistics are given above, and distilling and brewing. In the year 1900, out of a total of 199 distilleries at work in the United Kingdom, 159 were situated in Scotland. Table XXI. gives an indication of the progress of distilling and brewing actually and relatively to the United Kingdom:—

TABLE XXI.—*Illustrating Growth of Distilling and Brewing.*

	Scotland.		United Kingdom.	
	1890.	1900.	1890.	1900.
	£	£	£	£
Spirit duty .	4,372,400	7,650,675	13,860,002	20,124,003
Beer duty .	441,542	746,894	9,410,426	13,940,536
Total excise net receipt .	5,158,096	8,397,569	27,127,651	34,064,539

The number of gallons of whisky distilled in Scotland in 1900 was 31,798,465 (United Kingdom 59,246,277), compared with 21,472,441 in 1894 and 20,164,962 in 1884. The number of barrels of beer brewed in Scotland (in Edinburgh, Leith, and Alloa chiefly) was 2,137,030 in 1900 (United Kingdom 36,394,565), compared with 1,744,512 in 1894. The number of barrels retained for home consumption in 1899 was 1,918,426, compared with 1,425,769 in 1890.

The cheapness of sugar, while it ruined the refining industry of Greenock, brought about an enormous development of the manufacture of confectionery and preserves in Scotland, and helped, with the increase in the importation of flour, to develop the bakery trade. Preserve and confectionery making is, however, mainly confined to Glasgow, Edinburgh, Dundee, and Forfar. Printing continues to be one of the most important industries of Edinburgh, linoleum and floor-cloth manufacture of Kirkcaldy, granite-polishing and comb-making of Aberdeen. The manufacture of chemicals has its principal seat in Glasgow and neighbourhood, the manufacture of explosives in Ayrshire. German competition has almost killed the glass-bottle industry, and all the important potteries are concentrated in Glasgow, Edinburgh district, and Fife. The other widely spread industries of the country do not call for special notice.

Commerce and Shipping.—In order of commercial importance the ports of Scotland now stand as follow: Glasgow, Leith, Dundee, Grangemouth, Greenock, Aberdeen, Kirkcaldy, Granton. Table XXII. shows the net tonnage registered at Scottish ports for 1889 and 1900:—

TABLE XXII.—*Showing Registered Tonnage in Port for 1889 and 1900.*

	1889.		1900.	
	No.	Tons.	No.	Tons.
Sailing vessels . .	1644	827,417	1104	709,430
Steam vessels . .	1567	1,041,174	1980	1,528,032

Table XXIII. shows the progress of the foreign and colonial and coasting trade in the same years:—

TABLE XXIII.—*Illustrating Growth of Foreign and Colonial and Coasting Trade.*

	Coasting.		Colonial and Foreign.		Total.	
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
1889 .	7,188,703	6,998,516	3,931,010	4,412,607	11,119,773	11,411,123
1898 .	9,256,233	8,937,481	5,510,927	6,296,555	14,767,160	15,234,036
1900 .	7,213,574	6,791,959	5,657,200	6,602,545	12,870,774	13,394,504

Table XXIV. shows the development of the foreign and colonial trade:—

TABLE XXIV.—*Showing Growth of Foreign and Colonial Trade.*

	Imports.	Exports of Products of United Kingdom.
	£	£
1889 . .	36,771,016	22,310,006
1898 . .	36,224,982	23,643,143
1900 . .	38,691,245	32,166,561

Foreign and colonial merchandise transhipped was valued at £989,289 in 1889 and £738,440 in 1900. The customs revenue rose from £1,965,080 in 1894 to £2,305,259 in 1900.

Notwithstanding one or two set-backs, shipbuilding made steady and satisfactory progress, chiefly on the Clyde. Table XXV. gives details of the Scottish output in each of the years from 1895, showing the decadence of sailing shipbuilding, the progress made in steam shipbuilding, and the increase in the size of the steamers turned out:—

TABLE XXV.—*Illustrating Position of Shipbuilding Trade since 1895.*

	Sailing Vessels.		Steamers.		Total.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
1895 .	105	40,726	266	346,556	371	386,982
1896 .	97	46,814	329	392,110	426	438,924
1897 .	101	42,137	282	329,608	382	371,745
1898 .	48	8,945	360	506,252	408	515,197
1899 .	43	15,498	318	521,099	361	536,597
1900 .	...	...	...	...	406	534,759
1901 .	...	...	...	...	376	554,406

National Wealth.—The total amount of property and profits assessed to the income tax in Scotland was £61,125,422 in 1885 and £75,833,242 in 1900, the total remaining almost a constant tenth of the total for the United Kingdom. Real property under Schedule A increased in annual value from £19,790,187 in 1885 to £22,949,891 in 1900, and the amount under Schedule D (profits and trades) from £30,879,677 in 1885 to £45,390,788 in 1900. The amount which the Post Office and Trustees Savings Banks owed depositors in Scotland increased by about 250 per cent. between 1884 and 1900, the figure for the former year being £8,612,910 and for the latter £21,568,415; and while the Scottish total was little more than an eleventh of the total for the United Kingdom in 1894, it was between an eighth and a ninth in 1898. Joint-stock companies registered in Edinburgh averaged 268 yearly in 1891–1900, with an average total capital of £12,330,313. The total paid-up capital of the Scottish banks, 10 in number, at date of balance in 1901 was £9,302,000, and their total assets, £138,317,871.

Universities and Schools.—The four Scottish universities—St Andrews, Glasgow, Aberdeen, and Edinburgh—had in 1899, 128 professors in all and 97 lecturers. Radical changes were made in their constitution by an Act of 1889 and a Royal Commission which carried out its provisions. The University Court of each was made supreme authority in regard to finance, discipline, and the regulation of the duties of professors and lecturers; the universities were empowered to affiliate other academical institutions; an entrance examination was instituted; and large options were introduced into the course of study and the subjects of examination for old and new degrees; and women students were admitted on an equal footing with men. Under the Act the University College of Dundee was incorporated with the University of St Andrews, and Queen Margaret College became a part of the University of Glasgow, the buildings and endowments, which are used for women students exclusively, being handed over to the University Court. St Mungo's College, Glasgow, incorporated in 1889 under a Board of Trade licence, has medical and law faculties, and Anderson's College Medical School, Glasgow, was instituted in 1887. These are on the same footing as the extra-mural Edinburgh medical schools, their medical curricula qualifying for licence only, and not for Scottish university degrees. The Glasgow and West of Scotland Technical College, instituted in 1886 by the union of the non-medical part of the Andersonian University and other institutions in Glasgow, and the Heriot-Watt College, Edinburgh, incorporated under the Educational Endowments Act of 1882, are the leading technical schools of Scotland, and there are schools of almost equal rank at Aberdeen, Paisley, Coatbridge, and elsewhere. By the erection of chairs and lectureships in education, and otherwise, the training of teachers has been brought into closer touch with the universities, but the separate normal schools managed by the Churches are still carried on—the Established and Free Churches having each schools for both men and women in Edinburgh, Glasgow, and Aberdeen, the Episcopal Church a training school for women in Edinburgh, and the Roman Catholic Church one for women in Glasgow.

The secondary education system of the country has been largely reformed. After the reorganization of the Scottish Education Department in 1885, when it was separated from the English Department, it undertook the inspection of higher class schools; two years later it instituted a leaving certificate, which has, in conjunction with inspection, improved the efficiency of these schools, and also of the secondary departments of elementary schools, to which it was applied in 1893; 86 higher class schools (public, endowed, and voluntary) are under inspection, and pupils from 398 schools sat for the leaving certificate in 1898. In 1898 the functions of the Science and Art Department, as far as Scotland is concerned, were transferred to the Department, and arrangements are being made for spending part of the money available in encouraging school boards to provide organized course of instruction for children who have passed the elementary stage of education. Parliament has since 1892 subsidized secondary education under an Education and Local Taxation Act of that year, some £50,000 being dispensed by burgh and county committees, specially elected, to the managers of public secondary schools and the higher departments of elementary schools, and a further sum was made available by a Local Taxation Account of 1898 for similar purposes. A Technical Schools Act was passed in 1887, and has been applied by a few local authorities; but under an Act of 1890 burgh and county councils were empowered to expend a State subvention known as the "Residue" grant in supporting technical education, and about two-thirds of a sum which averages nearly £50,000 is either spent by the councils directly in subsidizing technical, science, and art institutions and classes, or handed over to the county committees mentioned above for allocation. In 1900 a Bill was introduced into Parliament which proposed to reconstitute the burgh and county committees, to give them complete control of the moneys mentioned above, and considerable

powers of supervision and guidance in regard to secondary and technical education.

Table XXVI. shows the progress that has been made in elementary education since the passing of the Education Act in 1872 :—

Table XXVI.—*Illustrating Educational Progress since 1872.*

	1872.	1880.	1890.	1900.
Estimated population . .	3,395,808	3,705,314	4,109,275	4,324,944
Number of schools inspected .	1,979	3,064	3,076	3,135
Accommodation . . .	281,688	602,054	714,865	893,842
Average attendance :				
Day scholars	213,549	404,618	512,690	626,089
Evening scholars . . .	3,653	14,297	11,636	43,962
Number of teachers :				
Certificated	2,566	5,330	7,745	10,845
Assistant	..	444	1,320	2,418
Pupil	3,642	4,582	3,883	3,926

The percentage of average attendance to estimated population increased from 12·08 in 1884–85 to 14·48 in 1899–1900. For the purposes of education in Scotland there was raised by rates in 1898–99, £861,078, by an average rate of 9·25 pence compared with 9·23 in the previous year ; by voluntary subscriptions, £28,883 ; in lieu of school fees there was granted to boards and managers, mostly out of a parliamentary vote, £367,618 ; and the ordinary parliamentary vote for day schools under inspection amounted to £677,964—total, £1,935,543. Thus the cost of maintenance per child in average attendance was in public schools £2 13s. 7¾d., in voluntary schools £2 6s. 9d. School fees were almost entirely abolished in 1889, and the loss is made up mainly by annual parliamentary grant and partly by a proportion, earmarked for the purpose, of the proceeds of imperial taxation diverted to local purposes under various Acts. Down to March of 1900, £7,684,577 had been spent in Scotland since 1872 in building public schools. The most important change effected in the elementary education system was the abolition of individual inspection of the lower standards, which was brought about in 1886. This reform has since been extended to the whole of the standards, and inspectors now apply a collective test to the efficiency of a school. By the Code of 1899 a merit certificate was instituted, which at once fixes a standard of attainment for pupils who have passed through an elementary school course, and qualifies for entrance upon courses of higher education in higher grade schools or departments which managers were, by the same code, liberally encouraged to organize for systematic instruction in science, subjects appertaining to commerce, or specially suited to girls. A Superannuation Act for teachers was passed in 1898.

Churches.—For the history of the Scottish Churches in recent years reference may be made to the separate articles, Scotland, Churches of, and Scotland, the Episcopal Church in. Table XXVII. gives comparative statistics (up to the union of the Free and United Presbyterian bodies in 1900) for the three Presbyterian Churches which command the allegiance of the bulk of the people of Scotland :—

Table XXVII.—*Illustrating Distribution and Contributions of Presbyterian Churches.*

	Congregations.		Members.		Contributions.	
	1885.	1899.	1885.	1899.	1885.	1899.
Church of Scotland.	1479	1770	565,261	648,476	£366,431	£484,275
Free Church . .	1067	1109	329,451	404,828	626,028	712,742
U.P. Church . .	543	589	177,517	197,476	387,355	428,106

The membership of the Free Church included in 1899, 111,144 adherents who were not communicants. The Reformed Presbyterian Church had in 1899 2 presbyteries and 12 churches ; the Original Secession Church, 4 presbyteries and 29 charges ; the Evangelical Union Church (the section which refused to unite with the Congregational Union in 1896), 10 charges ; and the Free Presbyterian Church, which separated from the Free Church on account of the Declaratory Act of 1892, had 12 congregations. The Congregational Union of Scotland embraced 184 churches in 1899 ; the Baptist Union of Scotland had 109 churches and 15,260 members ; the Wesleyans had 44 congregations and missions and 8502 members. The Episcopal Church of Scotland had 356 congregations, including missions, in 1899, 114,315 members, including 45,571 communicants, and raised £110,178 ; the corresponding figures for 1885 being 250 churches, 80,000 members, and 30,000 communicants. The Roman Catholic Church had in 1898, 346 churches, chapels, and stations, compared with 327 in 1885, and its missions numbered 209, while the "Catholic population" was 413,000, as against 340,000 in 1885.

Local Administration.—A large number of new police burghs have been formed since the passing of the Burgh Police (Scotland) Act, which consolidated burgh law and enlarged the powers of police commissioners. But the most important change introduced into local administration during the latter part of the 19th century was effected by the Local Government Act of 1889, which constituted county councils and abrogated nearly all the powers of the commissioners of supply. The council of each county exercises (with two exceptions) the whole powers and functions of the commissioners of supply and of the old Road Trust, acts as local authority under the Contagious Diseases (Animals) Act, as local authority under the Public Health Acts in all parishes (burghs and police burghs excluded), and performs all the administrative duties formerly committed to the justices of the peace. Only the judicial powers of the justices were left to them, and the principal function now discharged by the commissioners of supply is the appointment of half (the county council appointing the other half) of the members of the standing joint committee, which manages the county police, and whose consent in writing must be obtained before the county council undertakes any work involving capital expenditure. All but the smallest counties are subdivided into districts, and the Road Acts and the Public Health Acts are administered in these areas by district committees, composed of members of the county council and representatives of the parish and burgh councils of the district. The county council may also enforce the Rivers Pollution Act within the area under its jurisdiction. Another Local Government Act for Scotland was passed in 1894, by which the Board of Supervision was replaced by a Local Government Board, composed of the secretary for Scotland, the solicitor-general, and the under-secretary, and three appointed members—a vice-president, an advocate, and a medical practitioner. Parochial boards were abolished, and provision was made for the election in every poor-law parish of a parish council, to which the powers of the parochial board were transferred in regard to poor law, vaccination, registration, burial-grounds, &c. New powers conferred on the parish councils include the following :—A parish council may take over the management of any parish trust at the option of the trustees, and may accept the charge of churchyards, and move the county council in the matter of vindicating rights of way, or the formation of special lighting or scavenging districts ; and is entitled to the majority of seats in the sub-committee appointed to manage the affairs of such districts. The parish council may acquire recreation grounds, act as managers under the Allotments Acts, and may lease land for allotments ; and has certain powers of ensuring that the public health of its parish is properly looked after by the county council or district committee. (W. WA.)

Scotland, Churches of.—The history of the Churches in Scotland during the last quarter of the 19th century was marked by increased ecclesiastical activity and a considerable decline in church-going, the number of baptisms, and the attendance at Sunday schools. The number of congregations of all denominations was 3827 in 1879 and 4248 in 1899—an increase of 421. During the same period the population increased by 580,151, so that the addition to the number of congregations kept pace fairly well with the addition to the population; there were 987 persons per congregation in 1879 and 1002 persons per congregation 1899. On the other hand, censuses of church attendance, taken in a number of urban and rural communities in 1876 and 1896, showed that the average best attendance per thousand members at the churches of the three leading Presbyterian bodies in these places had fallen from 861 in the former to 636 in the latter year, and it is estimated that there is probably a churchless population in Scotland equal to 37½ per cent. of the whole, or more than 1,600,000 persons. The indifference of the age was, however, constantly combated, not only by church-planting, but by numerous additions to the Church agencies for Christian work. The labours of the Church of Scotland Committee on Christian Life and Work were emulated by the other Presbyterian Churches, and many elaborate inquiries into such subjects as the religious condition of the people resulted in the creation of new organizations for stimulating the religious sentiment, and checking the tendency to lapse from Church connexion. But the Committee on Life and Work kept the lead which it established in 1875, at least in devising novel aids to the parish minister. Women's work in the Church was fully recognized by the Assembly of the Establishment in 1886, and a Young Women's Guild and

Order of Deaconesses were founded, with a training home and Deaconess Hospital. Six years, from 1890 to 1896, were spent by a committee of the same Assembly in investigating all over Scotland the "state of religion and morals," and in preparing a series of interesting reports thereon; and a similar function is performed by a standing committee of the Free Church on Religion and Morals. The standard of parochial and congregational activity was everywhere raised; most congregations have agencies for overtaking different departments of socio-ecclesiastical work, in which the laity co-operate with the clergy; Young Men's Guilds, especially in the Church of Scotland, have an undoubted vitality; and the Free Church, at all events, has grappled seriously with the problem how to rid itself of inefficient ministers.

Concurrent with this evangelical energizing was a decided growth of tolerance and liberality of thought and scholarship in all the Presbyterian Churches. In contrast with the immediately preceding period, it was the Free Church, rather than the Establishment, that was, during the last twenty years of the 19th century, most "troubled" by advanced thinkers and scholars among its clergy; and while it constantly swelled the roll of its bold and distinguished Biblical critics and liberal thinkers, since the removal of the late Professor Robertson Smith from his chair in the Aberdeen College in 1881, it steadfastly refused to permit a prosecution for heresy; while the Established Church indulged in a heresy hunt so lately as 1896–97, when the Rev. Alexander Robinson, minister of Kilmun, was deposed for refusing to recant the views expressed in his book, *The Saviour in the Newer Light.* Development in the Church of Scotland in this respect has taken the line of mutual tolerance of the High, Broad, and Evangelical schools, which have marked themselves off more clearly from one another, while freely recognizing each other's right to be within the Church. The first-named school founded in 1892 the Scottish Church Society, "to defend and advance Catholic doctrine as set forth in the Ancient Creeds and embodied in the Standards of the Church of Scotland"; and the Kilmun prosecution was followed by the foundation of the Scottish National Church Union by members of the Broad school. In the Free Church the College chairs were almost uniformly filled by advanced critics or theologians, inspired more or less by Professor A. B. Davidson, who went to the Hebrew chair in the New College, Edinburgh, in 1863. Dr A. B. Bruce (author of *The Training of the Twelve*, &c., d. 1899) was appointed to the chair of Apologetics and New Testament Exegesis in the Glasgow College in 1889. Henry Drummond (author of *Natural Law in the Spiritual World*, &c., d. 1897) was made lecturer in Natural Science in the same College in 1879, and became professor in 1883; and Dr George Adam Smith (author of *The Twelve Prophets*, &c.) was called to the Hebrew chair in 1892. Attempts were made between 1890 and 1895 to bring all these professors, except Davidson, to the bar of the Assembly for unsound teaching or writing, but in every case these were abortive, the Assembly never taking any step beyond warning the accused that "their primary duty was to teach and defend the Church's faith as embodied in the Confession." After the failure of the first movement towards union of the Free and United Presbyterian Churches, the latter paid more attention to the efficient training of its ministry, and in 1891 its College was remodelled so as to furnish a full and regular theological curriculum, similar to those of the University Divinity Halls and the Free Church Colleges.

This Church showed the way to the others, with its Declaratory Act of 1879, in relaxing the stringency of the subscription to the Westminster Confession of Faith. In 1889 the Church of Scotland modified its formula for office-bearers' subscription; and a Declaratory Act, similar to that of the United Presbyterian Church, was passed by the Free Church Assembly in 1892, with the result that a small number of ministers and congregations severed their connexion with the Church and formed the Free Presbyterian Church of Scotland, on strictly and straitly orthodox lines. From 1885 till about 1895 much of the energy of all the Presbyterian Churches was absorbed by the Disestablishment agitation. In the former year the Free Church, having almost entirely shed the Establishment principle on which it was founded, began to rival the United Presbyterian Church in its resolutions calling for the Disestablishment of the Church of Scotland; and while the Established Assembly at first responded with offers to confer with both the dissenting Churches about union, the assaults upon its status waxed in vigour till in 1893 the Free Assembly hailed the result of the general election as a verdict of the constituencies in favour of Disestablishment, and insisted upon the Government of the day taking up Dr Cameron's Disestablishment Bill. The Church of Scotland began to counteract the agitation in 1890 by forming a defence organization all over the country, which was considered to be practically complete in 1895. After the general election of that year, however, the agitation became much less active. During the last four or five years of the 19th century the Free and United Presbyterian Churches devoted the greater part of their energy to arranging an incorporating union between them. The minor Courts of the Free Church first moved in the matter; and the supreme Court of the United Presbyterian Church in 1896 resolved to "take steps towards union." In the following year the Free Assembly responded by appointing a committee to confer with a committee of the other Church. The joint-committee discovered a "remarkable and happy agreement" between the doctrinal standards and rules and methods of the two bodies, and with very little of concession on either side a common constitution and common "questions and formula" for the admission of ministers and office-bearers were arranged. The supreme Courts approved the proposals of the joint-committee, which embraced, besides a Uniting Act, declarations conserving the liberty and privileges of individual members and congregations on either side in various important respects; and the union was completed in October 1900, at a meeting of the first General Assembly of the United Free Church of Scotland. The use of instrumental music was sanctioned in Free churches during this period. The jubilee of the Free Church was celebrated in 1893, and of the United Presbyterian Church in 1897. Church congresses on the English model were held for the first time in 1899 by the Established and Free Churches.

The following table shows the material progress of the principal Churches in Scotland during the last twenty years of the 19th century:—

	1879.	1899.
Population	3,677,558	4,257,709
Congregations—		
Established Church	1,337	1,447
Free Church	1,033	1,101
United Presbyterian	533	577
Other Denominations in 1885	924	1,123
Membership—		
Established Church	518,146	648,476
Free Church	246,250	293,684
United Presbyterian	172,150	195,498
Income—	1885-86.	1889-1900.
Established Church	£311,378	£492,816
Free Church	594,050	706,546
United Presbyterian	367,915	392,116

While the population of Scotland increased by 580,151 in the twenty years, or 15·78 per cent., congregations increased in the Established Church 8·23 per cent., the Free Church 6·58 per cent., the United Presbyterian Church 8·25 per cent., and in other denominations (1885–1899) 21·54 per cent.; and the membership of the Established Church 25·15 per cent., of the Free Church 19·26 per cent., and of the United Presbyterian Church 13·56 per cent. It has to be pointed out, however, that the only thoroughly trustworthy index of progress is the increase of congregations (the Church of Scotland, by the way, completed in 1900 the endowment of 408 new parishes since the Disruption). In the first place, a local reluctance to communicate relegates to the category of "adherents" a body of adults in the Highlands fairly estimated at about 61,500, and by so many diminishes the membership of the Free Church. In the second place, the accuracy of the returns of membership of all the Churches is seriously impugned on the ground of the discrepancy between the death-rate of the country and the death-rates of the communicants of the three Presbyterian Churches; for instance, in 1899 the death-rate for Scotland per ten thousand of the population was 185·78; and of the Church of Scotland per ten thousand communicants 145·20, of the Free Church 181·83, and of the United Presbyterian Church 176·36. In the Free Assembly Reports for 1900 it is correctly calculated that if the death-rate of the communicants of the three denominations were the same as the death-rate of the country, the exact number on the rolls of the Church of Scotland in the middle of 1899 would have been 509,798 (instead of 656,112), of the Free Church 288,622 (instead of 296,085), and of the United Presbyterian Church 188,234 (instead of 199,089).

The greater proportional increase of the congregations of "other denominations" is accounted for mainly by the remarkable growth of the Scottish Episcopal Church. During the last fifteen years of the 19th century, while the population rose by 7·78 per annum, the congregations of this Church increased by no less than 32·63 per 1000 per annum, as compared with 4·11 in the case of the Established Church, 3·29 in the case of the Free, and 4·13 in the case of the United Presbyterian Church.

The Roman Catholic hierarchy was restored in Scotland in 1878. There are six dioceses (with two archbishops, one of Edinburgh and St Andrews and the other of Glasgow), with, in 1900, 452 priests; 358 churches, chapels, and stations; and a Catholic population estimated at 413,400.

The Original Secession Church has 4 presbyteries and 27 congregations; and the remnant of the Reformed Presbyterian Church which did not join the Free Church in 1876, 2 presbyteries and 12 congregations. The Congregational and Evangelical Union (formed by the amalgamation of the Congregational and Evangelical Unions in 1896) has 179 churches; and the remnant of the Evangelical Union, 9 churches. The Baptist Union has 121 congregations, and the Wesleyan Methodists, 49 churches. (W. WA.)

Scotland, The Episcopal Church in, in communion with, but historically distinct from, the Church of England, is composed of seven dioceses: Aberdeen and Orkney; Argyll and the Isles; Brechin; Edinburgh; Glasgow and Galloway; Moray, Ross and Caithness; and St Andrews, Dunkeld and Dunblane. All, except Edinburgh, founded by Charles I., are pre-Reformation sees. The bishops constitute the Episcopal Synod, the supreme Court of appeal, whose president, elected by the members from among themselves, has the style, not the functions, of a metropolitan, being called Primus. The legislature is the Provincial Synod, consisting of the bishops, at whose discretion it is summoned, and a lower chamber of presbyters. The Canons have the authority of this Synod. The Representative Church Council, including laymen, administers finance. Each diocese has its Synod of the clergy. Its Dean is appointed by the Bishop, and, on the voidance of the see, summons the clerical and lay electors, at the instance of the Primus, to choose a bishop, who is presented to the Episcopal Synod for confirmation and to the Primus for consecration. There are cathedrals at Perth, Inverness, Edinburgh, and Cumbrae; the sees of Aberdeen, Brechin, and Glasgow have no cathedrals. The Theological College was founded in 1810, incorporated with Trinity College, Glenalmond, in 1848, and re-established at Edinburgh in 1876. There are 356 congregations, with a total membership of 124,335, and 324 working clergy (1900). No existing ministry can claim regular historic continuity with the ancient hierarchy of Scotland, but the bishops of the Episcopal Church are direct successors of the prelates consecrated to Scottish sees at the Restoration. On the refusal of the bishops to recognize William III. (1689), the presbyterian polity was established in the Kirk, the effect of which on its ecclesiastical status is a matter of theological opinion, but the Comprehension Act of 1690 allowed episcopalian incumbents, on taking the Oath of Allegiance, to retain their benefices, though excluding them from any share in the government without a further declaration of presbyterian principles. Many Non-jurors also succeeded for a time in retaining the use of the parish churches. The extruded bishops were slow to organize the episcopalian remnant under a jurisdiction independent of the State, regarding the then arrangements as provisional, and looking forward to a reconstituted national kirk under a "legitimate" sovereign. A few prelates, known as college bishops, were consecrated without sees, to preserve the succession rather than to exercise a defined authority. But at length the hopelessness of the Stewart cause and the growth of congregations outside the Establishment forced the bishops to dissociate canonical jurisdiction from royal prerogative and to reconstitute for themselves a territorial episcopate. The act of Queen Anne (1712), which protects the "Episcopal Communion," marks its virtual incorporation as a distinct society. But matters were still complicated by a considerable, though declining, number of episcopalian incumbents holding the parish churches. Moreover, the Jacobitism of the Non-jurors provoked a State policy of repression in 1715 and 1745, and fostered the growth of new Hanoverian congregations, served by clergy episcopally ordained but amenable to no bishop, who qualified themselves under the Act of 1712. This Act was further modified in 1746 and 1748 to exclude clergymen ordained in Scotland. These causes reduced the Episcopalians, who included at the Revolution a large section of the people, to what is now, save in a few corners of the west and north-east of Scotland, a small minority. The official recognition of George III. on the death of Charles Edward in 1788, removed the chief bar to progress. The "qualified" congregations were gradually absorbed, though traces of this ecclesiastical solecism still linger. In 1792 the penal laws were repealed, but clerical disabilities were only finally removed in 1864. In 1784 Seabury, the first American bishop, was consecrated at Aberdeen. The Book of Common Prayer, which came into general use at the Revolution, is now the authorized service book. The Scottish Communion Office, compiled by the Non-jurors in accordance with primitive models, has had a varying co-ordinate authority, and the modifications of the English liturgy adopted by the American Church were mainly determined by its influence. Among the clergy of

post-Revolution days the most eminent are Bishop Sage, a well-known patristic scholar; Bishop Rattray, liturgiologist; John Skinner, of Longside, author of *Tullochgorum*; Bishop Gleig, editor of the 3rd edition of the *Encyclopædia Britannica*; Dean Ramsay, author of *Reminiscences of Scottish Life and Character*; Bishop A. P. Forbes; G. H. Forbes, liturgiologist; and Bishop Charles Wordsworth.

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Scott, Robert (1811–1887), English divine and classical scholar, was born in 1811 at Bondleigh in Devonshire, of which parish his father was rector. Educated at Shrewsbury School under Dr Butler, he entered Christ Church, Oxford, and after a brilliant university career graduated in 1833 with a first class in *Literæ Humaniores*. In 1834 he won the Latin Essay and was elected fellow of Balliol, where he was tutor from 1835 to 1840. After holding successively the college livings of Duloe and South Luffenham, he was elected in 1854, on the death of Dr Jenkyns, master of Balliol. This office he held, together (from 1861) with that of the professorship of the exegesis of Holy Scriptures, down to 1870, when he accepted the deanery of Rochester. As master of Balliol he kept the college up to the high level it had attained under his predecessor. As a Greek scholar, Dr Scott had few equals among his contemporaries. His great literary achievement, which may be said to constitute his life's work, was his collaboration with Dean Liddell in the great Greek lexicon which bears their name. He died at Rochester on 2nd December 1887.

Scott, William Bell (1811–1890), British poet and artist, son of Robert Scott (1777–1841), the engraver, and brother of David Scott, the painter (*Ency. Brit.* xxi. 543), was born in Edinburgh, 12th September 1811. While a young man he studied art and assisted his father, and he published verses in the Scottish magazines. In 1837 he went to London, where he became sufficiently well known as an artist to be appointed in 1844 master of the Government school of design at Newcastle-on-Tyne. He held the post for twenty years, and did good work in organizing art-teaching and examining under the Science and Art Department. He did much fine decorative work, too, on his own account, notably at Wallington Hall, in the shape of eight large pictures illustrating Border history, with life-size figures, supplemented by eighteen pictures illustrating the ballad of *Chevy Chase* in the spandrels of the arches of the hall. For Penhill Castle, Perthshire, he executed a similar series, illustrating *The King's Quhair*. After 1870 he was much in London, where he bought a house in Chelsea, and he was an intimate friend of Rossetti and in high repute as an artist and an author. His poetry, which he published at intervals (notably *Poems*, 1875, illustrated by etchings by himself and Alma-Tadema), recalled Blake and Shelley, and was considerably influenced by Rossetti; he also wrote several volumes of artistic and literary criticism, and edited Keats, "L.E.L.," Byron, Coleridge, Shelley, Shakespeare, and Scott. He resigned his appointment under the Science and Art Department in 1885, and from then till his death (22nd November 1890) he was mainly occupied in writing his reminiscences, which were published posthumously in 1892, with a memoir by Professor Minto. It is for his connexion with Rossetti's circle that Bell Scott will be chiefly remembered.

Scranton, a city of Pennsylvania, U.S.A., capital of Lackawanna county. It is situated in 41° 24′ N., and 75° 43′ W., on the river Susquehanna, in the north-eastern part of the state, at an altitude of 738 feet. The city is well laid out with broad streets, is divided into 21 wards, is well paved (mainly with asphalt), has a good water-supply, and is well sewered. It is entered by five railways, the Central of New Jersey, the Delaware and Hudson, the Delaware, Lackawanna, and Western, the Erie and Wyoming Valley, and the New York, Ontario, and Western, which afford ample facilities for traffic. Scranton is in the heart of the anthracite coal region, and its industries relate to coal-mining and iron manufacture. In 1900 it contained 710 manufacturing establishments, in which was invested a total capital of $19,954,525. They employed 12,669 hands, and the product was valued at $27,646,418. Of this amount $10,231,139, or 37 per cent., consisted of iron and steel goods. Silk was manufactured to a value of $3,616,885, and foundry and machine shop products to a value of $1,755,909. It is perhaps the chief centre of distribution of the anthracite coal product of the country. In 1900 the assessed valuation of real and personal property was $23,354,046, on a very low valuation; the net debt of the city was but $747,463, and the rate of taxation was $38.70 per $1000. Population (1890), 75,215, showing 64 per cent. increase on the preceding ten years; (1900), 102,026, of whom 28,973 were foreign-born and 521 negroes. Of 28,075 males 21 years of age and over, 2985 were illiterate (could not write).

SCULPTURE.

BRITISH.

DURING the last quarter of the 19th century a great change came over British sculpture—a change so revolutionary that it gave a new direction to the aims and ambitions of the artist, and raised the British school to a level wholly unexpected. It cannot be pretended that the school equals, in technical accomplishment or in richness or elasticity of imagination, the schools of France and Belgium, for these have been built up upon the example of national works of many generations of sculptors during several centuries. British sculptors found themselves practically without a past of their own to inspire them, as there is no truly national tradition; so that with them it was simply a case of beginning at the beginning.

The awakening came from without, brought to England mainly by a Frenchman—Jules Dalou (d. 1902), and two Englishmen who had studied abroad, Alfred Gilbert and Onslow Ford. To Carpeaux, no doubt, the new inspiration was in a great measure due; for Carpeaux, who infused life and flesh and blood into his marble (too much of them to please the lovers of purism), was to his classic predecessors and contemporaries much the same that in painting Delacroix was to David and the cold professors of his formal school. But it was to Jules Dalou that was chiefly due the remarkable development in Great Britain. A political refugee at the time of the Commune, he received

a cordial welcome from the artists of England, and was invited to assume the mastership of the modelling classes at South Kensington. This post he retained for some years, until the amnesty for political offenders enabled him to return to his native land; but before he left, he had improved the work in the schools beyond all recognition. The whole conception of sculpture seemed to be modified, and intelligent enthusiasm was aroused in the students. When he departed, he left in his stead Professor Lantéri, who became a naturalized Englishman, and who exercised an influence equal to that of his predecessor. Meanwhile, the Lambeth Art Schools—where Mr W. S. Frith, a pupil of M. Dalou, was conducting his modelling class under the directorship of Mr John Sparkes—were being maintained with great success. And latterly at the Royal Academy, where in 1901 the professorship of sculpture was revived after many years, the inspiring genius of Mr Alfred Gilbert aroused in the students an enthusiasm curiously contrasting with the comparative apathy of earlier days. British sculpture, therefore, when it is not coloured directly from the Italian Renaissance, is certainly influenced from France. But it is remarkable that in spite of this turning of British sculptors to romantic realism as taught by Frenchmen and Italians, and in spite of the fact that the spirit of colour and decoration and greater realism in modelling, had been brought from abroad, the actual character of British sculpture, even in its most decorative forms, is not in the main other than British.

Nevertheless, there has been shown a strong tendency towards reviving the application of colour in sculpture which has not met with universal approval. Although the polychromatic work of the Renaissance, for example, may keep its place, it is held to clash with the idea of sculptural art; for though there is no absolute approach to imitation, there is a very strong suggestion of it. The use of a variety of marbles and metals, or other materials, such as has been increasingly adopted, does not offend in the same measure, as the result is purely formal. Yet, in the final result, the work becomes not so much sculpture as an "object of art."

Revival of polychromatic sculpture and metal-work.

Indeed, the sculptor has been greatly reinforced by the artificer in metal, enamel, and the like. But the revival of metal-work, cut, beaten, and twisted, however fine in itself, does not help sculpture forward very much. It may even keep it back; for popular and beautiful as it is, it really tends to divert the attention from form to design, and from light and shade, with planes, to ingenuity, in pleasing lines—a very beautiful and elevated art, but not sculpture. As an adjunct, it may be extremely valuable in the hands of a fine artist who does not mistake the mere wriggles and doublings which are the mark of the more extravagant phase of the so-called "New Art," for harmonious "line." But it must always suggest the man with the anvil, shears, and pincers, rather than the man with the clay and chisel. It is mainly to Mr Alfred Gilbert, R.A., that is due the delightful revival of metal-work in its finest form wedded to sculpture, with the introduction of marbles, gems, and the like, felicitous and elegant in invention and ornament, and so excellent in design and taste that in his hands, at least, it is subservient to the monumental character of his sculpture.

The first effectual rebellion against the Classic, and the birth of Individualism, dates back to Alfred Stevens (1817–1875; see 9th edition, vol. xxi. p. 561). The picturesque fancy of the Frenchman Roubiliac (1703–1762), with his theatrical arrangement and skilful technique, had left little mark on the Englishmen of his day. They went on, for the most part, with their pseudo-classic tradition, which Flaxman carried to the highest point. But until Stevens, few in England thought of instilling real life and blood and English thought and feeling into the clay and marble. It was not only life that Stevens realized, but dignity, nobility of form, and movement, previously unknown in English work. Follower though he was of Michael Angelo and the Italian Renaissance, he was entirely personal. He was no copyist, although he had the Italian traditions at his fingers' ends, and his feeling for architecture helped him to treat sculpture with fine decorative effect. Yet even Stevens and his brilliant example were powerless to weaken the passion for the Greek and Roman tradition that engrossed English sculptors—with their cold imitations and lifeless art, pursued in the name of their fetish, "the Antique."

Alfred Stevens, A.R.A.

Until towards the close of the 19th century this pseudo-classic art was blindly pursued by a non-Latin race, and a public favourite like W. Calder Marshall, R.A. (1813–1894) never attempted, except perhaps in the "Prodigal Son," to break away towards originality of thought.

W. Calder Marshall, R.A.

Thomas Woolner (*q.v.*), who had represented a modern heroine as a Roman matron, and had shown in his monument to Bishop Jackson in St Paul's Cathedral an archaic severity and dryness altogether excessive, sought elevation of conception such as brought him applause for his "Tennyson" in portraiture and for his "Virgilia Lamenting the Banishment of Coriolanus"—probably his most admirable and most exquisitely touching work.

T. Woolner, R.A.

Meanwhile, Baron Marochetti, R.A. (1805–1867), an Italian of French parentage, had tried to introduce a more modern feeling, and his "Richard Cœur de Lion" at Westminster evoked great enthusiasm. It is difficult, now, to admire the incongruity of the 12th-century king, mounted on a modern thoroughbred, and raising arm and weapon with an action devoid of all vigour. The intention was excellent and fruitful, notwithstanding, and the statue is not without merit. Later Charles Bell Birch, A.R.A. (1832–1893), with his German training, introduced a new picturesque element in his "Wood Nymph," "Retaliation," "The Last Call," and the "Memorial to Lieut. Hamilton, V.C., dying before Kabul"; but neither the vigour nor the individuality of his work influenced his contemporaries to any extent, doubtless on account of the German aspect in it, the outcome of his training.

Baron Marochetti, R.A.

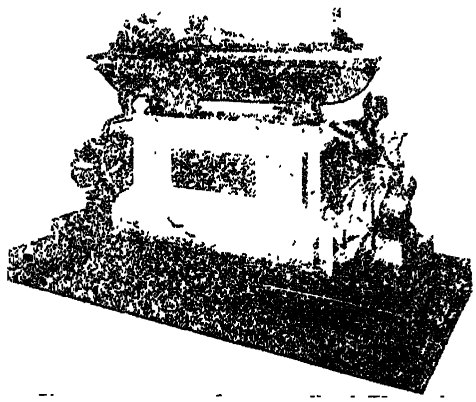
C. B. Birch, A.R.A.

Sir J. Edgar Boehm, R.A. (1834–1890), an Austrian by birth, was more successful, and his influence, helped by the talent of able studio-assistants (Professor Lantéri, Mr Alfred Gilbert, and others), contributed somewhat to thaw the chill which the cold marble still seemed to shed around. There was not much inspiration in his monument of "General Gordon" in St Paul's Cathedral, and his "Wellington Memorial" is cold and empty, though correct enough; but the "Herdsman and Bull," among his ideal subjects, the "Carlyle" on Chelsea Embankment, among his portrait-statues, had the right feeling in them.

Sir J. Edgar Boehm, R.A.

J. H. Foley, R.A. (see vol. ix., 9th edition), who at first was all for "the unities" and a "pure style," seemed in his later years to throw his previous convictions to the winds, when he produced the finely spirited equestrian statue of "General Sir James Outram," now erected in India. This statue was welcomed with enthusiasm in the art-world, and helped to remind the public that monuments need not be staid to dulness, nor stiff and dead in their imperturbability.

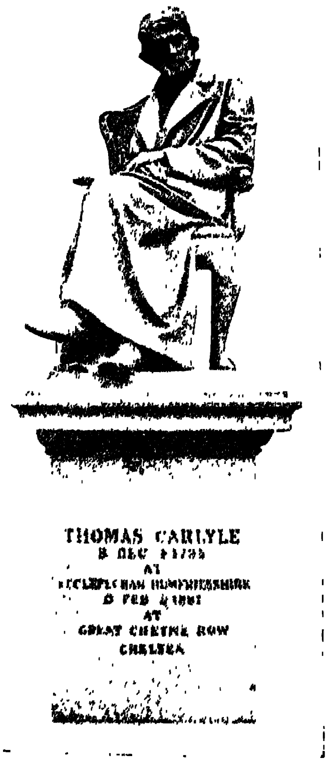
Alfred Drury, A.R.A. - Even



Thomas Brock, R.A.—Lord Leighton Memorial, St Paul's Cathedral.

G. F. Watts, R.A.—Clytie.

John M. Swan, A.R.A. Leopard Running.



Sir J. Edgar Boehm, R.A.—Carlyle.

W. R. Colton—The Crown of Love.

Thomas Brock, R.A.—The Genius of Poetry.

SCULPTURE. Plate I.—BRITISH (a).

G. Frampton, R.A.—Dame Alice Owen.

W. Hamo Thornycroft, R.A.—Dean Colet.

Lord Leighton, P.R.A.—The Sluggard.

H. Bates, A.R.A.—Homer.
(*From a Photograph by Frederick Hollyer.*)

H. H. Armstead, R.A.
Lieutenant Waghorn.

G. F. Watts, R.A.—Hugh Lupus.

A. Gilbert, R.A.—Icarus.

SCULPTURE. Plate II.—BRITISH (*b*).

Meanwhile Mr Henry Hugh Armstead (b. 1828; R.A. 1879), in 1902 the oldest of the living exhibiting sculptors (Mr G. F. Watts is dealt with later), who had begun by devoting himself to the art of the silversmith, fashioning the "St George's Vase," "The Packington Shield," and "The Outram Shield," was working in the spirit of the younger school. He was carrying out commissions of great magnitude—in the Palace of Westminster, and in the Abbey itself, for which he executed the marble reredos with its many figures, the whole of the external sculptural decorations for the Colonial Office in Whitehall, as well as the eighty-four life-sized figures on two sides of the podium of the Albert Memorial, with the four bronze statues, "Chemistry," "Astronomy," "Medicine," and "Rhetoric." Portrait-figures of all ages are here classed together, and the work is a better-sustained piece of designing and carving than is commonly understood. The statue set up at Chatham of "Lieutenant Waghorn" is a good example of Armstead's sculpture, impressive by its breezy strength and picturesqueness; but a more remarkable work, technically speaking, is the memorial to a son of the earl of Wemyss, "David and the Lion," now fixed in the Guards' Chapel. It is in very flat relief; Ninevite in character of treatment, and carved wholly by the artist directly from the living model, it is, in point of technique, one of his best productions. The work of Mr Armstead is monumental in character—the quality which has been so rare among British sculptors, yet the finest quality of all; and in almost everything he does there is a "bigness" of style which assures him his place in the British school.

H. H. Armstead, R.A. First appearance in the Exhibitions (1851).

Following the chronological order of the artists' first public appearance, as being the most convenient and the only consistent method that will prevent overlapping, we come to Mr F. J. Williamson (b. 1853), who executed many works for Queen Victoria; Mr John Hutchison, R.S.A. (b. 1856), a Scottish sculptor of the Classic school; and Mr George A. Lawson, H.R.S.A. Mr Lawson was a pupil of Alexander Ritchie, of the Royal Scottish Academy, and in a measure of Rome. Born in 1832, he came to London in 1867, and soon proved himself one of the best sculptors Scotland has produced. "In the Arena" was his first striking group. "Daphnis" is an excellent example of his Classic life-size work; and "Motherless," one of his greater successes in a more modern and pictorial spirit, a group full of pathetic pathos and free and sympathetic handling. "Callicles," the weary "Danaid," "Old Marjorie," and the statue of "Robert Burns," erected at Ayr—are all in their way remarkable. Mr Lawson's work, which only requires a little more animation to be very fine, has the quality of "style," and is strong, manly, and full of distinction.

G. A. Lawson, H.R.S.A. (1862).

Mr George Simonds (b. 1844) is a product of the foreign schools. He is the author of many monumental works and not a little decorative sculpture, but he is best recognized by ideal subjects, such as "The Goddess Gerd," "The Falconer" (in the Central Park, New York), "Cupid and Campaspe," and "Anemone, the Wind Flower." His treatment of the undraped female figure is refined and delicate, and there is an intellectual reality about his best work, as well as imagination in conception. Mr A. Bruce-Joy (b. Dublin, 1842) has produced ideal work and statues of our public men for public spaces.

G. Simonds (1866).

A. Bruce-Joy.

Mr Thomas Brock (b. 1847), the amount of whose work is prodigious, as well as solid and scholarly, came to London from Worcester in 1866, and entered as a pupil the studio of Foley, whose ablest assistant he soon became, and thus fell early under the influence of the sculptor who was soon to rebel against the formalism that prevailed. Had he gone on he would have become a second Foley; in fact, when his chief died, in 1874, Mr Brock was appointed to carry out the great unfinished works in the studio—the "O'Connell Monument" in Dublin, the "Lord Canning" in Calcutta, and several others. But he felt the foreign current; and even when his style was formed, his career being already assured, he was perceptive enough to modify it, and, so developed, he left his master very far behind. The ideal work that marked this transition was "The Moment of Peril," a fine, scholarly work representing a mounted Red Indian repelling the attack of a great serpent which has thrown his horse to earth. How greatly he improved in technical quality and in refinement of taste is to be seen in the life-sized marble statue called "The Genius of Poetry"—graceful where the "Moment of Peril" was violent in action, reposeful and harmonious where that was vigorous, and sculpturesque where that was anecdotal. A still higher intellectual point was reached in "Song" and in the "Eve," now in the Tate Gallery in London. A similar advance is to be observed in the portraiture of Mr Brock. The statues of "Robert Raikes" (on the Thames Embankment) and "Sir Richard Temple" (in Bombay Town Hall), for example, are finely treated, unconventional figures; but "The Rt. Rev. Henry Philpotts, D.D., Bishop of Worcester," in which the inherent difficulty of a seated figure is happily surmounted, marks the progress. The skill with which the artist has given the drapery, especially of the sleeves, a lightness not commonly seen, is striking. There are no black holes of shadow: the depressions are shallow and of the right shape to hold light even while securing shadow; yet weakness is avoided and crispness is secured by the sharpening of the edge of the folds—the principle which is established in the Pheidian group of "The Fates," for example, among the Elgin Marbles. Other works of importance in the same class are the effigy of "Dr Benson, archbishop of Canterbury," and the admirable statue of "Sir Richard Owen" in the Natural History Museum, South Kensington, both of a high order whether as to character or handling. The bust of "Queen Victoria" is one of the noblest and most dignified works of its class executed in England; full of tenderness and of character, lovingly rendered; and with a delicate feeling for form, rightly realized. This head heralded the noble work by which the memory of Lord Leighton is to be kept green in the aisle of St Paul's Cathedral. In proportion and in harmony of design and of line, alike in conception and in reticence, it is the sculptural expression of a well-ordered mind and taste. The effigy shows Leighton asleep, while figures personifying his arts, painting and sculpture, guard his sarcophagus at head and foot. There is a note of triumph in the great design for the "Queen Victoria Memorial," which is likely to provide London with its most elaborate sculptural effort, rising 70 feet high in a plateau 200 feet across, with numerous emblematical figures of great size and imposing arrangement. In Mr Brock's work the lines are always good. It is based on an elevated style, dignified, refined, and monumental; for he is a sculptor in the full sense of the term.

Thomas Brock, R.A. (1868).

Mr D. W. Stevenson, R.S.A. (b. 1842), in his general work has shown but little sympathy with modern developments. The "Bronze Lectern" (in St Cuthbert's Church, Edinburgh) is perhaps the most decoratively effective; but his most ambitious work, called "The Pompeian Mother," is a modern inspiration of the "Niobe and her Daughter" by a follower of the school of Scopas in the Uffizi Gallery.

D. W. Stevenson, R.S.A. (1868).

Although Mr Horace Montford, modelling-master at the Royal Academy, passed much time in the studio of Matthew Noble (1818–1876), he did not thereby lose his sculptural taste. Not that he displayed it much in the share he had, as assistant to Mr Birch, in the modelling of the notorious "City Griffin" at Temple Bar—a weird but spirited beast, the design for which had been supplied by the City architect, Sir Horace Jones. The statue of "Psyche and the Casket of Venus" may be named as typical of the style of Mr Montford, whose work is usually broad and sculpturesque, and distinguished by firmness and grace.

H. Montford (1870).

Sir Charles B. Lawes (b. 1843) has produced two large works which have attracted attention—the first an elaborate and spirited equestrian group of a female Mazeppa, "They Bound me On" (1888), and the other "The United States of America" (1890), decorative and not without elegance. His work is strong and robust, though somewhat lacking in repose.

Sir C. B. Lawes, Bt. (1870).

Mr W. Hamo Thornycroft (b. 1850; A.R.A. 1881; R.A. 1888), a pupil of his father and at the Royal Academy, had studied in Italy while yet a lad. Believing that the pendulum had overshot the swing from conventional classicality towards pictorial realism, he turned from this "fleshly school," as represented by Carpeaux, towards the Greeks, but he realized the artistic demand and aspirations of modern days. When his prize work, "A Warrior Bearing a Wounded Youth from the Field of Battle," was seen in the Royal Academy Exhibition, it divided attention with Woolner's "Tennyson" and Alfred Stevens's "Wellington." Mr Thornycroft aimed at the cunning contrast of the mature and the youthful naked forms—the tense muscles of the one, and the supine, languorous limbs of the other. "Lot's Wife" (1878) shows none of the prettiness prevailing at the time it was produced, in the rendering of the female form. The fine structure and vigorous modelling of the turned head, the twisted neck with its tense muscles and the strong shoulder, emphasized the pure taste and sense of style of the sculptor. The dramatic action is daring—Lot's wife, with her snatched-up jewels, has turned her head to look, and her lower limbs and drapery are already beginning to take columnar form, as her whole being is struck cold with the sudden transformation. Then came "Artemis" (1879), a surprise to those who imagined that they had taken their measure of the sculptor's exceptional power. The attitude and arrangement are original. From every point of view the group is beautiful; the forms and the head are nobly conceived; and the dog is a good piece of animal life, freely, though statuesquely, treated. Two years later Mr Thornycroft reached the high-water mark of his career with "Teucer." The Homeric bowman, mortified, and eager to redeem his eightfold failure to hit his man, has let fly one shaft more at Hector—and, retaining his attitude, tense and strained, he watches his last arrow in its flight. This figure, simple and severe, is realistic yet classic, instinct with life, and noble in form. It is now in the Chantrey Collection at the Tate Gallery. The great exterior frieze for Mr John Belcher's fine building for the Institute of Chartered Accountants was an important revival of the attempt to set the example of using sculpture by sculptors, instead of by masons, for the worthy embellishment of public buildings—an example that promised to be widely followed.

Hamo Thornycroft, R.A. (1871).

Turning to the ideal, in works entirely modern in motive and treatment, Mr Thornycroft produced "The Sower," a semi-realistic statue in which he sought to combat the difficulty of dress in the British peasant or farm labourer. The head, inclined to be classic, is not unsuited to the labourer; and what the sculptor loses in form, by reason of the design, he gains in action and in movement. "The Mower"—the British equivalent to Constantin Meunier's Flemish or Walloon labourer or workman—is strong and natural in pose, incisive in character, although but a type, masterly in modelling and in restrained suggestion of textures. The "Dean Stanley Memorial," erected in the old church at Holyhead, seems purposely to depart from the severity of line and solemnity of treatment usual in such works. The memorial of the "Bishop of Carlisle" is at once more grave and more fanciful. This leads to Mr Thornycroft's portrait-statues—the ideal and the real. An admirable example of the real, the "General Charles Gordon" in Trafalgar Square, is suggestive of the masterfulness, dignity, and quiet self-confidence of the hero, and is one of the best portrait-statues in England. Prominent among the ideal statues is the colossal "Oliver Cromwell" at Westminster—heavily handled in order to fit the character of the subject, and stolid in dignity and latent energy. The memorial to "Dean Colet," quaintly recalling Donatello or Verrocchio, appeared in its completed form in the Royal Academy of 1901; it is an illustration of the dignity, ease, and simplicity in Mr Thornycroft's more ideal work, for it has in it much of the feeling of the Italian school at its best period, by reason of the quietness, quaintness, and charm in its unostentatious arrangement. In Mr Thornycroft, then, we have to appreciate an unaffected sympathy with grandeur and style, and in all, a big, broad rendering of the human form, with something of the movement of the Greek sculptors and not a little of their repose, yet individual and unmistakably belonging to the British order of mind.

From the year 1873, Mr Roscoe Mullins produced numerous busts and statues, and his work was in the main ideal and decorative. His best figure is probably that of "Cain—My Punishment is Greater than I can Bear," executed in 1896. In architectural embellishment Mr Mullins's work is good in style, appropriate, and effective.

E. R. Mullins (1873).

Mr Swynnerton is a sculptor who has spent a good deal of his time in Rome and worked under her influence. His colossal fountain of flowers, zephyrs, and splashing nymphs is, on the contrary, rather rococo in style, with charming passages. On the other hand, "Love's Chalice" is classic in feeling. Generally speaking, Mr Swynnerton's work has an appearance of strength, without commonness or lack of effect.

J. Swynnerton (1873).

Onslow Ford (1852–1901; A.R.A. 1888; R.A. 1895)—who was lost to British art before he had passed middle age—became known by winning the competition for the statue of "Rowland Hill," now erected outside the Royal Exchange, London; but he made his first real success with his seated life-sized figure in marble of "Henry Irving as Hamlet," now in the Guildhall. It is a well-conceived piece of realism, with expression subtly marked, and verging upon the theatrical—which is precisely what an actor's character-portrait should be. Compared with this work, a later seated statue, that of "Huxley," keen and refined, is more strictly sculpturesque—for in it there is no "subject," and there are no ornaments to divert the attention and suggest a false appearance of decoration. The well-known statue of "Gordon," camel-mounted—reminding us of the "Arab Chief" by Barye—is more open to criticism on the score of the elaborateness of the ornamental details, which almost reach the boundary of what is allowable in sculpture. It is erected at Chatham and a replica has been set up (1902) in Khartum. A finer memorial is that to the honour of "Shelley"—better in its parts than in its entirety,

E. Onslow Ford, R.A. (1875).

because the decorative scheme injures, rather than helps, the sculptural dignity of the drowned poet's exquisitely-rendered figure. This monument is at University College, Oxford; but the replica of the figure, with a plain base, erected on the shore at Viareggio, where the body of Shelley was found, is perhaps finer, because a simpler and more perfectly proportioned work. Of Onslow Ford's other memorials, that of "Queen Victoria" at Manchester is perhaps the most discussed. Although it does not rank by any means with the best of which the artist was capable, the conception is dignified and characteristic. As a truthful portraitist Onslow Ford had few rivals. The busts of "Sir John Millais" as president of the Royal Academy, and of other distinguished artists, of "Sir Frederick Bramwell," "Herbert Spencer," "Queen Victoria," "A. J. Balfour," and very many others, show his talent for producing speaking likenesses. The sitter is before the spectator, without undue flattery, yet without ever showing the commoner side of the model. Flesh, bone, hair, clothing, are all in their true relation, and the whole is admirably realized. Idealism, or at least poetic realism, Onslow Ford cultivated in a considerable series of small works. "Folly," "Echo," "Peace," were varied by the severer "Egyptian Singer" and "Applause." His last figure, "Glory to the Dead," though statuesque, carries realism rather far in treatment. It might be objected that in funerary art, so to call it, the nude was never resorted to by the Greeks in such a relation; but Onslow Ford felt that he was working, not for ancient Greeks, but for modern Englishmen, and that sentiment, and not archæology, must in such matters be the guide. Among Onslow Ford's chief works not yet mentioned are the seated statues of "Dr Dale" and the "Duke of Norfolk." The chief of the standing statues is perhaps the "W. E. Gladstone" at the City Liberal Club, London; the principal equestrian statue, the "Lord Strathnairn," Knightsbridge, London; and the most ambitious monument, that to the "Maharaja of Durbarjah." There are, besides, the "Marlowe Memorial," set up in Canterbury, and the "Jowett Memorial," a wall decoration, in the style of the Italian Renaissance. The work of Onslow Ford always charms, for he had a strong sense of the picturesque and a true feeling for beauty. But for his delight in decorative detail, he would have been greater than he was; for over-enrichment is in inevitable opposition to the greater qualities of the monumental and the dignified in glyptic art, and abundance of small details involves poorness of effect. But against Ford's taste, especially against his admirable dexterity, little need be said. The high degree of refinement, the charm of modelling, grace of line and composition, sweetness of feeling, which are the note of his work, are in a great measure a set-off against occasional weakness of design and character.

H. R. H. Pinker (1875).

Mr Hope Pinker is primarily a portrait-sculptor. Among all his works the seated statue of "Dr Martineau" is perhaps the best, for interest, refinement, and for technical qualities. His reliefs are as numerous as his statues, of which the most popular is the "Henry Fawcett" in the Market Place of Salisbury, but his most important work is the colossal statue of Queen Victoria executed for the Government of British Guiana.

Lord R. Gower (1876).

The most remarkable work executed by any British amateur-sculptor is the "Shakespeare Memorial," presented to the nation by Lord Ronald Gower, and set up by him outside the Shakespeare Theatre at Stratford-on-Avon. This monument, carried out in Paris, represents the poet on the summit, attended below by the four great characters—"Hamlet," "Henry V.," "Lady Macbeth," and "Falstaff," designed with singular ability. Lord Ronald has also modelled statues of "Marie Antoinette," "The Dying Guardsman," and other works which have secured wide attention.

Lord Leighton, P.R.A. (1877).

In 1877 there burst upon the world a new sculptor, in the person of Sir Frederick (afterwards Lord) Leighton (*q.v.*), who, in the following year, was to be the president of the Royal Academy. His first work was "An Athlete Struggling with the Python," to which a brief allusion was made in the 9th edition (vol. xxi. p. 561). No piece of sculpture of modern times made a greater stir on its appearance; for here was a work by a painter, a work, it was declared, which would have done honour to the ancients, fine in style, noble in type and in form, learned in the knowledge of the figure it displayed, original and strong in pose, in action, and movement; scholarly in execution and instinct, with the manner of the painter himself. The group was hailed as a masterpiece by one who was thought to be not yet even a student in sculpture. Yet it is somewhat lacking in expression—in that kind of humanity which every really great masterpiece of art should exhibit; and connoisseurs applauded the technique, the surface qualities, and the like, when they should have been caught by the sentiment. But as Leighton was seeking only the beauty and expression of form, to the neglect of sentiment, he was well content with the reception and world-wide recognition of his work. One day the model for the "Athlete," tired out, rose and stretched himself, and the sculptor was so enraptured by the pose that he forthwith began the model for "The Sluggard." This work is in its way of still higher accomplishment than the "Athlete." It is just as Greek in its devotion to form and its worship of the beauty of the human frame. But it is a condition, a sensation, an idea, rather than an action, that is here recorded; and so it is the higher conception. And it has some of the mystery which is distinctive of the finest art of ancient times, but in which modern sculpture is almost entirely deficient. Yet while the "Athlete" may be compared, in idea, with the relatively debased "Laocoon," which it seems in some degree to follow if not to challenge, the "Sluggard" belongs to a more elevated expression of a distinctly pagan art, and, as it were, to a better period. Great as was the sensation made by these works, and by the charming statue of "Needless Alarms" (cast by the "waste-wax" process), Leighton seems to have left no direct follower or imitator among the younger men.

T. S. Lee (1878).

Mr Stirling Lee, by natural ability as well as by cultivation, is an artist of unusual elevation of mind and excellence of execution, and in his composition he aims at securing beauty by the arrangement of his figures in the panel, rather than at enriching them with details, as a designer would do. He is an ascetic in choice of materials, so that his works generally remain beautiful studies of the human form, draped or undraped. It is for his power of telling a story beautifully in marble—as in his panels for St George's Hall, Liverpool, which are among the finest work of their kind in England—that Mr Lee will continue to be admired: he is, beyond almost all others, a sculptor's sculptor.

J. M. Swan, A.R.A. (1878).

Mr John M. Swan, (b. 1847; A.R.A. 1897; A.R.W.S. 1896), a pupil of the Royal Academy and of M. Gérôme and Frémiet, has specialized as a sculptor of a particular class of subject. He is a stylist in a high degree, whose work is full of beauty and importance. For the most part his sculptures are studies of animals, mainly of the *felidæ*; but Mr Swan passes from the accentuation of action to the covering of skin and hair, without seeking much to emphasize the bone and flesh, because they alone display, with the

fascinating expressiveness of their sinuous bodies, the whole range of the passions in the most concentrated form. In the "Leopard Playing with a Tortoise," "Leopard Running," "Puma and Macaw," and similar works, we have the note of his art—sinuosity, with tense muscles, stretched and folded skin, suppressed frenzy of enjoyment. The note of Barye, the great Frenchman, from whom in some measure Mr Swan drew inspiration, is power and strength and decorative form, but Mr Swan aims rather at fine, grim, naturalistic studies of a great cat's crawl, with vivacity and vitality.

H. Dixon (1881).

Another student of animal life is Mr Harry Dixon, whose bronze "Wild Boar" is in the Tate Gallery. "A Bear Running," excellent alike in character, form, and construction, and especially in movement, "Otters and Salmon," and the figure-subject called "The Slain Enemy"—a prehistoric man with a dead wolf—are among his chief works.

A. C. Lucchesi (1881).

Mr Andrea Lucchesi is one of the few who, in spite of all discouragement, has not only persisted in concentrating his attention on ideal work, but has devoted most of it to the rendering of the female form. Prominent among his figures are those called "Destiny," "The Flight of Fancy," "The Mountain of Fame," and "The Myrtle's Altar." Mr Lucchesi's main excellence is in the treatment of nude forms, in which he has succeeded, through agreeable idea and excellent execution, in interesting a public usually indifferent to this branch of sculpture.

A. Gilbert, R.A. (1882).

Mr Alfred Gilbert (b. 1854; A.R.A. 1887; R.A. 1892; professor of sculpture, R.A., 1900) is one of the greatest figures in British sculpture, not only as being a master of his art, but as having preached in his work a great movement, and in less than a decade effected more than any other man for the salvation of the British school and influenced, quite as much as Carpeaux or Dalou, the young sculptors of the country. After acting as assistant to Boehm, he studied at the Beaux Arts under Cavelier, and then worked in Rome. His chief production there was the beautiful group of the "Mother and Child," produced when the classic sculptors of that city were immersed in the spirit of antiquity. This work brings to mind the teaching of the French school, and makes an irresistible personal appeal to the emotion and sympathy of the spectator. Mr Gilbert then produced "Perseus Arming," "Icarus," "The Offering of Hymen," two fine heads of a man and a girl, pure in style and incisive in character—most of which were cast by the *cire perdue*, or "waste-wax," process, which he had learned in Naples. Its introduction into Great Britain had considerable influence on the treatment of bronze sculpture by British artists. In Mr Gilbert's portraiture we have not merely likenesses in the round, but little biographies full of character, with a spiritual and decorative as well as a physical side, and the mental quality displayed with manly sympathy. Flesh and textures are perfectly realized, yet broad, simple, and modest. Many of these qualities are as obvious in his portrait-statues, such as the fine effigy set up to "John Howard" in the market-place of Bedford. The highly original pedestal has done a good deal to direct into a better channel what are apt to be the eccentricities of what is called the "New Art" school. But the monument with which Mr Gilbert's name will ever be associated is the magnificent "Statue of Queen Victoria" erected at Winchester. The queen is shown with extraordinary dignity. Large in its masses, graceful in its lines, the person of the queen enveloped by all the symbolical figures and fanciful ornaments with which the artist has chosen to enrich it, the monument marks the highest level in this class to which any sculptor and metal-worker has reached for generations. The profusion of an ardent and poetic imagination is seen throughout in the arrangement of the figure itself, in the exquisite "Victory" that surmounts the orb, in the stately throne. Invention, originality, and inspiration are manifest in every part, and every detail is worked out with infinite care, and birth is given to a score of dainty conceits, not all of them, perhaps, entirely defensible from the sculptural point of view. In a measure it suggests goldsmithry, to which the genius of Mr Gilbert has so often yielded, as in the exquisite epergne presented to Queen Victoria on her jubilee in 1887, typifying Britannia's realm and sea power in endless poetic and dainty suggestions of beautiful devices. Among Mr Gilbert's memorials are those to "Frank Holl, R.A.," and to "Randolph Caldecott," both in the crypt of St Paul's Cathedral, London; the "Henry Fawcett" memorial in Westminster Abbey, which, with its row of expressive little symbolical figures, has been styled "a little garden of sculpture"; and the finest work of its kind in England, the "Tomb of the Duke of Clarence" in St George's Chapel. Among Mr Gilbert's other works which should be mentioned are "The Kiss of Victory," "The Enchanted Chair," the statue of "Lord Reay" at Bombay, and the "Shaftesbury Fountain," London. Few artists in any age have shown greater genius as at once sculptor and artificer. Mr Gilbert is fond of dealing with a subject which allows his fancy full play. His work is full of colour; it is playful and broad. The smallest details are big in treatment, and every part is carefully thought out and most ingenious in design. His playfulness has caused him at times to be somewhat too florid in manner; but his taste is so just, that he has safely given rein to his fancy where another man would have run riot and come to grief.

R. Stark (1883).

Mr Robert Stark is an animal sculptor who has usually attracted the notice of connoisseurs rather than of the greater public, and his fine bronze statuette of an "Indian Rhinoceros" is to be seen in the Chantrey Collection. Mr Stark has a profound knowledge of animal anatomy; his range is considerable, and he is as easy with a rhinoceros as with a cart-horse or a hunter.

C. Dressler (1883).

Mr Conrad Dressler is best known for his busts of distinguished men, but his statue of "A Girl Tying up her Sandal," and his two large marble panels for St George's Hall, Liverpool, assured him his position. There is a cleverness, a daring, in his marked style, vigour of treatment, and a tendency towards emphasis, especially in his decorative work, much of which is designed for execution in Della Robbia ware.

H. Bates, A.R.A. (1884).

Harry Bates (1850–1899; A.R.A. 1892), at first a carver's assistant, and then a pupil of the Royal Academy Schools and of Dalou and Rodin, made his first impression with the bronze relief of "Socrates Teaching the People in the Agora," which proclaimed a new sculptor gifted with imagination and romantic feeling controlled, as it were, by classicism. In the three bronze panels on the subject of the "Æneid" which he exhibited in 1885, he gave the second of those admirable reliefs by which his name is best known, and will remain best known, to the public, for many years to come. Then followed his great panel, "Homer: A Blind Old Man, and Poor—Sweetest he Sings." In this work, with its balance and dignity, its rhythmical line and fine expression, is to be seen a flexibility which few young Englishmen had shown up to that time. Style and a genuinely modern treatment of classic form which is not weakened by touches of naturalism, were also to be recognized. Nor does the background detract from the main subject—Homer and Humanity in front; and behind,

A. GILBERT, R.A.—Statue of Queen Victoria.

E. ONSLOW FORD, R.A.—Shelley Memorial.

W. HAMO THORNYCROFT, R.A.—Teucer.

F. W. POMEROY—The Nymph of Loch Awe.

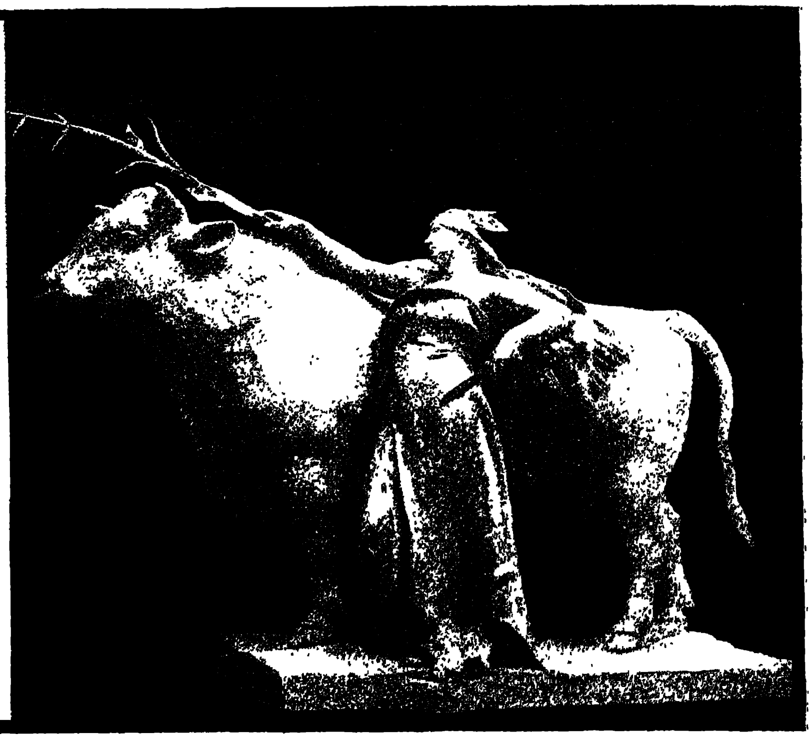
A. TOFT—Hagar.

C. B. BIRCH, A.R.A.—The Last Call.

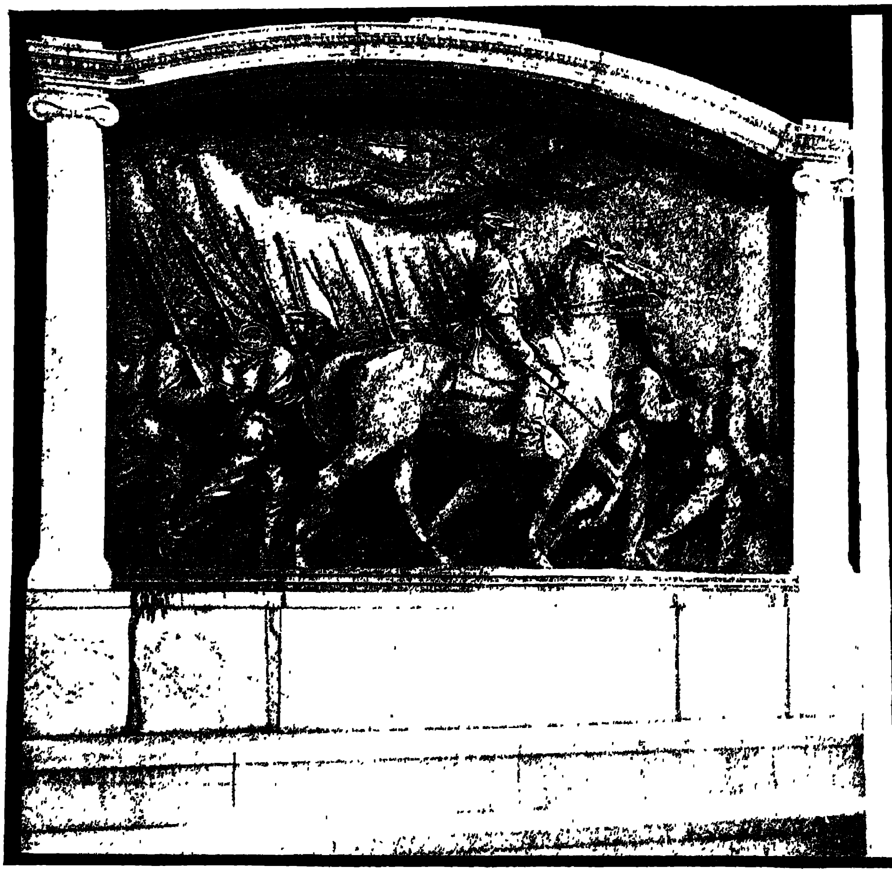
GOSCOMBE JOHN, A.R.A.—St John the Baptist.

SCULPTURE. PLATE III.—BRITISH (c).

J. Q. A. WARD—George Washington.



D. C. FRENCH—Indian Corn; Bull by E. C. POTTER.



AUGUSTUS ST GAUDENS—Memorial to Robert Gould Shaw.

FREDERICK MACMONNIES - Nathan Hale.

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SCULPTURE. PLATE IV.—AMERICAN.

a vision of the Parthenon and Pallas Athene, and the great Sun of Art rising with the dawn of Poetry. "Psyche" (1887) is more delicate in thought and treatment, but it has little of the originality or force of the "Homer," or of the classic style in the head called "Rhodope." The serene and reposeful statue of "Pandora," about to open her ivory casket, successfully achieves the purity of style at which the sculptor aimed. "Hounds in Leash" is a vigorous group which was undertaken by Bates in response to the criticism that he could design no figures but such as are at rest. It is in the Tate Gallery, where it figures along with the "Pandora." In "Endymion" the sculptor seems to have united in some degree the sculptural ideas expressed in the "Homer" and the central relief of "Psyche": there is in it a good deal of the grace of the one and of the decorative force of the other, together with a lofty sense of beauty. The portrait-busts of Harry Bates are good pieces of realism—strong, yet delicate in technique, and excellent in character. His statues have a picturesqueness in which the refinement of the sculptor is always felt. Among the chief of these is the fanciful "Maharaja of Mysore," somewhat overladen with ornament, and the equestrian statue of Lord Roberts upon its important pedestal, girdled with a frieze of figures, now set up in Calcutta.

G. J. Frampton, A.R.A. (1884).

Mr George Frampton (b. 1860; A.R.A. 1894; R.A. 1902), pupil of the Royal Academy, the Lambeth Schools, and Merció in Paris, is a particularly versatile and original artist, thoroughly in the "new movement" which he has done so much to direct. Highly accomplished, he is at home in every branch of his art, and covers the whole field. He first exhibited "Socrates Teaching" (1884), and followed this with "The Songster" (1887), "An Act of Mercy" (1888), "In Silence Prayeth She," "The Angel of Death" (1889), "Caprice" (1891), and in 1892 "The Children of the Wolf"—his last ideal statue of the kind. It was followed by "Mysteriarch," heralding a class of work with which the artist has since identified himself; for being in open rebellion against "white sculpture," he thenceforward devoted himself to colour. "Mother and Child" is an experiment in polychromatic figure-work. The half-length figure called "Lamia," with ivory face, head, and neck, and in a quaint head-and-neck dress of bronze jewelled, is a further departure from the true reserve of sculpture, but beautiful and delightful in feeling. The statue of "Dame Alice Owen," in bronze and marble, and "King Edward VI." are original, notwithstanding the pseudo-mediæval taste of their conception. Mr Frampton is happiest in distinctly decorative sculpture. His prolific and inventive fancy has expressed itself in such works as the bronze "The Steamship" and "The Sailing Ship" for Lloyd's Registry in London, and in the memorial "Monument to Charles Mitchell," at Newcastle-on-Tyne. Herein a new note is sounded, and we have some of the most striking features of Mr Frampton's design. That is to say, he seeks to escape from the purely architectural forms, pediments, and mouldings, introducing his own inventions of curved lines, and frequently substituting tree-forms for columns or pilasters, with roots for bases, trunks for pillars, and branches and foliage for capitals. Besides these should be mentioned "The Vision," the seven heroines from the *Morte d'Arthur*, "My Thoughts are my Children," "Music," and "Dancing," and memorials and busts of "Charles Keene," "R. Stuart Poole," "Leigh Hunt," "Passmore Edwards," "Dr Garnett," and a colossal statue of "Queen Victoria" erected in Calcutta. There are always charm of arrangement, delicacy of workmanship, and daintiness of feeling, as well as considerable power of design, simplicity, and breadth in his work.

W. S. Frith (1884).

Mr W. S. Frith, one of the most successful teachers of sculptors in England, is chiefly remarkable for the decorative quality of his work. As in the monument to "Wheatstone, Inventor of the Telegraph," or again, the standard lamps at the Astor Estate Office on the Thames Embankment, the sculptor shows charm of thought and spirit of design, vigour, and richness of effect. His ideal statuary and portraiture are not his chief work, however; his decorative sculpture for ecclesiastical and secular buildings is vast in extent and has had good influence on the younger school.

H. A. Pegram (1884).

Mr Henry Pegram, pupil of Mr Hamo Thornycroft and at the Royal Academy, attracted early attention with "Death Liberating a Prisoner," and by the two high reliefs "Ignis Fatuus" (acquired for the Chantrey Collection) and "The Doom of Medusa." These were followed by "Eve," "Sibylla Fatidica," "The Last Song," "The Bather," "Labour," and "Fortune," by decorative work for the exterior of the Imperial Institute, and later by the great candelabra which flank the interior western end of St Paul's Cathedral. His portraiture is also noteworthy, and his work generally is "big" in style and sculpturesque, with movement and life.

A. G. Walker (1884).

Mr A. G. Walker has produced notable work in the class of pure sculpture, including the relief representing "The Last Plague: The Death of the Firstborn," "Adam and Eve: And They were Afraid," and "The Thorn," graceful and quaintly charming, with elegance in the pose and in the action. His chief decorative work includes the sculptural figures in Stamford Hill Church.

A. Jones (1884).

The name of Mr Adrian Jones is chiefly associated with the spirited work called "Duncan's Horses," a group displaying great knowledge of equine anatomy, form, and action.

W. Reynolds-Stephens (1885).

Mr Reynolds-Stephens, latterly more devoted to goldsmith's figure-work than to larger and more searching sculpture, must be considered less as a statuary than as "a poet who sings in metal." A relief, after Sir L. Alma-Tadema's "Women of Amphessa" (1889), was followed by a "Wall Fountain," "Truth and Justice," and the "Sleeping Beauty," a bas-relief, full of thought, invention, and dainty conceits. In the highly decorated "Launcelot and the Nestling," "Guinevere and the Nestling," and similar works, the artist makes use of various coloured metals, ivory, gems, and the like, with pretty symbolism. Apart from his choice of material, there is a delicate languor about the lines of his figures and reliefs, which display a charming feeling and refined taste.

A. Drury, A.R.A. (1885).

Mr Alfred Drury (b. 1857; A.R.A. 1900) is a pupil specially of Dalou, whose assistant he became. The first result was the curious echo of the master's style, "The Triumph of Silenus" (1885). "The Genius of Sculpture" and "The First Reflection" (bought by the Queen of Saxony), and "The Evening Prayer" (1890, Manchester Corporation Gallery), were followed by the statue of "Circe" (1893), which, through its grace, elegance of line, and symbolical realization of the subject, achieved a great popular success and was acquired by Leeds. The bronze head of "St Agnes" (1894) is one of the first examples of Mr Drury's later style, belonging to the higher order of conception which, generally speaking, he has since maintained. This may be seen in "Griselda" (bought for the Chantrey Collection), "The Age of Innocence," and other stories of childhood, and in the scenes of "The Months," at Barrow Court. For the decoration of the City Square at Leeds Mr Drury executed the statue of Dr Priestly, consisting of the

colossal figure entitled "Even." Mr Drury's quiet, suave, and contemplative art lends itself well as decorative sculpture to architectural embellishment. His portraiture is also good, reticent, and full of character, and as a manipulator of clay he represents the highest contemporary standard of English sculptors.

F. W. Pomeroy (1885). Mr Frederick W. Pomeroy (pupil at the Lambeth and Royal Academy Schools, and of Mercié) is of equal taste and ability. After 1888, when he exhibited the bronze statuette "Giotto," he produced many ideal works—"Love the Conqueror" (Walker Art Gallery, Liverpool), "Pleasures are like Poppies Spread," "Boy Piping," "Dionysos" and "The Nymph of Loch Awe" (both in the Tate Gallery), "A Nymph Finding the Head of Orpheus," "Undine," "Pensée," and the clever study of the nude called "The Potter." "Perseus" is an inspiration from Benvenuto Cellini, but "The Spearman" is an original and powerful work. In ideal statuary he has produced "Admiral Blake," "Dean Hook" (a colossal work for Leeds), "Oliver Cromwell" (also colossal, for St Ives, Huntingdonshire), and "Robert Burns" for Paisley. In true portraiture, Mr Pomeroy executed the Liberal Memorial Statue of Mr Gladstone, in the lobby of the Houses of Parliament, and the recumbent effigy of the Duke of Westminster, for Chester Cathedral. His work is strong and sculpturesque, and his statues "stand" well. He sees nature in a big broad way, and his decoration is effective and well designed.

A. Toft (1885). Mr Albert Toft became known by his statue of "Lilith" (1889), and emphasized the impression then created by "Fate-Led" (1892, Walker Art Gallery), "Age and the Angel of Death," "In the Sere and Yellow Leaf" (a remarkable study of old age), "The Goblet of Life," and "Hagar." "The Spirit of Contemplation" and "The Cup of Immortality" are more complete and display dignity and refinement. Mr Toft's busts, such as those of W. E. Gladstone and Philip Bailey, have force and breadth of character; and in his ideal work there is an effort, well sustained and successful, after dignity, harmony, evenness of balance, and relation of the whole.

E. Lantéri (1885). Professor Édouard Lantéri, a naturalized Englishman, to whom British sculpture owes much, employed his own striking gifts to teach rather than to produce. But "The Fencing Master," "The Duet," and "A Garden Decoration" have exercised influence on the younger school through their fine sculptural qualities of vitality, richness, joyousness, sensuousness, and movement.

W. Birnie Rhind, R.S.A. (1885). Mr Birnie Rhind, R.S.A., has produced little work so important as the elaborate decorations for the doorway of the Scottish National Portrait Gallery, but some of his statues and busts—"King James V. of Scotland," "Lord Salisbury," and others—show the influence of the modern school.

Goscombe John, A.R.A. (1886). Mr Goscombe John (A.R.A. 1899) achieved an early reputation with a figure of "St John the Baptist," an austere creation of real importance. His other chief works are "Morpheus," "A Girl Binding her Hair," "A Boy at Play" (Tate Gallery), "The Glamour of the Rose," and "The Elf"—a weird creation of true comedy. In these are shown a love of the purity and refinement of nature, realized with delicacy and a feeling for beauty. In portraiture Mr John is not less successful. The colossal seated statue of "The Duke of Devonshire" has been acknowledged by the best critics in France and England to be one of the finest things of its kind, good in design and quiet suggestion of power.

B. Mackennal (1886). Mr Bertram Mackennal, the son of a Scottish sculptor settled in Australia, acknowledges no school, but he has been chiefly influenced by study in Paris. In his ideal works, such as "Circe," "For She Sitteth on a Seat in the High Places of the City," there are boldness and sense of drama, with a keen appreciation of elegance of form, not without severity, and power of design. His sculpture is marked by good style, with movement and nervousness of treatment.

H. Hampton (1886). Mr. Herbert Hampton made his first appearance in the Paris Salon with "The Mother of Evil," and then the statues of "David" and "Apollo," and "The Broken Vow," "A Mother and Child," "Narcissus," and other works were seen in the London galleries. Portraiture of merit has come from Mr. Hampton, but his greatest success, perhaps, has been achieved in decorative sculpture.

F. E. Schenck (1886). Mr F. E. Schenck is similarly and more emphatically an architect's sculptor—one of those who have done so much to embellish rightly the numerous great buildings which during the last twenty years of the 19th century were springing up all over Great Britain. The Municipal Buildings at Stafford and Oxford, the Public Library at Shoreditch, and the *Scotsman* Offices in Edinburgh—involving groups of colossal figures bearing close relation to their architectural setting—are among the works which have made his reputation.

J. W. Robbins (1887). Mr J. Wenlock Robbins is another architectual sculptor of real power and individuality, whose work for the New General Hospital in Birmingham and for the Town Hall of Croydon is of a high order. His portraiture is also good, the colossal statue of "Queen Victoria" for Belfast being the most important of his achievements. Of ideal work, the statue called "Nydia" is the best known.

H. C. Fehr (1887). Mr Henry C. Fehr (pupil at the Royal Academy and of Mr Brock) contributed the group of "Perseus and Andromeda" to the Academy in 1893, when it was purchased for the Chantrey Collection (Tate Gallery). His subsequent ideal works, "Hypnos Bestowing Sleep upon the Earth," "The Spirit of the Waves," "St George and the Rescued Maiden," and "Ambition's Crown Fraught with Pain," confirmed the high opinion of his cleverness; but in some of them his exuberance tells somewhat against their general effect, in spite of their inherent grace and strength. On the other hand, the statue of "James Watt" for the City Square of Leeds exhibits those qualities needful for open-air portraiture; and his busts and statues have character and life.

G. E. Wade (1887). Mr. George Wade is essentially a sculptor of busts and statues; the most noteworthy of his works are the memorial to Sir John Macdonald in Montreal, and the seated figure for Madras of the native judge, Sir T. Aiyar Muthuswamy.

G. Bayes (1888). Mr Gilbert Bayes, at first a modeller in the flat of horses treated in a decorative manner, produced "Vanity," "A Knight-Errant," and similar picturesque *bibelôts* on a large scale; and later still, such work as "The Fountain," showing a talent at once more serious, ordered, and graceful.

W. R. Colton (1889). Mr W. R. Colton is a sculptor of strong individuality, capable equally of deep feeling and dainty fancy. "The Girdle," "The Image-Finder," "The Crown of Love," "The Wavelet," and the "The Springtide of Life" reveal a sculptor of exceptional ability, whose love of truth and life sometimes inspires him to place a touch of rather awkward realism in a graceful and charming composition; the result is something unusual, yet quite natural and not objectionable. Mr Colton's

A. Falguière—St Vincent de Paul.

E. Barrias—The First Funeral.

E. Delaplanche.
The Virgin with the Lily.

A. Idrac—Mercury inventing the Caduceus.

Juste Becquer—St Sebastian.

L. Gérôme—Bonaparte at Cairo.

L. Marqueste—Galatea.

SCULPTURE. Plate V.—FRENCH (a).

L. Longepied—Immortality.

E. Frémiet—St George.

D. Puech—The Siren.

E. Guillaume—The Roman Marriage.

R. de Saint-Marceaux—Genius guarding the Secret of the Tomb.

A. Mercié—Souvenir.

A. Rodin—The Kiss.

SCULPTURE. Plate VI.—FRENCH (b).

true power of design and sense of style made him a force in the younger school of sculptors.

D. McGill (1889). Mr David McGill, an artist of the same class, first attracted attention with the relief of "Hero and Leander," following it with a series of figures, of which the most striking is "The Bather," a work at once of vigour and of humour. His work is good in pose and line, refined in drawing and feeling, and excellent in style.

C. J. Allen (1890). Mr Charles J. Allen belongs to the same group. "Love and the Mermaid" (Walker Art Gallery, Liverpool), "A Dream of Love," and "Rescued" are works of high merit, in every case good in treatment, free in modelling, and pleasing in design.

F. M. Taubman (1890). There are others who have to be recognized as important, if young, members of the school. Mr Taubman, who has had both French and Belgian teaching, has produced a series of works which display his power of design and strength of technique. "The Angel of Sad Flowers," "Orpheus and Eurydice," and "Adam and Eve" reveal his strength in ideal work; and his statue of "Sir Sidney Waterlow" at Highgate is a good example of his monumental portraiture.

J. P. Macgillvray, R.S.A. (1891). Mr Pittendrigh Macgillvray, R.S.A., belongs to the rather meagre Scottish group. His chief work consists mainly of monuments and colossal memorials. The "Peter Low" memorial in Glasgow Cathedral, the "Robert Burns," the "Allan Family Memorial," the fine relief of "Rhythm," and the "National Gladstone Memorial" for Scotland are his leading works.

Mr Paul Montford, Mr Oliver Wheatley, Mr John Tweed, Mr Hodge, Mr Poole, and Mr Derwent Wood are artists whose work is marked by strong individuality and elevated character, and may be considered leaders among those who are the hope of the future.

Women-sculptors. Women-sculptors (among whom may be included clever amateurs, such as Princess Louise, Duchess of Argyll, and Countess Gleichen) have attracted well-deserved attention in a measure unprecedented in England. Miss Margaret Giles, whose group "After 1900 Years, and still they Crucify" shows power and ability, Miss Ruby Levick, Miss Ellen Rope, Miss Williams, and others, have shown their capacity alike in poetic conception, sound modelling, and decorative design.

Sculptor-decorators. In the section of sculptor-decorators are such workers as Mr Lynn Jenkins, whose frieze in bronze, ivory, and mother-of-pearl at Lloyd's Registry is a remarkable achievement, and Mr Walter Crane, who designed for Manchester a mace that is remarkable for beauty of conception and felicity of symbolism. But other sculptors already mentioned, including Mr Thornycroft, Mr Gilbert, Mr Frampton, Mr Pomeroy, Mr Colton, and Mr Toft, have all devoted themselves to sculptural decoration pure and simple, whether in metal, stone, or marble.

Painter-sculptors. The painter-sculptors command extraordinary respect, for they may claim among them Alfred Stevens, Lord Leighton, Mr J. M. Swan, Mr Reynolds-Stephens, George Richmond, and Mr G. F. Watts. Richmond's real talent may be gauged by his "Monument to Bishop Blomfield" in St Paul's Cathedral. But none surpasses the greatest living English painter (1902), Mr George F. Watts (*q.v.*). He had educated himself artistically on the Elgin Marbles, and he has produced half a dozen pieces of sculpture which place him high among the world's finest sculptors of the 19th century. The recumbent effigy of "Bishop Lonsdale" in Lichfield Cathedral was an epoch-marking work, not only in the technical matter of the bold treatment of the drapery, but in largeness and breadth and its noble sense of style, and the "Lord Lothian" in Bickling Church is also very remarkable. The artist then produced the colossal equestrian group of "Hugh Lupus" for the duke of Westminster (Eaton Hall), a composition as imaginative and original as it is grand and sculpturesque. Then followed "Physical Energy," another equestrian group, which, after being about twenty years in progress, was cast in 1902; it was to be erected in duplicate, one copy in South Africa, to the memory of Cecil Rhodes, whose character it may be held to symbolize, and the other to be set up in London by the British Government. In 1902, also, the statue of "Lord Tennyson," destined for Lincoln's Inn, was completed. But the bust of "Clytie" is surpassed in "bigness" and classic purity of style and feeling by nothing ever produced in England: it is a complete and noble thing. There is no sculptor who has come nearer to obtaining the grandeur of form which is so wonderful in the Greek masterpieces. Simple in line, immense in character, full and rich in modelling, Mr Watts's work is instinct with vigour, breadth, and movement. It sets the true standard, and is a constant and a noble warning to sculptors of the younger school not to be led away by the dainty and fanciful, however alluring. ***G. F. Watts, R.A.***

Metal work. Especially it warns them against what has become a feature with a certain section—the devotion to metal-working, enamelling, and the like, and the free introduction of these accessories into serious sculptural work. Irresistible in the hands of a great artist like Mr Alfred Gilbert, such work, at all times attractive, is the goldsmith's and ironsmith's, but not the sculptor's; and if it has coloured the work of some of the younger sculptors of the day, it is not likely to obtain any very wide hold, or to exercise permanent influence for evil. As we have said, since the publication of the 9th edition no great section of the arts has so completely changed its characteristics as the British school of sculpture.

The subject of British sculpture has been curiously neglected, except in newspaper notices and occasional articles in the periodical press, such as "Living English Sculptors," *Century Magazine*, July 1883, by EDMUND GOSSE. The only volume published is the following:—M. H. SPIELMANN. *British Sculpture and Sculptors of To-day.* London, 1901. (M. H. S.)

FRENCH.

After 1870, when a great artistic movement marked the resuscitation of France after the Franco-German war, sculpture especially revived with exceptional vigour, and the last thirty years of the 19th century were a memorable epoch in its history. Not that many new and unexpected men of genius suddenly arose, for most of the artists who then came to the front had already distinguished themselves by equally noble work; but sculpture, like the other arts, benefited by the pause for thought, and by the ripe and manly tone stamped on the national mind by the discipline of events. Intense ardour animated the admirable group of French sculptors: the oldest still found some lofty expression; the men in their prime showed their powers with unwonted force and fire; and the younger generations grew up in rapid succession, a close phalanx of sculptors whose number is still increasing, for if we include only living artists, and those who have taken honours in the Salons, we find a list of seven hundred exhibitors. The first generation of survivors of the war, who led the way in the new period, still boasted of such men as Dumont (1801–84), Cavelier (1814–94), Bonnassieux (1810–92), Jouffroy (1806–82),

Schoenewerck (1820–85), Carrier-Belleuze (1824–87), Aimé Millet (1819–91), and Clésinger (1814–83). These artists, born in the first quarter of the 19th century, were for the most part each the head of a studio, their teaching being carried on till the end of the century. Next to them followed their immediate pupils, already their rivals, and some indeed famous before the new era; such were Guillaume, Dubois, and Frémiet; others, fresh from the Academy at Rome, at once rose to distinction, and all combined to form the remarkable group of artists to which the modern school of French sculpture owes its world-wide fame. At this time Eugène Guillaume was exhibiting his "Roman Marriage," his "Bust of Mgr Darboy," his "Orpheus," and "Andromache," works of learned skill and severe distinction. Paul Dubois executed his "Narcissus," and the "Tomb of General Lamoricière," on which the decorative figures of Charity, Faith, and Military Courage are popular favourites, full of grave and pathetic feeling. Chapu executed his exquisite figure of "Youth" for the tomb of Henri Regnault, and that of "Thought" for the tomb of Daniel Stern, his monuments to Berryer and to Mgr Dupanloup. Barrias' "First Interment" won him the medal of honour in 1878; besides his patriotic group of the "Defence of Paris." Falguière produced a remarkable series of statues, characterized by their life-like power; some dignified or pathetic, as "St Vincent de Paul," "La Rochejacquelein," and "Cardinal Lavigerie"; some full of bold and dashing spirit, as his "Diana," his "Nereids," and "Hunting Nymphs." Mercié gave us "Gloria Victis," "Quand Même," and his monuments, among which that called "Memory" must be mentioned; his pediment for the Tuileries; his "Genius of Art," &c. Delaplanche produced his "Mother's Teaching," "Music," "The Virgin with a Lily," and "Aurora"; and Allar "The Death of Alcestis." To these names must be added those of Degeorge, who, with Chapu, gave so powerful an impetus to the art of the medallist; of Gautherin, Hiolle, Thomas, Crauck, Lafrance, Maniglier, and Moreau-Vauthier—one of the men who, with Gérôme (the painter) and Frémiet, revived the taste for coloured sculpture, a style first attempted long before by Simart; besides many more. These artists created a supremely healthy and vital school of sculpture, dignified and elegant, learned and varied, fresh and charming, and, above all, as single-hearted and as well trained as in any period of history.

To understand, however, the position of contemporary sculpture in France, it will be necessary to look back even farther than 1870. It must be remembered that the whole history of French sculpture, as far back as the 17th century, is connected with the invasion of Italian influence in the 16th century, which remained paramount over French art for more than three hundred years. Statue-making, until then an art of expression—national, popular, human, and Christian—lost its primitive character under the dilettante refinement of an aristocratic society closely gathered round a king who made art subservient to his splendour or his pleasure; it sank into superficial and conventional beauty, and became almost exclusively the interpreter of trivial ingenuity or flattering allegories derived from the dead fables of heathen mythology. The best that would be expected from this was choice elegance of line, a harmonious treatment of mass and composition, a loving study of the nude—in short, a purely plastic type of art. And sculpture had become the art of the nobility and of the court, having no hold, as it had in the past, on the great human family—the nation. Still, even at the high tide of Louis XIV.'s reign, some dissatisfaction became evident, even some rebellion, in the great though solitary spirit of Puget, who strove to animate the marble with the passions of humanity. In the next century he found followers—Falconet, Pigalle, and Houdon, who also asserted their right to infuse life and passion and movement into their statues, seeking them in the despised province of stern reality. The great cataclysm of the Revolution, which might have been expected to break the bonds of thought, turned men's minds to contemplate the Antique, and though it certainly modified the style of sculpture, was far from changing the source of its inspiration, since it sent it once more to the Antique. Indeed, at the beginning of the 19th century, when the teaching of David was paramount in spite of Gros, who, then in the master's studio, was unconsciously sowing the seed of romanticism in painting, a robust individuality was developing among French sculptors—a spirit somewhat rugged, independent, and partly trained, beyond the academic pale, prepared to carry on the tradition of Puget, and quite simply, without any revolutionary airs of innovation, to shake off torpid conventionality. By the mere force of a strong plebeian temperament Rude quite naturally happened on a style of art—high art—at once expressive and popular. He was the first to raise the cry of liberty in sculpture, and he left successors who bravely worked out what he had begun. Barye and Carpeaux were both in 1875 on the threshold of an era to which they bequeathed a fruitful influence. Barye carried on Rude's tradition of expression, and transformed what had previously been mere decorative carving into a new style and branch of art now adopted by a whole phalanx of admirable artists: the sculpture, namely, of animals, the first glance that sculpture had till then bestowed on nature apart from man. Carpeaux, who was much younger, was in his day—as Puget had been—an exceptional personality; he carried on the slow revolt of two centuries which was to break the narrow mould of school-training and infuse a soul of more ardent vitality into sculptured forms.

The importance of these two great artists in relation to contemporary art was not fully seen till after their death. In point of fact Painting had until now amply filled the new part assigned to Art; its vehement efforts had strongly influenced public opinion; and as, in the early years of the 19th century, it had largely extended the field of human vision over the remote past and the domains of feeling, with the promise of surveying all nature, space, and time, the spirit of the age asked no more, and did not expect sculpture, too, to abandon old-world myths. It must also be said that those sculptors who at that time carried on the classical tradition had renewed its youth by their learned and enthusiastic love of it; they had reverted to the past, but it was the past of the really great masters, either of antiquity or of the early Florentine school, no less enamoured of life, beauty, and nature. Guillaume and Paul Dubois, Chapu and Falguière, Mercié and Delaplanche, were the rivals in sculpture of the great idealist painters—Puvis de Chavannes, Gustave Moreau, Ricard, Delaunay, Baudry, and Henner—who were working at the same time.

This it is which accounts for the fact that romanticism then found so little acceptance among sculptors. But in the next generation the sowers of the seed might see their harvest. The pupils of Rude, of Barye, and of Carpeaux, allied by school sympathies,—the little drawing-school conducted by Lecoq de Boisbaudran, which, in despite of the studios of the Beaux Arts, created a group of independent and highly original artists,—formed the centre of a distinct force which increased day by day. Young men, fresh from Rome, persistently kept up the spirit of the Antique. A galaxy of learned and refined artists

G. Michel—Dreaming.

J. Dalou—The Triumph of the Republic.

H. Chapu—Youth (Monument to Henri Regnault).

P. Aubé—Bailly.

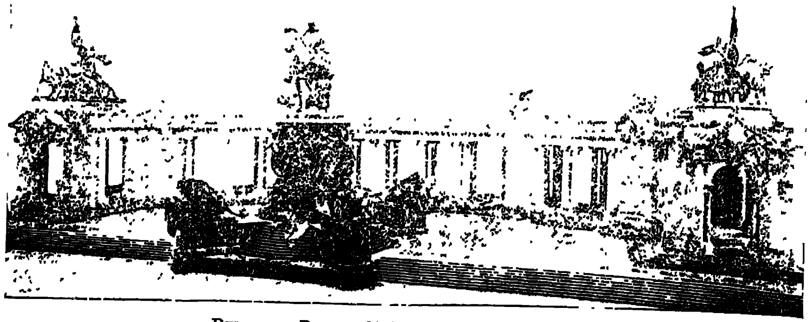
Roger Bloche—The Child.

Paul Dubois—Military Courage (Monument to General de la Moricière at Nantes).

A. Bartholomé—Fragment—Recumbent Group of the Monument to the Dead (Cemetery of Père Lachaise).

SCULPTURE. Plate VII.—FRENCH (c).

S. SINDING—The Captive Mother.
(Danish.)



REINHOLD BEGAS—Statue of Emperor William I.
(German.)
(From a Photograph by W. Titzenthaler, Berlin.)

ETTORE XIMENES—"Revolution."
(Italian.)

A. QUEROL—Memorial to Alphonso XII.
(Spanish.)

M. ANTOKOLSKI—Satan.
(Russian.)

JEF. LAMBEAUX—The Human Passions.
(Belgian.)

C. MEUNIER—Unloading.
(Belgian.)

SCULPTURE. PLATE VIII.—OTHER FOREIGN COUNTRIES.

was represented by such men as Hiolle ("Arion," "Orpheus"), Idrac ("Mercury inventing the Caduceus," "Salammbô"), Marqueste ("Galatea," "Eros," "Perseus beheading the Gorgon," "The Rape of Europa"), and Coutan ("Eros," "A Woman carrying Loaves," "A Sergeant-at-Arms," &c.), Lanson ("The Iron Age"), Longepied ("Immortality"), Peinte ("Orpheus charming Cerberus to Sleep"), Gustave Michel ("In a Dream" "Meditation"), Carlès ("Innocence," "Abel"), A. Boucher ("Earth," "Au but"), besides Carlier, Leonard, and Turcan—soon to be followed by another generation: Puech ("The Siren," "The Muse of André Chénier"), Verlet ("The Monument to Maupassant," "Orpheus"), Larche ("The Brook and the Meadow," "Violets"), Sicard ("Hagar and Ishmael"), and Daillon, Escoula, St Lami, and many more. In opposition to these there stood a group of sculptors, young and old, who sought their subjects in mythology, legend, history, or poetry, or merely in the scenes of daily life, and aimed at presenting the ideal of their time under its external aspects, but more especially the deepest emotions of the modern mind. It was Frémiet, with his striking and vivid conceptions, who led the advance with new and dramatic subjects: primeval man and the fierce beasts with which he disputed his rule ("A She-Bear and a Man of the Stone Age," "An Oran-utan and a Savage," "Gorillas"), or embodiments of the heroes of the past ("Joan of Arc," "Saint Louis," "Saint George," "Louis of Orleans," &c.); then followed Just Becquet, the excellent artist who represented the stricken figures of "Ishmaël" and "Saint Sebastian"; Christophe, with his symbolical presentments of "The Human Comedy," "Fortune," and "The Supreme-Kiss"; Aubé ("Monument to Gambetta," "Dante," "Bailly," &c.); A. Legros, the naturalized English painter and sculptor, who executed some fine fountains for the duke of Portland; Injalbert, returned from Rome ("Hippomène," "Christ on the Cross," "The Herald"); and, younger than these, Desbois ("Leda"), Dampt ("A Grandmother's Kiss," "Melusine"), Alexandre Charpentier, Carries, Baffier, Pierre Roche, Madame Marie Cazin, and many more.

The disruption of the Salons in 1890 showed very plainly the bent of this group, who seceded to the Champ de Mars, where the leaders were Dalou and Rodin, and where Bartholomé made an unexpected and original appearance. Foreigners added a contingent of the highest merit, such as the American St Gaudens, and, more especially, the Belgian Constantin Meunier, affiliated to France by their early training, to say nothing of descent. Meunier especially, with his statues and statuettes of labouring figures — miners, puddlers, hammerers, glass-blowers, and the like—gave to his art a keynote new to France, which found a response even in academic circles. A broad democratic current was swaying public feeling. The questions which turn on the status of the working man had become the programme of every party, even of the most conservative. Art being the mirror of society, the novel, the drama, and painting devoted themselves to the glorification of a new factor in modern life, namely, Labour. Sculpture now, in rivalry with painting, through which Millet had immortalized the peasant, and Courbet the working man, also sought inspiration from such themes; and at the same time the demands of the democratic movement called for monuments to the memory and deeds of great or useful men.

Sculpture, under this modern tendency, has assumed an unexpected aspect; its highest expression is seen in the work of three very dissimilar men: Dalou, Rodin, and Bartholomé. In Belgium, as has been said, where modern social questions are strongly felt, Constantin Meunier had interpreted the democratic impulse in a very striking manner, under the influence, no doubt, of J. F. Millet. In France, Jules Dalou, with a broader view, aimed at creating an art which should represent the aspirations and dreams of this phase of society while adhering to the fine old traditions of the art of Louis XIV., stamped with magnificence and grandeur, but applied with graver, simpler, and severer feeling to the glorification of the people. He revived the older style of sculpture, giving it greater power and truer dignity by a close study of life, supported by a scholarly and serious technique. In his "Triumph of the Republic," and the monuments to "Alphand," to "Delacroix," to "Floquet," to "Victor Hugo," and others, he strove to create a style apart from life, to which he is alien and indifferent, but based on life, the outcome of the needs of society, the impersonation of its characteristics, the expression in eloquent form of its nature, spirit, and moral idiosyncrasy.

Treading the same path, though in a different step, is Auguste Rodin. He disregards every contingent fact; even when he takes his subject from legend or history, whether "Eve" or "St John the Baptist," "The Age of Bronze" or "The Burgesses of Calais," "Victor Hugo" or "Balzac," he avoids all the conventional details and attributes of his personages to embody the very essence of humanity as expressed in the quivering flesh. He, like Carpeaux, has gone back to Dante and to Michaël Angelo to force the "Gates of Hell"—the subject chosen for the entrance to the Musée des Arts Décoratifs—and to read the deepest mysteries of the human soul. His is the art of suffering, anguish, and terror, of cruel and despairing pleasure—a wild cycle of proud and bitter melancholy. All the efforts made in the past to infuse life into Art, all that Puget, Falconet, Pigalle, and Houdon tried to effect, and that Rude, Barye, and Carpeaux strove for in their turn—all this was part of the endeavour of these their successors, but with a clearer purpose and more conscious aim. By good hap or providence they were greeted on their way by the voice of the most devoted apostle who was to preach the new doctrine, namely, Louis Courajod, the founder of the French sculpture gallery in the Louvre. From his professor's chair in the schools he cursed the Italian intruders of the 16th century for having debased French art with "noble attitudes," extravagant gestures, and allegorical antics; and he carried his pupils and his hearers back to the great national period of French sculpture, which, in the dark mediæval ages, had created the splendid stone images of the noble French cathedrals.

A marked individuality now appeared in protest against academic traditions—Albert Bartholomé. He, after beginning as a painter, was tempted by sculpture, more particularly, in the first instance, by a wish to execute a monument to a comrade he had loved. From this first effort, carried out in his studio, without any school training, but with a firm determination to master technical difficulties and fulfil his dream, followed a broader purpose to execute a great expressive and vitally human work which should appeal to the heart of the populace. From this arose the idea of a "Monument to the Dead" in Père Lachaise. Bartholomé had started without a guide, but he instinctively turned to the great tradition of Northern Christianity, which his mind subsequently associated with that of the antique race who had ever done most honour to Death, the people of Egypt.

Thus two currents contended, as it were, for the guidance of French sculpture, each claiming a descent from the historic past; one inheriting the classic tradition of the Renaissance, of Latin and Hellenic origin, to which the French school, since the time of Jean Goujon, has owed

three centuries of glory. This is the pagan art of the South; its marks are balance, reasonableness, and lucidity; it was the composer of apotheoses, the preserver of the ideal of beauty. The other, reverting, after centuries of resignation or of impotent rebellion, to the genuine French past which produced the noble works of the 11th, 12th, and 13th centuries,—to the tradition of Flanders and of Burgundy, which was smothered in the 16th century by Italian art,—to the Christian and naturalistic art of the North, which renounced the canons of antiquity, and expressed itself by methods essentially human and mutable, living and suffering,—appeals to all mankind. The immediate result of this antagonism was no doubt a period of agitation. The outcome, on the whole, is confusion. Still, however vexatious the chaos of form and movement may be, it is Life, a true reflection of the tumult of modern thought in its complexity and bewilderment; it is the reawakening of sculpture.

Monumental and decorative statuary found an extended sphere through the founding or restoration of public buildings after the events of 1870. Memorial sculpture obtained constant employment on patriotic or republican monuments erected in various parts of France, and not yet complete. Illustrious masters have done themselves honour in such work. Dalou, Mercié, Barrias, Falguière, and many others less famous executed monuments to the glory of the Republic or in memory of the national defence, and figures of Joan of Arc as a symbol of patriotism, &c., as well as numberless statues erected in the market places of humble towns, or even of villages, in commemoration of national or local celebrities: politicians, soldiers, savants, and artists—Thiers, Gambetta, Jules Ferry, Carnot, Pasteur, Claude Bernard, Delacroix, Ingres, Corot, Millet, Victor Hugo, Lamartine, and many more. The garden of the Luxembourg alone has become a sort of Elysian Fields, where almost every day some fresh statue rises up in memory of contemporary French poets. The funereal style of monument, in which French art was at all times conspicuously distinguished, was also revived in sympathy with that general sentiment which regards reverence for the dead as a religion, and gave rise, as we have seen, to some splendid work by Chapu (the monuments to Regnault, to Daniel Stern, of Mgr Dupanloup); by Paul Dubois (the monument to General Lamoricière); by Mercié (the tombs of Baudry, of Cabanel, of King Louis Philippe and his queen Marie Amélie); by Dalou (the monuments to Victor Noir, to Floquet, and Blanqui); and by many more, with Bartholomé at their head. The cemetery of Père Lachaise is indeed one of the best spots to visit for a review of contemporary sculpture.

While man has been diligently studied in every class of sculpture, more particularly in portrait sculpture, which finds a more practical adaptation to daily uses by a bust or small statue, such as Théodore Rivière was the first to produce, by medallions, or by medals, closely related to statuary, nature now holds a place in the sculpture of animals,—a place created, so to say, by Barye and carried on by Frémiet, Mêne, Caïn, and, with even greater vigour and a closer study of character, by Gardet ("Panthers," in the Luxembourg, "Lions" and "Dogs," at Chantilly, &c.); Peter, Valton, Le Duc, Isidore Bonheur, Peyrol, Cordier, Surand, Virion, Mérite, and others. Finally, the class of *La Petite Sculpture*—the statuette and small group—after long hesitation in the hands of the two men who first cultivated it, Frémiet and the painter Gérôme, made a sudden start into life, due in no small measure to the success attending the charming and pathetic statuettes of Théodore Rivière ("Salammbô and Malthô," "Ultimum feriens," "Charles VI. and Odette," "The Vow," "Fra Angelico," "The Shunamite Woman," &c.). Rivière was wont to use—as Gérôme did in his "Bellona," and subsequently in his small "Tamerlane"—materials of various colours, and even precious stones and metals, which he employed with great effect. A whole class of art was not, indeed, originated, but strongly vivified by this method of treatment. Claudius Marioton and Dampt, who always affected small and precious work, Agathon Léonard (*e.g.*, a table decoration of "Dancers" in Sèvres china), Laporte Blairsy, Ferrary, Levasseur, Belloc, E. Lafont, &c., utilized every process and every kind of material—marble and metal, wood and ivory, enhanced by the most costly goldsmiths' work and gems.

It would seem now that sculpture, thus endowed with new ideas and the most various means of expression, and adapted to every comprehension and every situation, was fully on a level with the other graphic arts. What it had chiefly to fear was, in fact, the wealth of means at its disposal, and its competition or collaboration with other arts. And this the later generations seem to have understood—the men who were the outcome of the two conflicting traditions: order and moderation on one side; character, life, and emotion on the other. Though very variously inspired by the facts or ideals of contemporary life, such young artists as Jean Boucher ("Evening," "The Antique and the Modern"), Roger Bloche ("Childhood," "Cold"), Derré, Boverie, Hippolyte Lefebvre, Desruelles, Gaston Schnegg, Pierre Roche, Fix-Masseau, Couteilhas, and others, seem to show that French sculpture is about to assume a solid position on a sound foundation, while not ceasing to keep in touch with the tastes, aspects, and needs—in short, the ideal—of the day. (L. BE.)

UNITED STATES.

The early names in American sculpture—Shem Drowne, the maker of weather-vanes; Patience Wright; William Rush (1756–1833), carver of figure-heads for ships and portrait sculptor; John Frazer (1790–1850), the stone-cutter; and Hezekiah Augur (1791–1858)—have the interest of chronicle at least. Hiram Powers (1805–73), coming later, had a certain technical skill, and his statues of the "Greek Slave" and "Eve before the Fall" were important agents in overcoming the Puritanic abhorrence of the nude.

Horatio Greenough (1805–52), Joel T. Hart (1810–77), S. V. Clevenger (1812–43), and Clark Mills (1815–83) all received many commissions but made no additions to the advancement of a true art-spirit. Thomas Crawford (1814–57) began the bas-reliefs for the bronze doors of the Capitol and showed skill. They were finished by W. H. Rinehart, whose "Latona" has considerable grace. Henry K. Brown (1814–86) achieved, among less noteworthy works, the heroic Washington in Union Square, New York City. It is one of the noblest of equestrian statues, both in breadth and certainty of handling and in actual majesty. It reflects unwonted credit on its period. There is undeniable skill, which yet lacks the highest qualities, in the work of Thomas Ball (b. 1819), William Wetmore Story (1819–1896), whose "Cleopatra" shows power, Randolph Rogers (1825–1892), J. S. Hartley (b. 1845), Launt Thompson (1833–1894). The works of Olin L. Warner (1844–1896) and J. Q. A. Ward (b. 1830) reveal at times far greater originality. Warner's two graceful classical figures for a fountain in Portland, Oregon, and his portrait statue of William Lloyd Garrison, show a nice discernment of the fitness of manner to matter. He was also successful in modelling medallions. Ward has a sturdiness and individuality quite his own.

But almost all the works down to this time lacked utterly that modernity, that sympathy with the present, which

are in some senses vital to art. American sculpture, like American painting, was awakened by French example. The leading spirit in the new movement was Augustus St Gaudens. Born in Ireland (1848) of Franco-Irish parentage, but brought to America in infancy, at the age of 19 he went to France for three years' study. He must be counted one of the great sculptors of his generation, his perfect technique being the servant of a strong and magnetic personality. In the "Farragut," with its bluff and cheerful grace, the ungainly majesty of "Lincoln," the stern and forceful "Puritan," the monument to Colonel Shaw and his negro troops, and in other statues, he has won the hard victory over modern costume and made it contribute artistic feeling and character. In ideal works, such as the superb mortuary figure called "The Peace of God," decorative caryatids, and the like, he has shown a lofty sense of line and plane. His work in high and low relief is distinguished, notably in his girl with a guitar, the portraits of Stevenson and Bastien-Lepage. In all his works he shows the thorough harmonious welding of treatment with text.

Daniel Chester French has attacked difficult problems with success of the highest order. His "Gallaudet Teaching a Deaf Mute" is an example of how a difficult subject can be turned into a triumph of grace. His "Death and the Young Sculptor" is almost the last word on the beautifying of the idea of death. In collaboration with E. C. Potter he has modelled various important groups of human and animal kind, particularly the "Indian Corn" and the equestrian "Washington."

Frederick MacMonnies stands high among contemporary sculptors by reason of his essentially sculpturesque methods and the magnetic sentiment that imbues them. His "Bacchante" is a triumph of modelling and of joyous humour. Minutely perfect handling and realistic vitality characterize his "Young Pan" and many other works, while his statue of "Nathan Hale" in City Hall Park, New York, shows the artist's power in the treatment of a serious theme, and combines strength, refinement, and lofty feeling.

Modelling in the nude is the test of a sculptor, though almost of necessity anachronistic, but the strenuous achievements of George Grey Barnard have both high skill and high sincerity. His "Two Natures," his "Brotherly Love," his "Pan," and the design for a Norwegian stove are among the strongest of modern statuary. Ranking with him, though different in thought and method, stands Paul Wayland Bartlett—one of the best and most successful of modern sculptors. Success, too, artistically has been accorded to the fine works of Charles Grafly, Herman MacNeil, and Lorado Taft. The beautiful busts of Herbert Adams; the thoroughly artistic miniature figures of Mrs Clio Hinton Bracken; the graceful figurines of Mrs Potter Vonnoh; Edwin F. Elwell's "Egypt" and "Orchid"; and the work of F. Wellington Ruckstuhl, J. Massey Rhind, Frederick Remington, John Donohue, and Charles H. Niehaus should also be mentioned.

(R. HU.)

Scutari, a town of Asia Minor, beautifully situated on the eastern shore of the Bosphorus opposite to Constantinople, of which it is reckoned a suburb. It has a lively trade in Asiatic products. It is built mostly of wood, but on the hills behind the town are many substantial residences. It has a population of about 50,000, mostly Turks. In June 1883 a gunpowder explosion caused the loss of 150 lives.

Scutari, a town of Turkey, in Albania, with a population estimated at 35,000. The trade, both inwards and outwards, has diminished through the connexion of Salonica with the European railway system, but its character has undergone no change. The exports consist of grain, wool, hides and skins, tobacco, and sumach; the imports, of woollen and cotton yarns and piece goods, metals, and sundries. As nothing is done by the Government to develop local resources, the country remains stagnant, and Scutari is a less prosperous and less busy town than it was in 1885.

Sea, Command of the, is a technical term of naval warfare, and indicates a definite strategical condition. The term has been substituted sometimes for the much older "Dominion of the sea" or "Sovereignty of the sea," a legal term expressing a claim, if not a right. It has also been sometimes treated as though it were identical with the rhetorical expression, "Empire of the sea." Mahan, instead of it, uses the term "Control of the sea," which has the merit of precision, and is not likely to be misunderstood or mixed up with a form of words meaning something different. The expression, "Command of the sea," however, in its proper and strategic sense, is so firmly fixed in the language that it would be a hopeless task to try to expel it; and as, no doubt, writers will continue to use it, it must be explained and illustrated. Not only does it differ in meaning from "Dominion or Sovereignty of the sea," it is not even truly derived therefrom, as can be briefly shown. "It has become an uncontested principle of modern international law that the sea, as a general rule, cannot be subjected to appropriation" (W. E. Hall, *Treatise on Internationl Law*, 4th ed. 1895, p. 146). This, however, is quite modern. Great Britain did not admit the principle till 1805; the Russians did not admit it till 1824; and the Americans, and then only tacitly, not till 1894. Most European nations at some time or other have claimed and have exercised rights over some part of the sea, though far outside the now well-recognized "three miles' limit." Venice claimed the Adriatic, and exacted a heavy toll from vessels navigating its northern waters. Genoa and France each claimed portions of the western Mediterranean. Denmark and Sweden claimed to share the Baltic between them. Spain claimed dominion over the Pacific and the Gulf of Mexico, and Portugal over the Indian Ocean and all the Atlantic south of Morocco (Hall, pp. 148–9). The claim which has made the greatest noise in the world is that once maintained by the kings of England to the seas surrounding the British Isles. Like other institutions, the English sovereignty of the sea was, and was admitted to be, beneficent for a long period. Then came the time when it ought to have been abandoned as obsolete; but it was not, and so it led to war. The general conviction of the maritime nations was that the Lord of the Sea would provide for the police of the waters over which he exercised dominion. In rude ages when men, like the ancients, readily "turned themselves to piracy," this was of immense importance to trade; and, far from the right of dominion being disputed by foreigners, it was insisted upon by them and declared to carry with it certain duties. In 1299, not only English merchants, but also "the maritime people of Genoa, Catalonia, Spain, Germany, Zealand, Holland, Frisia, Denmark, Norway, and several other places of the empire" declared that the kings of England had from time immemorial been in "peaceable possession of the sovereign lordship of the seas of England," and had done what was "needful for the maintenance of peace, right, and equity between people of all sorts, whether subjects of another kindgom or not, who pass through those seas" (J. K. Laughton, "Sovereignty of the Sea," *Fortnightly Review*, August 1866). The English sovereignty was not exercised as giving authority to exact toll. All that was demanded in return for keeping the sea safe for peaceful traffic was a salute, enforced no doubt as a formal admission of the right which permitted the (on the whole, at any rate) effective police of

Different from Sovereignty or Dominion, &c.

the waters to be maintained. The Dutch in the 17th century objected to the demand for this salute. It was insisted upon. War ensued; but in the end the Dutch acknowledged by solemn treaties their obligation to render the salute. The time for exacting it, however, was really past. S. R. Gardiner ("The First Dutch War," *Navy Records*, vol. xiii. 1899) maintains that though the "question of the flag" was the occasion, it was not the cause of the war. There was not much, if any, piracy in the English Channel which the king of England was specially called upon to suppress, and if there had been the merchant vessels of the age were generally able to defend themselves, while if they were not their Governments possessed force enough to give them the necessary protection. Great Britain gave up her claim to exact the salute in 1805.

The necessity of the foregoing short account of the "Sovereignty or Dominion of the Seas" will be apparent as soon as we come to the consideration of the first struggle, or rather series of struggles, for the command of the sea. Gaining this was the result of England's wars with the Dutch in the 17th century. At the time of the first Dutch war, 1652–54, and probably of the later wars also, many people, and especially seamen, believed that the conflict was due to a determination on her part to retain, and on that of the Dutch to put an end to, the English sovereignty or dominion. The obstinacy of the Dutch in objecting to pay the old-established mark of respect to the English flag was quite reason enough in the eyes of most Englishmen, and probably of most Dutchmen also, to justify hostilities which other reasons may have rendered inevitable. The remarkable thing about the Dutch wars is that in reality what England gained was the possibility of securing an absolute command of the sea. She came out of the struggle a great, and in a fair way of becoming the greatest, naval power. It is this which prompted Vice-Admiral P. H. Colomb to hold that there are various kinds of command, such as "absolute or assured," "temporary," "with definite ulterior purpose," &c. An explanation that would make all these terms intelligible would be voluminous and is unnecessary here. It will be enough to say that the absolute command—of which, as Colomb tell us, the Anglo-Dutch wars were the most complete example—is nothing but an attribute of the nation whose power on the sea is paramount. It exists and may be visible in time of peace. The command which, as said above, expresses a definite strategical condition is existent only in time of war. It can be easily seen that the former is essential to an empire like the British, the parts of which are bound together by maritime communications. Inability to keep these communications open can have only one result, viz., the loss of the parts with which communication cannot be maintained. Experience of war as well as reason will have made it evident that inability to keep open sea-communications cannot be limited to any single line, because the inability must be due either to incapacity in the direction of hostilities or insufficiency of force. If Great Britain has not force enough to keep open all the communications of her widely extended empire, or if—having force enough—she is too foolish to employ it properly, she does not hold the command of the sea, and the empire must fall if seriously attacked.

Attempts to gain command.

The strategic command of the sea in a particular war or campaign has equal concern for all maritime belligerents. Before seeing what it is, it will be well to learn on high authority what it is not. Mahan says that command, or, to use his own term, "control of the sea, however real, does not imply that an enemy's single ships or small squadrons cannot steal out of port, cannot cross more or less frequented tracts of ocean, make harassing descents upon unprotected points of a long coast-line, or enter blockaded harbours. On the contrary, history has shown that such evasions are always possible, to some extent, to the weaker party, however great the inequality of naval strength" (*Influence of Sea-Power on History*, London 1890, p. 14). The Anglo-French command of the sea in 1854–56, complete as it was, did not enable the Allies to intercept the Russian ships in the north-western Pacific, nor did that held by the Federals in the American Civil War put an early stop to the cruises of the Confederate vessels. What the term really does imply is the power possessed from the first, or gained during hostilities, by one belligerent of carrying out considerable over-sea expeditions at will. In the Russian war just mentioned the Allies had such overwhelmingly superior sea-power that the Russians abandoned to them without a struggle the command of the sea; and the landing in South Africa (1899–1902), more than six thousand miles away, of a large British army without even a threat of interruption on the voyage is another instance of unchallenged command. In wars between great Powers and also between secondary Powers, if nearly equally matched, this absence of challenge is rare. The rule is that the command of the sea has to be won after hostilities begin. To win it the enemy's naval force must be neutralized. It may be driven into his ports and there blockaded or "marked," and thus rendered virtually innocuous; or it must be defeated and destroyed. The latter is the preferable, because the more effective plan. As was perceptible in the Spanish-American war of 1898, as long as one belligerent's fleet is intact or at large the other is reluctant to carry out any considerable expedition over-sea. In fact, the command of the sea has not been secured whilst the enemy continues to have a "fleet in being" (see SEA-POWER).

Strategic command.

In 1782 a greatly superior Franco-Spanish fleet was covering the siege of Gibraltar. Had this fleet succeeded in preventing the revictualling of the fortress the garrison would have been starved into surrender. A British fleet under Lord Howe, though much weaker in numbers, had not been defeated and was still at large. Howe, in spite of the odds against him, managed to get his supply-ships in to the anchorage and to fight a partial action, in which he did the allies as much damage as he received. There has never been a display of higher tactical skill than this operation of Howe's, though, curiously enough, he owes his fame much more to his less meritorious performance on the 1st of June. The revictualling of Gibraltar surpassed even Suffren's feat of the capture of Trincomalee in the same year. In 1798 the French, assuming that a temporary superiority in the Mediterranean had given them a free hand on the water, sent a great expedition to Egypt. Though the army which was carried succeeded in landing there, the covering fleet was destroyed by Nelson at the Nile, and the army itself was eventually forced to surrender. The French had not perceived that, except for a short time and for minor operations, you cannot separate the command of the Mediterranean or of any particular area of water from that of the sea in general. Local command of the sea may enable a belligerent to make a hasty raid, seize a relatively insignificant post, or cut out a vessel; but it will not ensure his being able to effect anything requiring considerable time for its execution, or, in other words, anything likely to have an important influence on the course of the war. If Great Britain has not naval force enough to retain command of the Mediterranean she will certainly not have force enough to retain command of the

Various instances.

English Channel. It can be easily shown why it should be so. In war danger comes less from conditions of locality than from the enemy's power to hurt. Taking up a weak position when confronting an enemy may help him in the exercise of his power, but it does not constitute it. A maritime enemy's power to hurt resides in his fleet. If that can be neutralized his power disappears. It is in the highest degree improbable that Great Britain could attain this end by splitting up her fleet into fragments so as to have a part of it in nearly every quarter in which the enemy may try to do her mischief. The most promising plan—as experience has often proved—is to meet the enemy when he shows himself with a force sufficiently strong to defeat him. The proper station of the British fleet in war should, accordingly, be the nearest possible point to the enemy's force. This was the fundamental principle of Nelson's strategy, and it is as valid now as ever it was.

Seeking the enemy's fleet. If Great Britain succeeds in getting into close proximity to the hostile fleet with an adequate force of her own, her foe cannot obtain command of the sea, or of any part of it, whether that part be the Mediterranean or the English Channel, at any rate until he has defeated her. If he is strong enough to defeat her fleet he obtains the command of the sea in general; and it is for him to decide whether he shall show the effectiveness of that command in the Mediterranean or in the English Channel.

In smaller operations. In the smaller operations of war temporary command of a particular area of water may suffice for the success of an expedition, or at least will permit the execution of the preliminary movements. When the main fleet of a country is at a distance—which it ought not to be except with the object of nearing the opposing fleet—a small hostile expedition may slip across, say the English Channel, throw shells into a coast town or burn a village, and get home again unmolested. Its action would have no sort of influence on the course of the campaign, and would, therefore, be useless. It would also most likely lead to reprisals; and, if this process were repeated, the war would probably degenerate into the antiquated system of "cross-raiding," discarded centuries ago, not at all for reasons of humanity, but because it became certain that war could be more effectually waged in other ways. The Power in command of the sea may resort to raiding to expedite the formal submission of an already defeated enemy, as Russia did when at war with Sweden in 1719; but in such a case the other side cannot retaliate. Temporary command of local waters will also permit of operations rather more considerable than mere raiding attacks; but the duration of these operations must be adjusted to the time available. If the duration of the temporary command is insufficient the operation must fail. It must fail even if the earlier steps have been taken successfully. The command of the English Channel, which Napoleon wished to obtain when maturing his invasion project, was only temporary. It is possible that a reminiscence of what had happened in Egypt caused him to falter at the last; and that, quite independently of the proceedings of Villeneuve, he hesitated to risk a second battle of the Nile and the loss of a second army. It may have been this which justified his later statement that he did not really mean to invade England. In any case, the British practice of fixing the station of their fleet wherever that of the enemy was, would have seriously shortened the duration of his command of the English Channel, even if it had allowed it to be won at all. Moreover, attempts to carry out a great operation of war against time as well as against the efforts of the enemy to prevent it are in the highest degree perilous.

In war the British navy has three prominent duties to discharge. It has to protect the maritime trade, to keep open the communications between the different parts of the empire, and to prevent invasion. If Great Britain commands the sea these duties will be discharged effectually. As long as she does that, the career of cruisers sent to prey on her commerce will be precarious, because command of the sea carries with it the necessity of possessing an ample cruiser force. As long as the condition mentioned is satisfied her ocean communications will be kept open, because an inferior enemy, who cannot obtain the command required, will be too much occupied in seeing to his own safety to be able to interfere seriously with that of any part of the British empire. This being so, it is evident that the greater operation of invasion cannot be attempted, much less carried to a successful termination, by the side which cannot make head against the opposing fleet. Command of the sea is the indispensable preliminary condition of a successful military expedition sent across the water. It enables the nation which possesses it to attack its foes where it pleases and where they seem to be most vulnerable. At the same time it gives to its possessor security against serious counter-attacks, and affords to his maritime commerce the most efficient protection that can be devised. It is, in fact, the main object of naval warfare.

Authorities for the above may be given as naval histories in general, placing in the first rank the well-known works of Captain A. T. MAHAN, U.S.N. The book which must be specially referred to is the late Vice-Admiral P. H. COLOMB's *Naval Warfare*, 3rd ed., London, 1900. (C. A. G. B.)

Sea-fishing.—Sea-fishing as a sport is a comparatively modern institution. Many years ago a few amateurs might be found following the methods of the professional, laying long-lines, using coarse hand-lines, even netting on occasions, and whiffing and working drift-lines for pollack and bass. But it was not until the last few years of the 19th century that any considerable number of persons attempted to catch fish with the more refined and delicate methods, or modifications of them, practised on rivers and lakes. Several volumes on the subject were published between the years 1897 and 1900, and this diffusion of information, coupled with a serious falling-off of sport in many fresh-water fisheries, induced large numbers of anglers to look to the sea for the practice of their favourite recreation, and laid the foundation of the British Sea-Anglers' Society, which soon numbered very nearly a thousand members. *British Sea-Anglers' Society.* The absence of private rights in sea-fisheries renders the sea an appropriate fishing-ground for the general public. Even in navigable estuaries such rights do not exist, save where a charter from the Crown was granted in ancient times.

Sea-fishing as a sport, as we now understand it, is mainly concerned with the use of a rod and line in the sea, though for the heavier work with big bottom-swimming fish, such as the conger, the stronger and coarser hand-line is under certain conditions still deemed necessary by some fishermen. Probably the finest sea-fishing which has yet been discovered by the enthusiastic angler is that afforded by the tarpon, or silver king, of the Gulf of Mexico, a gigantic herring which often exceeds 100 ℔ in weight, and fights with demoniacal fury when hooked. *Tarpon and tunny.* So favourite a form of sea-fishing has this become that tarpon hotels have sprung up on the coast of Florida, and not a few Englishmen journey across the Atlantic from time to time to take part in this exciting sport. The bait commonly used is a small mullet threaded on a large hook attached to an unleaded line. It is cast out from a boat and allowed to

lie on the bottom. When the tarpon picks it up, time is allowed for the bait to be gorged, as the mouth of these fish is extremely hard and bony, and affords scant holding-place for the hook. Another kind of big fish angling afforded by American waters is tunny-fishing, which is carried on by the members of the Flying Tuna Club, of Avalon, Santa Catalina Island, who think little of capturing fish weighing considerably over 200 ℔. Tunnies and other big members of the mackerel family are also caught from ocean-going vessels. Sharks have been taken from time immemorial in tropical waters, and the capture of specimens 5 and 6 feet in length, on British coasts, is not uncommon; but, generally speaking, the sea-angler desires to avoid rather than to capture them. The coasts of Australia, Africa, India, and the tropical seas generally all afford excellent sea-fishing of various kinds in due season.

The bass.

In British and Irish waters the fish which holds the highest place in the angler's list is undoubtedly the bass, which will take fly, spinning, or indeed almost any bait, and when hooked is as game as salmon. To capture the very large specimens of these fish, and such captures are not common, it is desirable to fish at night, or in the dusk of early morning. In the daytime success is not often obtained unless the water is slightly thickened by recent gales. The big fish particularly favour the mouths of harbours, where they may be caught on such malodorous baits as a stale piece of bloater, a piece of ray's liver, small dead fish, chicken's or rabbit's entrails, &c. They have the habit, either acquired in such places, or natural to them, of foul feeding. Sometimes the bait intended for bass is worked round the edges of rocks by means of float-tackle much the same as pike-fishers use, except that it terminates in a large, strong, single hook instead of the usual triangles. A better plan, where the bottom is clear, is to use a salmon-gut ledger with a lead of sufficient weight to hold the bottom. Medium-sized bass of from 2 to 5 ℔ are found in shoals during the late summer months, and when these are feeding close to the surface on the young of other fish—herrings, sprats, mackerel, &c.—the fly-fisher has an opportunity of enjoying some very excellent sport. The gaudier salmon-flies will take bass, but a piece of dried sole-skin, cut in the shape of a fish and whipped to a hook, is frequently used for the purpose. Baits such as sand-eels, or other small fish, are often trailed behind a boat, but they are better harled across the tidal current in the manner practised on salmon rivers. Perhaps the most deadly method of taking bass is to use a live fish on a drift line, two of the best baits being a sand-eel and a small flat-fish. The hook is attached to a snood several fathoms in length, above which are placed small pipe-leads at intervals of one and a half to two fathoms. The tide carries out the bait, and a sufficient amount of the lead-bearing line is let out to ensure the bait being at a proper depth. In this method, which is most suitable for estuaries and channels between islands where there is a fairly good tide running, the boat should be moored.

Pollack and coal-fish.

Pollack and coal-fish, termed lythe and saithe in Scotland, rank next after bass as sport-giving sea-fish, and are far easier of capture. Pollack lurk among rocks and weeds, coming to the surface in the evening in search of food. Rocky points projecting far out into the sea are certain places to find them. One of the best baits is a small conger-eel about 4 inches in length, trailed behind a boat. Failing this, the rubber imitation may be tried. Sand-eels are also very good. In fact, pollack, when feeding, will run at almost any small fish. In the daytime the line should be heavily leaded to bring the bait down close to the weeds. In the evening the sea-angler fishes near the surface. Pollack will also take the usual pike spinning-baits, phantoms (red for preference), spoons, and the like. Live-baiting for them is carried on in exactly the same manner as for bass, and is suitable in places where the boat can be moored over a rocky ground in a current sufficient to extend the drift-line. The tackle has to be exceedingly strong, as these fish have a habit of darting down into the weeds when hooked, and must in consequence be given no line. Coal-fish, which have many local names, are somewhat similar in form to pollack, but differ in colour, the beautiful olive, bronze, and brown tints of the pollack giving way to a very dark greeny blue back and white sides and belly. They are freer swimming fish than pollack, roaming in shoals in search of food, and at times affording very fine sport. They will take all the usual pollack and bass baits, and in the North they are often fished for with rough feather baits, from 2 to 4 inches in length. On the Irish coast the fishermen catch large numbers of medium-sized coal-fish, called, locally, "glissaunes," by trailing flies, the lines being attached to long bamboo poles projecting from the stern of sailing boats. For pollack, coal-fish, and bass, ordinary salmon and pike rods furnished with strong lines can be used, except for the method of drift-lining, the special tackle for which has been described.

Grey mullet.

Grey mullet are much sought after by sea-anglers, but are extremely difficult of capture owing to their shyness and to their peculiar mouths, which are apparently formed to suck in very soft food, and to eject quickly anything hard, such as a hook. The very large grey mullet are, indeed, rarely caught on hook and line; but the bass fisher, using ray's liver or similar bait at the mouth of a harbour, sometimes obtains a specimen. During the summer months these fish run up rivers, and at night-time forage along the shore near towns, doubtless attracted there by the refuse. The smaller mullet of 1 or 2 ℔ are caught in large numbers in docks, harbours, and at the mouths of rivers on the south coast, on a stout perch paternoster baited with rag-worms; but, generally speaking, success is only obtained by those who are on the water a little before daybreak. There are a few creeks round English coasts where large mullet are often seen. In such places an attempt may be made to catch them, their suspicions being lulled by the throwing in of ground-bait of a similar character to that on the hook. For this purpose boiled macaroni, chopped up, may be tried. The tackle may be a paternoster bearing several hooks supported by a float, and allowed to swim down at whatever speed the current will take it. Mullet, however, are more likely to feed just at the top of high water when the tide is slack. If this tackle is drawn against the tide, or held in an unnatural way against it, the fish are likely to ignore the baits. This, however, does not apply to paternostering with rag-worms for the small mullet in harbours and river mouths where a sink-and-draw motion is often given to the baits. A method of mullet-fishing which is occasionally successful is to float the paternoster, without a lead, on the surface of the water by means of small fragments of cork placed at intervals, and to bait the hooks with macaroni or paste. Bread crumbs are sprinkled on the surface near the tackle to bring up the fish. The angler should keep himself at a considerable distance from the baits, out of sight of the fish.

Mackerel-ing.

Mackerel-fishing is, as a rule, carried on in much the same way by amateurs as by the professional fishermen, many of these latter having adopted the use of gut snoods with excellent results. When, however, the wind is very slight and the day bright, the amateur often catches mackerel by using still finer tackle

and very small lead, the professional fisherman's gear being absolutely useless under such conditions. In late summer, when the mackerel are inshore on some parts of the coasts, a very pretty method of capturing them is to moor the boat and use float-tackle, the float being about 10 feet or less above the bait—a strip of mackerel skin. This arrangement is carried out by the tide about 20 yards, the moving tide working the bait and giving it a lifelike appearance. If the current is very slight it is sometimes better to dispense with both float and lead, and fish by touch. Mackerel are also to be caught near the bottom on some parts of the coast towards the end of summer and in early autumn. The best baits are squid, pilchard skin, mussels, and pieces of sand-eels. The tackle may be the ordinary paternoster, or a paternoster in which the plummet at the end is dispensed with, a pipe-lead placed where the running line joins the gut taking its place. Mackerel, when near the surface, will take a fly, but when they are shoaling inshore, breaking the surface every now and again, it is difficult to keep within casting distance of them. The fly-fisher, however, sometimes obtains good sport with these fish when they have collected in narrow and shallow inlets of the sea. The best time of the day for mackerel-fishing is from six o'clock in the morning, or even earlier, to 11 A.M.

It is when fishing on the bottom for cod, conger, whiting, flat-fish, gurnet, &c., with heavy leads, that special forms of tackle are most requisite. The ordinary pike-rod 11 feet long is no use for working a tackle bearing a weight of $1\frac{1}{2}$ lb to 2 lb. The rings fray the line, and the leverage on the wrist, owing to the length of the rod, is enormous. The reels of freshwater fishermen are too small for this purpose. Very excellent sea-rods have, however, been designed by anglers and tacklemakers. These vary from 6 feet to 8 feet in length, are stout and strong, frequently have a spliced whalebone top, and in the place of rings are fitted small sheaves working between metal supports. At the end of the rod are various forms of blocks, none, however, being more satisfactory than the ordinary block used by sailors, but, of course, very much reduced in size. Large reels of the Nottingham type, made of non-corrosive material, 6 inches and even 7 inches in diameter, are used. These will easily hold 200 yards of line, and by reason of their large diameter wind up as quickly as a hand-line can be hauled in. A modern innovation is the use of plaited wire lines. These have great strength, are fine, and do not hold the water; but they are apt to kink and break unless very carefully used. The ordinary hemp or silk line for sea-fishing should be tanned with catechu.

The modern sea-rod.

The most generally useful form of tackle for fishing on or near the bottom is the paternoster, which may be of single twisted gut or gimp, according to the fish which are being sought after. Far better than the ledger for fishing from a boat is a paternoster with the last link extended to 2 feet or a little more, and bearing two hooks which will lie on the bottom if the lead is lowered to a sufficient depth. Over weeds or rocks this tackle can be kept a foot or two from the bottom, and is very generally useful. Leads should be provided of various sizes, the angler always using the lightest which will hold the bottom, increasing its weight as the tide strengthens, decreasing it as the tide slackens. The heavier the lead the more difficult it is to feel the bites of the fish. The eyed hooks of good quality used by freshwater fishermen have largely taken the place of the old flatted, tinned hooks of the professional sea-fisherman. In conger-fishing amateurs usually mount their hooks on gimp, but a soft snood of plaited hemp or flax is better. The best conger and bream fishing is at night. When paternostering on the bottom, and the tidal current is slight, it may be found necessary to use small wire booms 3 inches or 4 inches in length to extend the hook-links from the vertical portion of the paternoster, which they might otherwise foul. A swivel to keep the line from kinking and one at the end of each boom are useful. Among the best baits for fishing on or near the bottom are lug-worms, mussels, sand-worms, rag-worms, shrimps, prawns, oysters, squid, cuttle-fish, pilchard, herring, sprat, mackerel, hermit-crab, and soft-crab.

Advantages of the paternoster.

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Seaford, a parish, railway station, and watering-place, Sussex, England, in the Eastbourne parliamentary division of the county, 13 miles east of Brighton. Its ancient corporation was dissolved in 1886, and it is now governed by an urban district council. A parade was built in 1881–82, and in 1887 a concrete groyne. In 1896 Queen's Hall was built, a church institute was founded in 1898, and in 1897 a cemetery of 5 acres was opened. There are golf links extending for about 3 miles. The population of the urban district in 1891 was 1991; in 1901, 3355.

Seaham Harbour, a parish, urban district (1894), and seaport town, Durham, England, in the South-Eastern parliamentary division of the county, 6 miles south of Sunderland by rail. Besides the coal trade there are extensive bottle works, and electrozone works. The population of the urban district was in 1891, 9044; in 1901, 10,163.

Seal.—The fur seals or "sea bears" and sea lions (*Otariidæ*), with the walruses, constituting the sub-order Gressigrada, are closely related to the bears, and are very distinct from the true or hair seal (*Phocidæ*), with which they have been more or less confused. Of the two groups or genera of fur seals, *Arctocephalus* (*A. townsendi*, Guadalupe Island; *A. philippii*, Galapagos Islands; *A. australis*, southern coasts of South America and neighbouring islands; *A. delalandii*, islands and coasts of South Africa; *A. gazella*, Kerguelen and Prince Edward Islands; *A. forsteri*, coasts of New Zealand and South-Western Australia) was once widely distributed over the pelagic islands of the southern hemisphere, but is now practically extinct in the greater part of its habitat. Remnants of importance exist only on Lobos Island in the mouth of the river Plata in Uruguay, and on the islands off Cape Horn; both of these now receive protection from Government. The other genus, *Callorhinus* (*C. ursinus*, Commander Islands; *C. alaskanus*, Pribiloff Islands, both in Bering Sea; *C. kurilensis*, Robben Island and Kurile Islands, Sea of Okhotsk), is limited to the waters of the North Pacific Ocean.

Of the southern herds little authentic information exists, but the records for the northern herds are fairly complete. At the period of its maximum development, 1870 to 1880, the herd of the Pribiloff Islands numbered about $2\frac{1}{2}$ million animals; that of the Commander Islands about one-half as many. The third herd is one of minor importance, numbering in 1897 less than 1000 animals on Robben Island. All three herds became greatly reduced, and in 1896–97 numbered in all not more than 600,000 animals. The typical adult male or bull (*sikatch*) attains maturity about the seventh year, and weighs from 400 to 500 lb. He is 6 feet in length, with a girth of $4\frac{1}{2}$ feet. His fur is blackish or dark brown, with long yellowish-

white water hairs, especially long and firm on the back of the neck, forming the so-called "wig" or mane. The fore limbs, or flippers, are modified as oars and used in swimming. The animal stands erect and runs or lopes along the ground when on land. The adult female, or cow (*matka*), is much smaller, averaging about 80 ℔ in weight, with length and girth in proportion. Her fur is of varying shades of brown. She bears her first young at the age of three years.

The breeding-grounds are boulder-strewn beaches or rocky hill slopes near the shore. On these the gregarious instinct of the animals leads them to congregate in close-set masses called rookeries. The unit of rookery life is the family group, or harem, each bull getting about him as many females as he can control. The number ranges from 1 to 100 or more, averaging about 30. The bulls reach the islands early in May and take up their places. The cows begin to arrive the first week in June. The number on the rookeries from day to day grows steadily to a climax about the middle of July, when about one-half are present, the number actually on the ground diminishing to about one-fourth at and after the close of the breeding season with the end of July. The single young, or pup (*kotik*), weighing 10 to 12 ℔ and jet black in colour, is born within six to forty-eight hours after the arrival of the cow. Within a week the latter is served by the bull, and by the end of another week she goes to sea to feed, returning at gradually lengthening intervals through the summer to nourish her young, left in the meantime to care for itself on the rookeries. The bulls, having fasted since their arrival in May, go away in August to feed. The pups learn to swim at the age of a month or six weeks, and in November, with the approach of winter, they swim away with their mothers to the south. The winter migration of the Pribiloff seals extends as far south as the latitude of southern California, the return course following the coast. The Commander seals reach the latitude of southern Japan and return on their course. The fur seals find their food, chiefly squid (*Gonatus amœnus*), the Alaska pollack (*Theragra chalcogramma*), and especially a small smelt-like fish (*Therobromus callorhini*), in deep water, and their feeding-grounds in Bering Sea and on the migrations lie mainly along the 100-fathom curve.

The Commander Islands were discovered by Vitus Bering in 1741, and our first knowledge of the northern fur seal herds comes from the notes of Georg Wilhelm Steller, a German naturalist accompanying Bering's expedition. The Pribiloff Islands were discovered in 1786, and were transferred with the territory of Alaska to the possession of the United States in 1867. The Russians, in their half-century or more of experience with the fur seals, worked out the principle, based on the polygamous habit of the animals, of affording absolute protection to the breeding female herd, and confining the killing to the superfluous males. This principle is still rigidly adhered to in the operations of land killing. The young males, or bachelors, haul out to rest and sleep on beaches adjacent to, but distinct from, the breeding-grounds. Here they are surrounded at night by the sealing gangs (natives from the Aleutian Islands, brought over by the Russians to carry on the sealing operations), rounded up in droves of from 1000 to 3000, and driven inland to the killing-grounds. The large droves are broken up into successive "pods," or groups, of from 20 to 50, of which the "killable" seals (animals of three years of age or approximating to such in size) are knocked down with clubs, those too large or too small being allowed to escape. The skins are removed, salted in kenches, and, when cured, shipped to London, where practically all the fur sealskins of the world are dressed. The two important processes in dressing the skins are the removal of the long water hairs which grow out through the short thick fur, and the dyeing of the fur itself black—both delicate and difficult operations.

The decline already noted in the fur seal herds of Bering Sea is due to the growth of a rival sealing industry—the hunting of the animals at sea with spear or shotgun, now known as pelagic sealing. Stragglers from the migrating herd had from the earliest times been taken by the Indians of Cape Flattery and Vancouver Island, going out from the shore in their canoes, but the number so captured was small. In 1879, however, sailing vessels began to be used to carry the hunters and their canoes out to the main body of the herd, and to enable them to follow its movements. The industry developed rapidly, by 1892 employing a fleet of 122 sailing vessels, each with from five to twenty hunting crews. The catch at sea grew to a maximum in 1894 of 140,000 skins. The operations of the fleet gradually extended to cover the entire migration route of the herd, and in 1883 the sealers entered its summer feeding-grounds in Bering Sea. Pelagic hunting, necessarily indiscriminate, affected most seriously the herd of breeding females. Investigations carried on in Bering Sea in 1895 and 1896 show that from 62 to 84 per cent. of the pelagic catch are of this class, the death of the female involving the death of her unborn offspring, as well as that of the unweaned young.

Under sanction of a claim made by Russia in 1821 to exclusive jurisdiction in Bering Sea, a claim decided by the Paris Tribunal of 1893 to be untenable, the United States in 1886 seized sealing vessels operating in that sea—among them Canadian vessels. This brought on a diplomatic discussion with Great Britain, which culminated in 1892 in a treaty by which it was agreed to submit to a court of arbitration the claims of the United States to jurisdiction in Bering Sea in the interests of her fur seal herd when beyond the ordinary territorial limits. The Tribunal of Arbitration met in Paris in 1893. Its decision was adverse to the contentions of the United States, and equally adverse to the life of the fur seal herds. As agreed upon in such event, the tribunal formulated a set of rules for the regulation of pelagic sealing, with a view to the protection of the seals. These regulations provided for a close season in May, June, and July, and a protected zone of 60 miles' radius about the breeding islands. The regulations failed utterly of their object, because the breeding females do not feed within the protected area, but far outside of it, and are therefore taken without restriction on the feeding-grounds in August and September, their young being left to starve.

In 1896, with a view to a revision of the regulations, it was agreed between the United States and Great Britain that a new investigation of the facts of seal life should be made. At the close of this inquiry in 1897 the two Commissions met in Washington as a Joint Conference of Fur Seal Experts, and after a discussion of the results of their labours, a substantial agreement was reached on all essential facts. On the basis of this agreement the fur seal question passed into the hands of a Joint High Commission, representing Great Britain, the United States, and Canada, called at Quebec in September 1898 to consider a number of questions at issue between the United States and Canada. There the matter rested. Meanwhile the herds have continued to decline, and the pelagic catch has itself fallen off rapidly with the depleted herds.

For a full discussion of the fur seals and fur seal industries reference should be made to the reports of D'Arcy W. Thompson, Commissioner for Great Britain, and his associates, for 1896 and 1897 (*Parliamentary Papers*, "United States," No. 3 (1897), and No. 1 (1898)), and especially to the elaborate final report of David S. Jordan, Commissioner for the United States, and his associates,

for the same years (*Treasury Department Document*, No. 2017, "Fur Seals and Fur Seal Islands of North Pacific Ocean," 4 vols. and atlas. Washington, 1898). Other papers of importance are: Henry W. Elliott's "Monograph of the Seal Islands of Alaska," Bull. 147, *U.S. Fish Commission*, 1882, and the report of C. Hart Merriam and Thomas C. Mendenhall, the American Commissioners for 1891, *Proc. Paris Arb.* vol. ii. pp. 311–396.

The table herewith appended gives the statistics, so far as available, of the fur seal herds as represented by the product taken on land and at sea. The records prior to 1870 are more or less unsatisfactory, but those subsequent to that date are authentic :—

Fur Seal Skins from various Sources, 1743 to 1897.

Year.	Land Sealing.			Pelagic Sealing.		Southern Seals.	
	Exported from Russian Colonies.	Pribiloff Herd.	Commander Herd.	Pribiloff Herd.	Commander Herd.	Lobos Island.	Cape Horn.
1743 to 1820 .	2,167,040	...	...	...	...	...	...
1821 to 1842 .	458,502	...	...	...	...	...	...
1843 to 1867 .	571,612	...	...	...	...	...	...
1868 .	...	240,000	...	4,307	...	...	...
1869 .	...	87,000	...	4,430	...	...	...
1870 .	...	23,773	...	8,086	...	...	...
1871 .	...	102,960	3,058	16,911	...	...	...
1872 .	...	108,819	29,356	5,336	...	...	...
1873 .	...	109,177	30,399	5,229	...	3,956	...
1874 .	...	110,585	31,300	5,873	...	8,509	...
1875 .	...	106,460	36,279	5,033	...	8,179	...
1876 .	...	94,657	26,960	5,515	...	11,353	6,306
1877 .	...	84,310	21,533	5,210	...	13,066	7,631
1878 .	...	109,323	31,340	5,544	...	12,301	8,227
1879 .	...	110,411	42,740	8,557	310	12,295	12,180
1880 .	...	105,718	48,504	8,718	1,192	14,836	17,562
1881 .	...	105,063	43,522	10,382	...	13,569	13,164
1882 .	...	99,812	44,020	15,551	...	13,200	11,711
1883 .	...	79,509	28,699	16,557	28	12,861	4,655
1884 .	...	105,434	53,263	16,971	212	16,258	6,743
1885 .	...	105,024	43,575	23,040	1,920	10,953	3,404
1886 .	...	104,521	54,591	28,494	11,000	13,067	909
1887 .	...	105,760	46,347	30,628	16,000	11,068	2,762
1888 .	...	103,304	47,362	26,189	726	20,747	4,403
1889 .	...	102,617	52,850	29,858	13,300	8,755	3,021
1890 .	...	28,059	53,780	40,814	11,000	18,541	2,450
1891 .	...	12,040	36,005	59,568	8,432	15,834	3,114
1892 .	...	7,511	31,244	46,642	26,752	12,202	6,292
1893 .	...	7,396	32,818	30,812	66,143	13,624	2,131
1894 .	...	16,270	27,287	61,838	79,305	12,145	62
1895 .	..	14,816	17,719	56,291	37,935	12,017	1,888
1896 .	...	28,904	14,741	43,917	24,101	14,019	2,510
1897 .	...	20,890	11,335	24,321	13,801	12,701	1,265

SUMMARY.

From all sources prior to 1868	3,197,154
Land sealing, 1868–97, Pribiloff herd	2,440,218
" " Commander herd . . .	942,736
Pelagic sealing, 1868–97, Pribiloff herd . . .	651,282
" " Commander herd . . .	312,247
Lobos Island skins	316,746
Cape Horn skins	122,390
Grand Total	7,982,768

(D. S. J. ; G. A. C.)

Seamanship.—The art of seamanship consists in causing a vessel to contend successfully with wind and with sea. The modern development of steam engines and the employment of steel in the construction of the hulls have created a further demand for punctuality and comfort in the performance of voyages, and have resulted in a great increase in the size of vessels for all but mere coasting and fishing purposes. The tendency of this demand, coupled with inter-oceanic thoroughfares of communication, such as the Suez Canal, has constantly lessened the proportion of vessels propelled by sails to that of machine-propelled steamers, capable of attaining the habitual punctuality of the present day. In the United Kingdom, in the middle of the 'seventies, 132 steam-vessels of wood or of iron were in process of construction, and 317 sailing vessels of the same materials. In the latter part of 1898, 533 steamers of steel, iron, and wood were being built, and only 25 sailing vessels of greater size than 100 tons; in that year 646 steamers were completed and added to the mercantile marine of the United Kingdom, and 195 were either lost or broken up; 242 sailing vessels, mostly small, were added, and 448 were wrecked or destroyed. Thus the steam navy has largely increased, and the sailing navy is rapidly dwindling. The same qualities in the seaman that led to national success in the era of sails are now required for corresponding efficiency under the stringent requirement of forcing passages in all weathers and at all seasons. In modern ships the demands on the human endurance of executive officers, and of engineers and their subordinates, are greater and more prolonged than on those of a rapidly passing generation; for while it may be granted that during heavy weather, and specially in narrow waters, severe strain is brought on the seamanship of officers and crews of sailing vessels, long interludes of moderate and calm weather afford periods of comparative relief. But in these days of almost universal steam-power, the hurry and drive of making rapid passages last without cessation from port to port. If we gauge the distances traversed by modern steamers by immunity from accident, as compared with the lesser distances covered by the sailing vessel, between year's end and year's end, the percentage of calamitous accidents has greatly diminished, for the men who follow the sea have developed qualities of seamanship suitable to the mechanical necessities of their time.

Seamen, Merchant.—Since the article on LAWS RELATING TO SEAMEN (*Encyclopædia Britannica*, 9th edition, vol. xxi. p. 605) was written, a reform therein indicated as urgently required has been effected. The law had at that date to be gathered from the Merchant Shipping Act, 1854, and a long series of amending Acts. Further amending Acts were passed until 1894, but in that year the whole of the existing merchant shipping Acts were repealed and consolidated in one statute, the Merchant Shipping Act, 1894. To that Act, and especially to Part II., which deals with masters and seamen, and Part V., which deals with safety, and not to the repealed Acts mentioned in the article, reference must now be made. With some modifications which are indicated below, the law is substantially as stated in the previous article, and it will here only be necessary to call attention to recent changes, and in some respects to amplify the earlier statement.

The law as to the engagement and discharge of seamen has not been altered. But it should be pointed out that these must take place before a superintendent only when the employment is on a foreign-going ship. If the ship is a home-trade ship, the signing on and discharge take place before a superintendent only if the master so desire. But if the signing on does not take place before a superintendent, the master must cause the agreement to be read and explained to the seaman, and the seaman must sign it in the presence of a witness; copies of all such agreements must be transmitted to the proper Board of Trade officials. A copy of every agreement with the crew must be posted up in some part of the ship which is accessible to the crew. In any British possession abroad other than that in which the ship is registered, a seaman must be engaged before a superintendent or officer of customs, and at any port abroad where there is a British consular officer, before such officer. Before a seaman can be discharged at any place abroad, the master must obtain the sanction, endorsed on the agreement with the crew, of the like officials or, in their absence, of merchants there resident. When a seaman is discharged in a foreign country, he is entitled to be provided with adequate employment on some other British ship bound to the port in His Majesty's dominions at which he was originally shipped, or to a port in the United Kingdom agreed to by the seaman, or to be furnished with the means of returning to such port or of a passage home. It is a misdemeanour wrongfully to force a seaman on shore, or otherwise wrongfully leave him behind in any place before the completion of the voyage for which he was engaged, or the return of the ship to the United Kingdom. The only persons by whom seamen may be engaged or supplied in the United Kingdom are a superintendent, the master, the mate, a servant *bonâ fide* in the constant employ of the owner, and any person holding a licence from the Board of Trade.

The law as to seamen's wages has not been altered. Where a seaman is discharged before a superintendent in the United

Kingdom, his wages must be paid through or in the presence of the superintendent, and in the case of home-trade ships may be so paid if the master or owner so desire. The master must in every case deliver either to the superintendent or to the seaman a full account, in a form approved by the Board of Trade, of the wages and of all deductions therefrom; such deductions will only be allowed if they have been entered by the master during the voyage in a book kept for that purpose, together with a statement of the matters in respect of which they are made. Where a seaman is left abroad on the ground of his unfitness or inability to proceed on the voyage, the account of wages must be delivered to the superintendent, chief officer of customs, consular officer, or merchants, from whom the master obtains the certificate without which he may not leave the seaman behind. In order to protect seamen from crimps, advance notes, or documents authorizing or promising the future payment of money on account of a seaman's wages conditionally on his going to sea from any port of the United Kingdom, and made before those wages had been earned, were from 1880 to 1889 wholly void, and no money paid in satisfaction or in respect of any such document could be deducted from a seaman's wages. Since 1889 this restriction has been removed to the extent of one month's wages, provided that the agreement with the crew contains a stipulation for such advance. It is to be observed that this does not extend to cases where the seaman is going to sea from any port not in the United Kingdom. In such cases there is no limitation upon the right to make any agreement for advances or to make advances to any amount. It has been held that the old statute, 8 Geo. I. c. 24, § 7, does not forbid an advance to a seaman engaged abroad, or if it does, does not enable a seaman to recover the sum advanced again as unpaid wages.

As under the former law, the scale of provisions must be entered in the agreement with the crew, and compensation made for short or bad provisions, and means are provided whereby the crew can raise complaints. But, in addition, in the case of ships trading or going from any port in the United Kingdom through the Suez Canal or round the Cape of Good Hope or Cape Horn, the provisions and water are put under inspection by the Board of Trade, and if they are deficient, the ship may be detained until the defects are remedied.

The law as to the property of deceased seamen, the reimbursement of relief to seamen's families, the relief of destitute and distressed seamen, discipline, and volunteering into the navy, remains substantially unaltered. The law as to medicines, anti-scorbutics, and medical inspection, and as to crew space, continues the same. If a seaman receives hurt or injury in the service of the ship, the expense of medical attendance and maintenance, together with the cost of bringing him home, is to be borne by the owner of the ship, and cannot be deducted from wages.

The safety of the crew is secured by provisions which are designed to prevent overloading and undermanning, to restrict the carriage of dangerous cargoes, to secure adequate life-saving appliances, and generally to prevent ships from being sent to sea in an unseaworthy state. The stringency of these provisions has been much increased. Life-saving appliances, including boats, life-belts, and the like, according to a scale and rules prescribed by the Board of Trade, must be carried by every British ship. Except where the ship is under 80 tons register, employed solely in the coasting trade, or is employed solely in fishing, or is a pleasure yacht, the position of each deck above water must be marked by conspicuous lines, and the maximum load line in salt water, to which it shall be lawful to load the ship, must be marked at such level as may be approved by the Board of Trade below the deck line, and in accordance with tables and regulations prescribed by the Board of Trade. It is this load line which is commonly known as the Plimsoll mark. It is an offence to load a ship so as to submerge the load line, and a ship so loaded may be detained as unsafe. Dangerous goods, *e.g.*, explosives, must not be shipped or carried without being distinctly marked as such. Timber must not be carried on deck in the winter months. In the carriage of grain cargoes, rules prescribed by the Board of Trade to prevent shifting must be complied with. The officers of the Board of Trade (subject to appeal to a Court of Survey from an order of final detention) have power to detain any unsafe ship, that is a ship which is, by reason of the defective condition of the hull, equipments, or machinery, or of undermanning, overloading or improper loading, unfit to proceed to sea without serious danger to human life, having regard to the service for which she is intended. Provision is made for the investigation of complaints by seamen that a ship is unfit to proceed to sea.

The manning of British merchant ships has received much consideration, but has hitherto been little affected by statute law. The effect of the Acts is thus given in the report, issued in 1896, by a Board of Trade Committee on the Manning of Merchant Ships:—"Since the final repeal of the Navigation Laws, which required that the master and three-fourths of the crew of every British ship should be British subjects, and reserved the coasting trade entirely to British ships and British seamen, the whole world has been open as a recruiting ground to British shipowners, who have not been hampered in their selection by any restriction as to colour, language, qualification, age, or strength. Except with regard to certificates, which must be held by masters, officers, and engineers in certain cases, and which, moreover, may be obtained by men of any nationality, there is at present practically no bar to the employment of any person of any nationality in any capacity whatsoever on board any British ship."

Certificates of competency as masters, mates, and engineers are granted by the Board of Trade. Such certificates are for the following grades, viz., master or first mate, or second mate, or only mate of a foreign-going ship, master or mate of a home-trade passenger ship, first or second class engineer. By virtue of Orders in Council under section 102 of the Act of 1894, certificates granted in many of the British colonies have the same force as if granted by the Board of Trade. The following are the requirements of the Act as to the officers to be carried by ships:—*Masters*: A properly certificated master must be carried by every foreign-going ship and every home-trade passenger ship, whatever their tonnage. *Mates*: A mate, with the certificate of the grade of first or only mate, or master, must, in addition to the certificated master, be carried by every foreign-going ship of 100 tons or upwards, unless more than one mate is carried, in which case the first and second mates must have valid certificates appropriate to their several stations on such ship or of a higher grade; and a mate, with a certificate of the grade of first or only mate or master, must, in addition to the certificated master, be carried by every home-trade passenger ship of 100 tons or upwards. *Engineers*: Every foreign-going steamship of 100 nominal horse power or upwards must have two certificated engineers—the first possessing a first-class engineer's certificate, and the second possessing a second-class engineer's certificate, or a certificate of the higher grade. Every other foreign-going steamship, and every sea-going home-trade passenger steamship, is required to carry as the first or only engineer an engineer having a second-class certificate, or a certificate of the higher grade. Vessels in the home trade (*i.e.*, United Kingdom and continent of Europe between the Elbe and Brest) are not required to carry certificated masters or officers unless they are passenger ships of 100 tons or upwards; and vessels in the foreign trade of less than 100 tons are not required to carry any mate.

The Merchant Shipping Act, 1897, gives power to the Board of Trade to detain ships unseaworthy by reason of undermanning, but prescribes no rules for determining when a ship is to be deemed to be undermanned. And apart from that Act, the law does not interfere with the number or qualifications of the crew. The law does not prescribe that the crew or any portion of it should be British, or that it should consist, in any proportion, of able-bodied seamen. In 1898 a slight attempt was made to encourage shipowners to carry apprentices to the sea service. The Merchant Shipping Act of that year, which dealt with light dues, provided that "on proof to the satisfaction of the Board of Trade that a British ship has during any financial year carried, in accordance with the scale and regulations to be made by the Board of Trade, with the concurrence of the Treasury, boys between the ages of 15 and 19, there shall be paid to the owner of the ship, out of moneys to be provided by Parliament, an allowance not exceeding one-fifth of the light dues paid during that year in respect of that ship. Provided that no such payment shall be made in respect of anybody

unless he has enrolled himself in the Royal Naval Reserve, and entered into an obligation to present himself for service when called upon in accordance with rules to be issued by the Admiralty." This enactment is to continue until 1905; it has been so little acted upon that some more efficient means will have to be devised, if apprenticeship to the sea service is to be revived; at present it has practically ceased to exist, except in the case of boys who intend to become officers.

Some only of the provisions of the Acts apply to ships belonging to the general lighthouse authorities and pleasure yachts. But, with these exceptions, the whole of Part II. (Masters and Seamen) applies, unless the contract or subject-matter requires a different application, to all sea-going ships registered in the United Kingdom. Where a ship is a British ship, but not registered in the United Kingdom, the provisions of Part II. apply as follows:—The provisions relating to the shipping and discharge of seamen in the United Kingdom and to volunteering into the navy apply in every case. The provisions relating to lists of the crew and to the property of deceased seamen and apprentices apply where the crew are discharged or the final port of destination of the ship is in the United Kingdom. All the provisions apply where the ship is employed in trading or going between any port in the United Kingdom, and any port not situate in the British possession or country in which the ship is registered. The provisions relating to the rights of seamen in respect of wages, to the shipping and discharge of seamen in ports abroad, to leaving seamen abroad, and the relief of seamen in distress in ports abroad, to the provisions, health, and accommodation of seamen, to the power of seamen to make complaints, to the protection of seamen from imposition, and to discipline, apply in every case except where the ship is within the jurisdiction of the government of the British possession in which the ship is registered.

The law as to the registration of fishing boats, and generally as to men employed in fishing, is now to be found in the Merchant Shipping Act, 1894, and especially in Part IV. of that Act. The Act does not apply to fishing boats in British possessions, and, speaking generally, fishing boats in Scotland are governed by Part II. (Master and Seamen) and not by Part IV. By a recent change in the law, a trawler of 25 tons and upwards must carry a certificated second hand as well as a certificated skipper.

In most British colonies there are laws affecting merchant seamen. In some cases such legislation is identical with the Imperial Act, but in most there are differences of more or less importance, and the colonial statutes should be consulted. Reference may be made to the following Indian and Colonial Acts and ordinances:—*Bahamas:* 2 Vict. c. 3; 21 Vict. c. 2; 27 Vict. c. 2; 28 Vict. c. 1; 28 Vict. c. 28; 33 Vict. c. 15; 36 Vict. c. 1; 43 Vict. c. 20. *Barbados:* No. 45 of 1891; No. 12 of 1898. *Bermuda:* No. 17 of 1782; No. 22 of 1848; No. 6 of 1849; No. 14 of 1867; No. 13 of 1873; No. 7 of 1876; No. 4 of 1878; No. 10 of 1878; Nos. 2 and 5 of 1880; No. 5 of 1884; Nos. 16, 25, and 31 of 1900. *British Guiana:* No. 6 of 1864; No. 4 of 1883; No. 2 of 1895; No. 10 of 1900. *Canada:* Revised statutes, chapters 73, 74, 76 and 77; Nos. 21 and 22 of 1889; Nos. 38, 40 and 41 of 1891; No. 22 of 1893; Nos. 42, 43, 44 and 45 of 1894; Nos. 45 and 46 of 1898; No. 34 of 1901. *Cape of Good Hope:* No. 13 of 1855; No. 3 of 1863; No. 2 of 1870; No. 13 of 1874. *Ceylon:* No. 7 of 1863; No. 3 of 1880; No. 3 of 1884; No. 3 of 1888; No. 6 of 1899. *Honduras:* Consolidated Laws, chapters 54 and 55. *Hong Kong:* No. 36 of 1899. *India:* No. 1 of 1859; No. 13 of 1873; No. 13 of 1876; No. 7 of 1880; No. 5 of 1883; No. 7 of 1884; Nos. 6, 12, and 17 of 1891; No. 15 of 1894. *Jamaica:* 2 Will. IV. c. 32; 6 Will. IV. c. 19; No. 21 of 1875; No. 11 of 1878; No. 17 of 1881; No. 27 of 1900. *Leeward Islands:* No. 2 of 1878; No. 8 of 1888. *Mauritius:* No. 17 of 1855; No. 10 of 1858; No. 13 of 1869; No. 5 of 1874; No. 15 of 1887; No. 16 of 1891; No. 7 of 1892; No. 40 of 1897; No. 18 of 1899; Nos. 8 and 10 of 1900; No. 10 of 1901. *Natal:* No. 10 of 1883; No. 4 of 1884; No. 1 of 1890. *New Brunswick:* Revised Statutes, chapters 22, 86, and 87; No. 4 of 1865; No. 21 of 1866. *Newfoundland:* Consolidated Statutes, chapters 97 and 98; No. 5 of 1891; No. 4 of 1901. *New South Wales:* Nos. 46 and 47 of 1898; No. 60 of 1901. *New Zealand:* No. 4 of 1860; No. 54 of 1877; No. 15 of 1885; No. 10 of 1889; No. 15 of 1890; No. 62 of 1894. *Queensland:* No. 17 of 1840; No. 21 of 1843; No. 23 of 1847; No. 28 of 1849; No. 25 of 1852; No. 36 of 1853; No. 10 of 1874; No. 3 of 1876; No. 12 of 1882; No. 31 of 1896. *South Australia:* No. 237 of 1881; No. 541 of 1891; No. 614 of 1894; No. 691 of 1897. *Straits Settlements:* No. 1 of 1859 and 15 of 1863 (Indian Acts); No. 28 of 1867; No. 14 of 1869; No. 1 of 1873; No. 18 of 1889. *Tasmania:* Nos. 7 and 8 of 1859; No. 22 of 1870; No. 11 of 1878; No. 34 of 1889; No. 27 of 1895; No. 33 of 1896. *Trinidad:* No. 8 of 1883. *Victoria:* No. 1139 (1890); No. 1165 (1890); No. 1357 (1894); No. 1360 (1894); No. 1557 (1898); No. 1771 of 1901; *West Australia:* No. 2 of 1870; No. 14 of 1877; No. 19 of 1878; No. 1 of 1880.

Sea-Power.—A term used to indicate two distinct, though cognate, things. The affinity of these two and the indiscriminate manner in which the term has been applied to each have tended to obscure its real significance. The obscurity has been deepened by the frequency with which the term has been confounded with the old phrase, "Sovereignty of the sea," and the still current expression, "Command of the sea" (*vide* SEA, COMMAND OF). A discussion—etymological, or even archæological in character—of the term must be undertaken as an introduction to the explanation of its now generally accepted meaning. It is one of those compound words in which a Teutonic and a Latin (or Romance) element are combined, and which are easily formed and become widely current when the sea is concerned. Of such are "sea-coast," "sea-forces" (the "land- and sea-forces" used to be a common designation of what we now call the "Army and Navy"); "sea-service," "sea-serpent," and "sea-officer" (now superseded by "naval officer"). The term in one form is as old as the 15th century. Edward III., in commemoration of the naval victory of Sluys, coined gold "nobles" which bore on one side his effigy "crowned, standing in a large ship, holding in one hand a sword and in the other a shield." An anonymous poet, who wrote in the reign of Henry VI., says of this coin:—

History of the term.

> For four things our noble showeth to me,
> King, ship and sword, and *power of the sea.*

Even in its present form the term is not of very recent date. Grote (*Hist. of Greece*, v. p. 67, published in 1849, but with preface dated 1848) speaks of "the conversion of Athens from a land-power into a sea-power." In a lecture published in 1883, but probably delivered earlier, the late Sir J. R. Seeley says that "commerce was swept out of the Mediterranean by the besom of the Turkish sea-power" (*Expansion of England*, p. 89). The term also occurs in vol. xviii. of this Encyclopædia, published in 1885. At p. 574 of that volume (PERSIA) we are

told that Themistocles was "the founder of the Attic sea-power." The sense in which the term is used differs in these extracts. In the first it means what we generally call a "naval power"—that is to say, a State having a considerable navy in contradistinction to a "military power," a State with a considerable army but only a relatively small navy. In the last two extracts it means all the elements of the naval strength of the State referred to; and this is the meaning that is now generally, and is likely to be exclusively, attached to the term owing to the brilliant way in which it has been elucidated by Captain A. T. Mahan of the United States Navy in a series of remarkable works (*Influence of Sea-power on History*, published 1890; *Influence of Sea-power on the French Revolution and Empire*, 2 vols. 1892; *Nelson: the Embodiment of the Sea-power of Great Britain*, 2 vols. 1897). The double use of the term is common in German, though in that language both parts of the compound now in use are Teutonic. One instance out of many may be cited from the historian Adolf Holm (*Griechische Geschichte*, Berlin, 1889). He says (ii. p. 37) that Athens, being in possession of a good naval port, could become "*eine bedeutende Seemacht*," *i.e.*, an important naval power. He also says (ii. p. 91) that Gelon of Syracuse, besides a large army (*Heer*), had "*eine bedeutende Seemacht*," meaning a considerable navy. The term, in the first of the two senses, is old in German, as appears from the following, extracted from Zedler's *Grosses Universal Lexicon*, vol. xxxvi. (Leipzig and Halle, 1743): "Seemachten, Seepotenzen; Latin, *summae potestates mari potentes*." "Seepotenzen" is probably quite obsolete now. It is interesting as showing that German no more abhors Teuto-Latin or Teuto-Romance compounds than English. We may note, as a proof of the indeterminate meaning of the expression until his own epoch-marking works had appeared, that Mahan himself in his earliest book used it in both senses. He says (p. 35), "The Spanish Netherlands ceased to be a sea-power." He alludes (p. 42) to the development of a nation as a "sea-power," and (p. 43) to the inferiority of the Confederate States "as a sea-power." Also (p. 225) he remarks of the war of the Spanish Succession that "before it England was one of the sea-powers, after it she was *the* sea-power without any second." In all these passages, as appears from the use of the indefinite article, what is meant is a naval power, or a State in possession of a strong navy. The other meaning of the term forms the general subject of his writings above enumerated. In his earlier works Mahan writes "sea power" as two words; but in a published letter of the 19th February 1897, he joins them with a hyphen, and defends this formation of the term and the sense in which he uses it. We may regard him as the virtual inventor of the term in its more diffused meaning, for—even if it had been employed by earlier writers in that sense—it is he beyond all question who has given it general currency. He has made it impossible for any one to treat of sea-power without frequent reference to his writings and conclusions.

Appreciation of sea-power by the ancients.

There is something more than mere literary interest in the fact that the term in another language was used more than two thousand years ago. Before Mahan no historian—not even one of those who specially devoted themselves to the narration of naval occurrences—had evinced a more correct appreciation of the general principles of naval warfare than Thucydides. He alludes several times to the importance of getting command of the sea. Great Britain would have been saved some disasters and been less often in peril had British writers—taken as guides by the public—possessed the same grasp of the true principles of defence as Thucydides exhibited. One passage in his history is worth quoting. Brief as it is, it shows that on the subject of sea-power he was a predecessor of Mahan. In a speech in favour of prosecuting the war, which he puts in the mouth of Pericles, these words occur:—*οἱ μὲν γὰρ οὐχ ἕξουσιν ἄλλην ἀντιλαβεῖν ἀμαχεί, ἡμῖν δέ ἐστι γῆ πολλὴ καὶ ἐν νήσοις καὶ κατ᾽ ἤπειρον· μέγα γὰρ τὸ τῆς θαλάσσης κράτος.* The last part of this extract, though often translated "command of the sea," or "dominion of the sea," really has the wider meaning of sea-power, the "power of the sea" of the old English poet above quoted. This wider meaning should be attached to certain passages in Herodotus (iii. 122 in two places; v. 83), which have been generally interpreted "commanding the sea," or by the mere titular and honorific "having the dominion of the sea." One editor of Herodotus, Ch. F. Baehr, did, however, see exactly what was meant, for, with reference to the allusion to Polycrates, he says, *classe maximum valuit.* This is perhaps as exact a definition of sea-power as could be given in a sentence.

Can only be explained historically.

It is, however, impossible to give a definition which would be at the same time succinct and satisfactory. To say that "sea-power" means the sum total of the various elements that go to make up the naval strength of a State would be in reality to beg the question. Mahan lays down the "principal conditions affecting the sea-power of nations," but he does not attempt to give a concise definition of it. Yet no one who has studied his works will find it difficult to understand what it indicates. Our present task is, within the necessarily restricted limits of an article in an encyclopædia, to put readers in possession of the means of doing this. The best, indeed—as Mahan has shown us—the only effective way of attaining this object is to treat the matter historically. Whatever date we may agree to assign to the formation of the term itself, the idea—as we have seen—is as old as history. It is not intended to give a condensed history of sea-power, but rather an analysis of the idea and what it contains, illustrating this analysis with examples from history ancient and modern. It is important to know that it is not something which originated in the middle of the 17th century, and having seriously affected history in the 18th, ceased to have weight till Captain Mahan appeared to comment on it in the last decade of the 19th. With a few masterly touches Mahan, in his brief allusion to the second Punic war, has illustrated its importance in the struggle between Rome and Carthage. What has to be shown is that the principles which he has laid down in that case, and in cases much more modern, are true and have been true always and everywhere. Until this is perceived there is much history which cannot be understood, and yet it is essential to the welfare of Great Britain as a maritime power that she should understand it thoroughly. Her failure to understand it has more than once brought her, if not to the verge of destruction, at any rate within a short distance of serious disaster.

The high antiquity of decisive naval campaigns is among the most interesting features of international conflicts. Notwithstanding the much greater frequency of land wars, the course of history has been profoundly changed more often by contests on the water. That this has not received the notice it deserved is true, and Mahan tells us why. "Historians generally," he says, "have been unfamiliar with the conditions of the sea, having as to it neither special interest nor special knowledge; and the profound determining influence of maritime strength on great issues has consequently been overlooked." Moralizing on that which might have been is admittedly a sterile process; but it is sometimes necessary to point, if

only by way of illustration, to a possible alternative. As in modern times the fate of India and the fate of North America were determined by sea-power, so also at a very remote epoch sea-power decided whether or not Hellenic colonization was to take root in, and Hellenic culture to dominate, central and northern Italy as it dominated southern Italy, where traces of it are extant to this day.

Early manifestations of sea-power.

A moment's consideration will enable us to see how different the history of the world would have been had a Hellenized city grown and prospered on the Seven Hills. Before the Tarquins were driven out of Rome a Phocæan fleet was encountered (537 B.C.) off Corsica by a combined force of Etruscans and Phœnicians, and was so handled that the Phocæans abandoned the island and settled on the coast of Lucania (Mommsen, *Hist. Rome*, English trans. i. p. 153). The enterprise of their navigators had built up for the Phœnician cities and their great off-shoot Carthage, a sea-power which enabled them to gain the practical sovereignty of the sea to the west of Sardinia and Sicily. The control of these waters was the object of prolonged and memorable struggles, for on it—as the result showed—depended the empire of the world. From very remote times the consolidation and expansion, from within outwards, of great continental States have had serious consequences for mankind when they were accompanied by the acquisition of a coast-line and the absorption of a maritime population. We shall find that the process loses none of its importance in recent years. "The ancient empires," says the historian of Greece, Ernst Curtius, "as long as no foreign elements had intruded into them, had an invincible horror of the water." When the condition, which Curtius notices in parenthesis, arose the "horror" disappeared. There is something highly significant in the uniformity of the efforts of Assyria, Egypt, Babylon, and Persia to get possession of the maritime resources of Phœnicia. Our own immediate posterity will perhaps have to reckon with the results of similar efforts in our own day. It is this which gives a living interest to even the very ancient history of sea-power, and makes the study of it of great practical importance to us now. We shall see, as we go on, how the phenomena connected with it reappear with striking regularity in successive periods. Looked at in this light the great conflicts of former ages are full of useful, indeed necessary, instruction.

Wars of the Greeks and Persians.

In the first and greatest of the contests waged by the nations of the East against Europe—the Persian wars—sea-power was the governing factor. Until Persia had expanded to the shores of the Levant the European Greeks had little to fear from the ambition of the great king. The conquest of Egypt by Cambyses had shown how formidable that ambition could be when supported by an efficient navy. With the aid of the naval forces of the Phœnician cities the Persian invasion of Greece was rendered comparatively easy. It was the naval contingents from Phœnicia which crushed the Ionian revolt. The expedition of Mardonius, and still more that of Datis and Artaphernes, had indicated the danger threatening Greece when the master of a great army was likewise the master of a great navy. Their defeat at Marathon was not likely to, and as a matter of fact did not, discourage the Persians from further attempts at aggression. As the advance of Cambyses into Egypt had been flanked by a fleet, so also was that of Xerxes into Greece. By the good fortune sometimes vouchsafed to a people, which, owing to its obstinate opposition to, or neglect of a wise policy, scarcely deserves it, there appeared at Athens an influential citizen who understood all that was meant by the term sea-power. Themistocles saw more clearly than any of his contemporaries that, to enable Athens to play a leading part in the Hellenic world, she needed above all things a strong navy. "He had already in his eye the battle-field of the future." He felt sure that the Persians would come back, and come with such forces that resistance in the open field would be out of the question. One scene of action remained—the sea. Persuaded by him the Athenians increased their navy, so that of the 271 vessels comprising the Greek fleet at Artemisium, 147 had been provided by Athens, which also sent a large reinforcement after the first action. Though no one has ever surpassed Themistocles in the faculty of correctly estimating the importance of sea-power, it was understood by Xerxes as clearly as by him that the issue of the war depended upon naval operations. The arrangements made under the Persian monarch's direction, and his very personal movements, show that this was his view. He felt, and probably expressed the feeling, exactly as—in the war of American Independence—Washington did in the words, "Whatever efforts are made by the land armies, the navy must have the casting vote in the present contest." The decisive event was the naval action of Salamis. To have made certain of success, the Persians should have first obtained a command of the Aegean, as complete for all practical purposes as the French and English had of the sea generally in the war against Russia of 1854–56. The Persian sea-power was not equal to the task. The fleet of the great king was numerically stronger than that of the Greek allies; but it has been proved many times that naval efficiency does not depend on numerical superiority alone. The choice sections of the Persian fleet were the contingents of the Ionians and Phœnicians. The former were half-hearted or disaffected; while the latter were, at best, not superior in skill, experience, and valour to the Greek sailors. At Salamis Greece was saved not only from the ambition and vengeance of Xerxes, but also and for many centuries from oppression by an Oriental conqueror. Persia did not succeed against the Greeks, not because she had no sea-power, but because her sea-power, artificially built up, was inferior to that which was a natural element of the vitality of her foes. Ionia was lost and Greece in the end enslaved, because the quarrels of Greeks with Greeks led to the ruin of their naval States.

Peloponnesian War.

The Peloponnesian was largely a naval war. The confidence of the Athenians in their sea-power had a great deal to do with its outbreak. The immediate occasion of the hostilities, which in time involved so many States, was the opportunity offered by the conflict between Corinth and Corcyra of increasing the sea-power of Athens. Hitherto the Athenian naval predominance had been virtually confined to the Aegean Sea. The Corcyræan envoy, who pleaded for help at Athens, dwelt upon the advantage to be derived by the Athenians from alliance with a naval State occupying an important situation "with respect to the western regions towards which the views of the Athenians had for some time been directed" (Thirlwall, *Hist. Greece*, iii. p. 96). It was the "weapon of her sea-power," to adopt Mahan's phrase, that enabled Athens to maintain the great conflict in which she was engaged. Repeated invasions of her territory, the ravages of disease among her people, and the rising disaffection of her allies had been more than made up for by her predominance on the water. The scale of the subsequent Syracusan expedition showed how vigorous Athens still was down to the interruption of the war by the peace of Nicias. The great expedition just mentioned overtaxed her strength. Its failure brought about the ruin of the State. It was

held by contemporaries, and has been held in our own day, that the Athenian defeat at Syracuse was due to the omission of the government at home to keep the force in Sicily properly supplied and reinforced. This explanation of failure is given in all ages, and should always be suspected. The friends of unsuccessful generals and admirals always offer it, being sure of the support of the political opponents of the administration. After the despatch of the supporting expedition under Demosthenes and Eurymedon no further great reinforcement, as Nicias admitted, was possible. The weakness of Athens was in the character of the men who swayed the popular assemblies and held high commands. A people which remembered the administration of a Pericles, and yet allowed a Cleon or an Alcibiades to direct its naval and military policy, courted defeat. Nicias, notwithstanding the possession of high qualities, lacked the supreme virtue of a commander—firm resolution. He dared not face the obloquy consequent on withdrawal from an enterprise on which the popular hopes had been fixed; and therefore he allowed a reverse to be converted into an overwhelming disaster. "The complete ruin of Athens had appeared, both to her enemies and to herself, impending and irreparable. But so astonishing, so rapid, and so energetic had been her rally, that [a year after Syracuse] she was found again carrying on a terrible struggle" (Grote, *Hist. Greece*, v. p. 354). Nevertheless her sea-power had indeed been ruined at Syracuse. Now she could wage war only "with impaired resources and on a purely defensive system." Even before Arginusæ it was seen that "superiority of nautical skill had passed to the Peloponnesians and their allies" (*ibid.* p. 503).

Struggle between Rome and Carthage.

The great, occasionally interrupted, and prolonged contest between Rome and Carthage was a sustained effort on the part of one to gain and of the other to keep the control of the western Mediterranean. So completely had that control been exercised by Carthage, that she had anticipated the Spanish commercial policy in America. The Romans were precluded by treaties from trading with the Carthaginian territories in Hispania, Africa, and Sardinia. Rome, as Mommsen tells us, "was from the first a maritime city and, in the period of its vigour, never was so foolish or so untrue to its ancient traditions as wholly to neglect its war marine and to desire to be a mere continental power." It may be that it was lust of wealth rather than lust of dominion that first prompted a trial of strength with Carthage. The vision of universal empire could hardly as yet have formed itself in the imagination of a single Roman. The area of Phœnician maritime commerce was vast enough both to excite jealousy and to offer vulnerable points to the cupidity of rivals. It is probable that the modern estimate of the sea-power of Carthage is much exaggerated. It was great by comparison, and of course overwhelmingly great when there were none but insignificant competitors to challenge it. Mommsen holds that, in the fourth and fifth centuries after the foundation of Rome, "the two main competitors for the dominion of the Western waters" were Carthage and Syracuse. "Carthage," he says, "had the preponderance, and Syracuse sank more and more into a second-rate naval power. The maritime importance of the Etruscans was wholly gone. . . . Rome itself was not exempt from the same fate; its own waters were likewise commanded by foreign fleets." The Romans were for a long time too much occupied at home to take much interest in Mediterranean matters. The position of the Carthaginians in the western basin of the Mediterranean was very like that of the Portuguese long afterwards in India. The latter kept within reach of the sea; "nor did their rule ever extend a day's march from their ships" (R. S. Whiteway, *Rise of the Portuguese Power in India.* Westminster, 1899, p. 12). "The Carthaginians in Spain," says Mommsen, "made no effort to acquire the interior from the warlike native nations; they were content with the possession of the mines and of stations for traffic and for shell and other fisheries." Allowance being made for the numbers of the classes engaged in administration, commerce, and supervision, it is nearly certain that Carthage could not furnish the crews required by both a great war-navy and a great mercantile marine. No one is surprised on finding that the land-forces of Carthage were composed largely of alien mercenaries. We have several examples from which we can infer a parallel, if not an identical, condition of her maritime resources. How, then, was the great Carthaginian carrying-trade provided for? The experience of more than one country will enable us to answer this question. The ocean trade of those off-shoots or dependencies of the United Kingdom, viz., the United States, Australasia, and India, is largely or chiefly conducted by shipping of the "old country." So that of Carthage was largely conducted by old Phœnicians. These may have obtained a "Carthaginian Register," or the contemporary equivalent; but they could not all have been purely Carthaginian or Liby-Phœnician. This must have been the case even more with the war-navy. British India for a considerable time possessed a real, and indeed highly efficient navy; but it was officered entirely and manned almost entirely by men from the old country. Moreover, it was small. The wealth of India would have sufficed to furnish a larger material element; but, as the country could not supply the *personnel*, it would have been absurd to speak of the sea-power of India apart from that of England. As soon as the Romans chose to make the most of their natural resources the maritime predominance of Carthage was doomed. The artificial basis of the latter's sea-power would not enable it to hold out against serious and persistent assaults. Unless this is perceived, it is impossible to understand the story of the Punic wars. Judged by every visible sign of strength, Carthage, the richer, the more enterprising, ethnically the more predominant among her neighbours, and apparently the more nautical, seemed sure to win in the great struggle with Rome which, by the conditions of the case, was to be waged largely on the water. Yet those who had watched the struggles of the Punic city with the Sicilian Greeks, and especially that with Agathocles, must have seen reason to cherish doubts concerning her naval strength. It was an anticipation of the case of Spain in the age of Philip II. As the great Elizabethan seamen discerned the defects of the Spanish naval establishment, so men at Rome discerned those of the Carthaginian. Dates in connexion with this are of great significance. A comprehensive measure, with the object of "rescuing their marine from its condition of impotence" was taken by the Romans in the year 267 B.C. Four *quæstores classici*—in modern naval English we may perhaps call them port-admirals—were nominated, and one was stationed at each of four ports. The objects of the Roman Senate, so Mommsen tells us, were very obvious. They were "to recover their independence by sea, to cut off the maritime communications of Tarentum, to close the Adriatic against fleets coming from Epirus, and to emancipate themselves from Carthaginian supremacy." Four years afterwards the first Punic war began. It was, and had to be, largely a naval contest. The Romans waged it with varying fortune, but in the end triumphed by means of their sea-power. The victory of Catulus over the Carthaginian fleet off the Aegadian Islands decided the war and left to the Romans the possession of Sicily and the power of possessing them-

selves of Sardinia and Corsica. It would be an interesting and perhaps not barren investigation to inquire to what extent the decline of the mother states of Phœnicia, consequent on the campaigns of Alexander the Great, had helped to enfeeble the naval efficiency of the Carthaginian defences. One thing was certain. Carthage had now met with a rival endowed with natural maritime resources greater than her own. That rival also contained citizens who understood the true importance of sea-power. "With a statesmanlike sagacity from which succeeding generations might have drawn a lesson, the leading men of the Roman Commonwealth perceived that all their coast-fortifications and coast-garrisons would prove inadequate unless the war-marine of the State were again placed on a footing that should command respect" (Mommsen, i. 427). It is a gloomy reflection that the leading men of the United Kingdom could not see this in 1860. A thorough comprehension of the events of the first Punic war enables us to solve what, until Mahan wrote, had been one of the standing enigmas of history, viz., Hannibal's invasion of Italy by land instead of by sea in the second Punic war. Mahan's masterly examination of this question has set at rest all doubts as to the reason of Hannibal's action (*Influence on Hist.* pp. 13–21). The naval predominance in the western basin of the Mediterranean acquired by Rome had never been lost. Though modern historians, even those belonging to a maritime country, may have failed to perceive it, the Carthaginians knew well enough that the Romans were too strong for them on the sea. Though other forces co-operated to bring about the defeat of Carthage in the second Punic war, the Roman navy, as Mahan demonstrates, was the most important. As a navy, he tells us in words like those already quoted, "acts on an element strange to most writers, as its members have been from time immemorial a strange race apart, without prophets of their own, neither themselves nor their calling understood, its immense determining influence on the history of that era, and consequently upon the history of the world, has been overlooked."

Expansion of Roman dominion furthered by sea-power.

The attainment of all but universal dominion by Rome was now only a question of time. "The annihilation of the Carthaginian fleet had made the Romans masters of the sea" (Schmitz, *Hist. Rome*, p. 256). A lodgment had already been gained in Illyricum, and countries farther east were before long to be reduced to submission. A glance at the map will show that to effect this the command of the eastern basin of the Mediterranean, like that of the western, must be secured by the Romans. The old historic navies of the Greek and Phœnician States had declined. One considerable naval force there was which, though it could not have prevented, was strong enough to have delayed the Roman progress eastwards. This force belonged to Rhodes, which in the years immediately following the close of the second Punic war reached its highest point as a naval power (C. Torr, *Rhodes in Ancient Times*, p. 40). Far from trying to obstruct the advance of the Romans the Rhodian fleet helped it. Hannibal, in his exile, saw the necessity of being strong on the sea if the East was to be saved from the grasp of his hereditary foe; but the resources of Antiochus, even with the mighty co-operation of Hannibal, were insufficient. In a later and more often quoted struggle between East and West—that which was decided at Actium—sea-power was again seen to "have the casting vote." When the whole of the Mediterranean coasts became part of a single State the importance of the navy was naturally diminished; but in the struggles within the declining empire it rose again at times. The contest of the Vandal Genseric with Majorian and the African expedition of Belisarius—not to mention others—were largely influenced by the naval operations (Gibbon, *Decline and Fall*, chaps. xxxvi. xli.).

Extension westward of Mahommedan conquest.

A decisive event, the Mahommedan conquest of northern Africa from Egypt westwards, is unintelligible until it is seen how great a part sea-power played in effecting it. Purely land expeditions, or expeditions but slightly supported from the sea, had ended in failure. The emperor at Constantinople still had at his disposal a fleet capable of keeping open the communications with his African province. It took the Saracens half a century (A.D. 647–698) to win "their way along the coast of Africa as far as the Pillars of Hercules" (Hallam, *Mid. Ages*, chap. vi.); and, as Gibbon tells us, it was not till the Commander of the Faithful had prepared a great expedition, this time by sea as well as by land, that the Saracenic dominion was definitely established. It has been generally assumed that the Arabian conquerors who, within a few years of his death, spread the faith of Mahommed over vast regions, belonged to an essentially non-maritime race; and little or no stress has been laid on the extent to which they relied on naval support in prosecuting their conquests. In parts of Arabia, however, maritime enterprise was far from non-existent; and when the Mahommedan empire had extended outwards from Mecca and Medina till it embraced the coasts of various seas, the consequences to the neighbouring states were as serious as the rule above mentioned would lead us to expect that they would be. "With the conquest of Syria and Egypt a long stretch of sea-board had come into the Saracenic power; and the creation and maintenance of a navy for the protection of the maritime ports as well as for meeting the enemy became a matter of vital importance. Great attention was paid to the manning and equipment of the fleet" (Amir Ali, Syed, *Short Hist. Saracens*, p. 442). At first the fleet was manned by sailors drawn from the Phœnician towns, where nautical energy was not yet quite extinct; and later the crews were recruited from Syria, Egypt, and the coasts of Asia Minor. Ships were built at most of the Syrian and Egyptian ports, and "also at Obolla and Bushire on the Persian Gulf," whilst the mercantile marine and maritime trade were fostered and encouraged. The sea-power thus created was largely artificial. It drooped—as in similar cases—when the special encouragement was withdrawn. "In the days of Arabian energy," says Hallam, "Constantinople was twice, in 668 and 716, attacked by great naval armaments." The same authority believes that the abandonment of such maritime enterprises by the Saracens may be attributed to the removal of the capital from Damascus to Bagdad. The removal indicated a lessened interest in the affairs of the Mediterranean Sea, which was now left by the administration far behind. "The Greeks in their turn determined to dispute the command of the sea," with the result that in the middle of the 10th century their empire was far more secure from its enemies than under the first successors of Heraclius." Not only was the fall of the empire, by a rational reliance on sea-power, postponed for centuries, but also much that had been lost was regained. "At the close of the 10th century the emperors of Constantinople possessed the best and greatest part" of southern Italy, part of Sicily, the whole of what is now called the Balkan Peninsula, Asia Minor, with some parts of Syria and Armenia (Hallam, chap. vi.; Gibbon, chap. li.).

Neglect of sea-power by those who can be reached by sea brings its own punishment. Whether neglected or not, if it is an artificial creation it is nearly sure to disappoint those who wield it when it encounters a rival power of natural growth. How was it possible for the Crusaders, in their various expeditions, to achieve even

the transient success that occasionally crowned their efforts? How did the Christian kingdom of Jerusalem contrive to exist for more than three-quarters of a century? Why did the Crusades more and more become maritime expeditions? The answer to these questions is to be found in the decline of the Mahommedan naval defences and the rising enterprise of the seafaring people of the West. Venetians, Pisans, and Genoese transported crusading forces, kept open the communications of the places held by the Christians, and hampered the operations of the infidels. Even the great Saladin failed to discern the important alteration of conditions. This is evident when we look at the efforts of the Christians to regain the lost kingdom. Saladin "forgot that the safety of Phœnicia lay in immunity from naval incursions, and that no victory on land could ensure him against an influx from beyond the sea" (Amir Ali, Syed, pp. 359–360). Not only were the Crusaders helped by the fleets of the maritime republics of Italy, they also received reinforcements by sea from western Europe and England, on the "arrival of *Malik Ankiltar* [Richard Cœur de Lion] with twenty shiploads of fighting men and munitions of war."

Sea-power and the Crusades.

Participation in the Crusades was not a solitary proof of the importance of the naval states of Italy. That they had been able to act effectively in the Levant may have been in some measure due to the weakening of the Mahommedans by the disintegration of the Seljukian power, the movements of the Moguls, and the confusion consequent on the rise of the Ottomans. However that may have been, the naval strength of those Italian states was great absolutely as well as relatively. Sismondi, speaking of Venice, Pisa, and Genoa, towards the end of the 11th century, says "these three cities had more vessels on the Mediterranean than the whole of Christendom besides" (*Ital. Republics*, English ed., p. 29). Dealing with a period two centuries later, he declares it "difficult to comprehend how two simple cities could put to sea such prodigious fleets as those of Pisa and Genoa." The difficulty disappears when we have Mahan's explanation. The maritime republics of Italy—like Athens and Rhodes in ancient, Catalonia in mediæval, and England and the Netherlands in more modern times—were "peculiarly well fitted, by situation and resources, for the control of the sea by both war and commerce." As far as the western Mediterranean was concerned, Genoa and Pisa had given early proofs of their maritime energy, and fixed themselves, in succession to the Saracens, in the Balearic Isles, Sardinia, and Corsica. Sea-power was the Themistoclean instrument with which they made a small State into a great one.

Sea-power of Italian republics.

A fertile source of dispute between States is the acquisition of territory beyond sea. As others have done before and since, the maritime republics of Italy quarrelled over this. Sea-power seemed, like Saturn, to devour its own children. In 1284, in a great sea-fight off Meloria, the Pisans were defeated by the Genoese with heavy loss, which, as Sismondi states, "ruined the maritime power" of the former. From that time Genoa, transferring her activity to the Levant, became the rival of Venice. The fleets of the two cities in 1298 met near Cyprus in an encounter, said to be accidental, that began "a terrible war which for seven years stained the Mediterranean with blood and consumed immense wealth." In the next century the two republics, "irritated by commercial quarrels"—like the English and Dutch afterwards—were again at war in the Levant. Sometimes one side, sometimes the other was victorious; but the contest was exhausting to both, and especially to Venice. Within a quarter of a century they were at war again. Hostilities lasted till the Genoese met with the crushing defeat of Chioggia. "From this time," says Hallam, "Genoa never commanded the ocean with such navies as before; her commerce gradually went into decay; and the 15th century, the most splendid in the annals of Venice, is till recent times the most ignominious in those of Genoa." Venice seemed now to have no naval rival, and had no fear that any one could forbid the ceremony in which the Doge, standing in the bows of the *Bucentaur*, cast a ring into the Adriatic with the words, "*Desponsamus te, mare, in signum veri perpetuique dominii.*" The result of the combats at Chioggia, though fatal to it in the long run, did not at once destroy the naval importance of Genoa. A remarkable characteristic of sea-power is the delusive manner in which it appears to revive after a great defeat. The Persian navy occasionally made a brave show afterwards; but in reality it had received at Salamis a mortal wound. Athens seemed strong enough on the sea after the catastrophe of Syracuse; but, as already stated, her naval power had been given there a check from which it never completely recovered. The navy of Carthage had had similar experience; and, in later ages, the power of the Turks was broken at Lepanto and that of Spain at Gravelines notwithstanding deceptive appearances afterwards. Venice was soon confronted on the sea by a new rival. The Turkish naval historian, Haji Khalifeh (*Maritime Wars of the Turks*, Mitchell's trans., p. 12), tells us that, "After the taking of Constantinople, when they [the Ottomans] spread their conquests over land and sea, it became necessary to build ships and make armaments in order to subdue the fortresses and castles on the Rumelian and Anatolian shores, and in the islands of the Mediterranean." Mahommed II. established a great naval arsenal at Constantinople. In 1470 the Turks, "for the first time, equipped a fleet with which they drove that of the Venetians out of the Grecian seas" (Sismondi, p. 256). The Turkish wars of Venice lasted a long time. In that which ended in 1503 the decline of the Venetian naval power was obvious. "The Mussulmans had made progress in naval discipline; the Venetian fleet could no longer cope with theirs." Henceforward it was as an allied contingent of other navies that that of Venice was regarded as important. Dyer (*Hist. Europe*, i. p. 85) quotes a striking passage from a letter of Æneas Sylvius, afterwards Pope Pius II., in which the writer affirms that, "if the Venetians are defeated, Christendom will not control the sea any longer; for neither the Catalans nor the Genoese, without the Venetians, are equal to the Turks."

Sea-power and progress of the Turks.

The last-named people, indeed, exemplified once more the rule that a military State expanding to the sea and absorbing older maritime populations becomes a serious menace to its neighbours. Even in the 15th century Mahommed II. had made an attack on southern Italy; but his sea-power was not equal to the undertaking. Suleymân the Magnificent directed the Ottoman forces towards the west. With admirable strategic insight he conquered Rhodes, and thus freed himself from the danger of a hostile force on his flank. "The centenary of the conquest of Constantinople was past, and the Turk had developed a great naval power besides annexing Egypt and Syria" (Seeley, *British Policy*, i. p. 143). The Turkish fleets, under such leaders as Khair-ad-din (Barbarossa), Piale, and Dragut, seemed to command the Mediterranean including its western basin; but the repulse at Malta in 1565 was a serious check, and the defeat at Lepanto in 1571 virtually put an end to the prospect of Turkish maritime dominion. The predominance of Portugal in the Indian Ocean in the early part of the 16th century had seriously diminished the Ottoman resources. The wealth derived from the

trade in that ocean, the Persian Gulf, and the Red Sea, had supplied the Mahommedans with the sinews of war, and had enabled them to contend with success against the Christians in Europe. "The main artery had been cut when the Portuguese took up the challenge of the Mahommedan merchants of Calicut, and swept their ships from the ocean" (Whiteway, p. 2). The sea-power of Portugal wisely employed had exercised a great, though unperceived influence. However, though enfeebled and diminishing, the Turkish navy was still able to act with some effect in the 17th century. Nevertheless, the sea-power of the Turks ceased to count as a factor of importance in the relations between great States.

In the meantime the State which had a leading share in winning the victory of Lepanto had been growing up in the West. Before the union of its crown with that of Castile and the formation of the Spanish monarchy, Aragon had been expanding till it reached the sea. It was united with Catalonia in the 12th century, and it conquered Valencia in the 13th. Its long line of coast opened the way to an extensive and flourishing commerce; and an enterprising navy indemnified the nation for the scantiness of its territory at home by the important foreign conquests of Sardinia, Sicily, Naples, and the Balearic Isles. Among the maritime states of the Mediterranean Catalonia had been conspicuous. She was to the Iberian Peninsula much what Phœnicia had been to Syria. The Catalan navy had disputed the empire of the Mediterranean with the fleets of Pisa and Genoa. The incorporation of Catalonia with Aragon added greatly to the strength of that kingdom. The Aragonese kings were wise enough to understand and liberal enough to foster the maritime interests of their new possessions (Prescott, *Ferdinand and Isabella*, Introd. sects. i., ii.) Their French and Italian neighbours were to feel, before long, the effect of this policy; and, when the Spanish monarchy had been consolidated, it was felt not only by them, but by others also. The more Spanish dominion was extended in Italy the more were the naval resources at the command of Spain augmented. Genoa became "Spain's water-gate to Italy. . . . Henceforth the Spanish crown found in the Dorias its admirals; their squadron was permanently hired to the kings of Spain." Spanish supremacy at sea was established at the expense of France (G. W. Prothero, in M. Hume's *Spain, 1479–1788*, p. 65). The acquisition of a vast domain in the New World had greatly developed the maritime activity of Castile, and Spain was as formidable on the ocean as in the Mediterranean. After Portugal had been annexed the naval forces of that country were added to the Spanish, and the great port of Lisbon became available as a place of equipment and as an additional base of operations for oceanic campaigns. The fusion of Spain and Portugal, says Seeley, "produced a single State of unlimited maritime dominion. . . . Henceforth the whole New World belonged exclusively to Spain." The story of the tremendous catastrophe—the defeat of the Armada—by which the decline of this dominion was heralded is well known. It is memorable, not only because of the harm it did to Spain, but also because it revealed the rise of another claimant to maritime pre-eminence—the English nation. The effects of the catastrophe were not at once visible. Spain still continued to look like the greatest power in the world; and, though the English seamen were seen to be something better than adventurous pirates—a character suggested by some of their contemporary exploits—few could have comprehended that they were engaged in building up what was to be a sea-power greater than any known to history.

Spanish sea-power, Catalonia, &c.

They were carrying forward, not beginning, the building of this. "England," says Professor J. K. Laughton, "had always believed in her naval power, had always claimed the sovereignty of the Narrow Seas; and more than two hundred years before Elizabeth came to the throne, Edward III. had testified to his sense of its importance by ordering a gold coinage bearing a device showing the armed strength and sovereignty of England based on the sea" (*Armada*, Introd.) It is impossible to make intelligible the course of the many wars which the English waged with the French in the Middle Ages unless the true naval position of the former is rightly appreciated. Why were Créçy, Poitiers, Agincourt—not to mention other combats—fought, not on English, but on Continental soil? Why, during the so-called "Hundred Years' war," was England in reality the invader and not the invaded? We of the present generation are at last aware of the significance of naval defence, and know that, if properly utilized, it is the best security against invasion that a sea-surrounded State can enjoy. It is not, however, commonly remembered that the same condition of security existed and was properly valued in mediæval times. The battle of Sluys in 1340 rendered invasion of England as impracticable as did that of La Hogue in 1692, that of Quibéron Bay in 1759, and that of Trafalgar in 1805; and it permitted, as did those battles, the transport of troops to the Continent to support Great Britain's allies in wars which, had she not been strong at sea, would have been waged on the soil of her country. Her early Continental wars, therefore, are proofs of the long-established efficiency of her naval defences. Notwithstanding the greater attention now paid to naval affairs, it is doubtful if Great Britain even yet recognizes the extent to which her security depends upon a good fleet as fully as her ancestors did seven centuries ago. The narrative of pre-Elizabethan campaigns is interesting merely as a story; and, when told—as, for instance, D. Hannay has told it in the introductory chapters of his *Short History of the Royal Navy*—it will be found instructive and worthy of careful study at the present day. Each of the principal events in England's early naval campaigns may be taken as an illustration of the idea conveyed by the term "sea-power," and of the accuracy with which its meaning was apprehended at the time. To take a very early case, we may cite the defeat of Eustace the Monk by Hubert de Burgh in 1217. Reinforcements and supplies had been collected at Calais for conveyance to the army of Prince Louis of France and the rebel barons who had been defeated at Lincoln. The reinforcements tried to cross the Channel under the escort of a fleet commanded by Eustace. Hubert de Burgh, who had stoutly held Dover for King John, and was faithful to the young Henry III., heard of the enemy's movements. "If these people land," said he, "England is lost; let us therefore boldly meet them." He reasoned in almost the same words as Raleigh about four centuries afterwards, and undoubtedly "had grasped the true principles of the defence of England." He put to sea and defeated his opponent. The fleet on which Prince Louis and the rebellious barons had counted was destroyed; and with it their enterprise. "No more admirably planned, no more fruitful battle has been fought by Englishmen on water" (Hannay, p. 7). As introductory to a long series of naval operations undertaken with a like object it has deserved detailed mention here.

Early manifestations of British sea-power.

The 16th century was marked by a decided advance in both the development and the application of sea-power. Previously its operation had been confined to the Mediterranean or to coast waters outside it. Spanish or Basque seamen—by their proceedings in the English Channel—had proved the practicability of, rather than been engaged

in, ocean warfare. The English, who withstood them, were accustomed to seas so rough, to seasons so uncertain, and to weather so boisterous, that the ocean had few terrors for them. All that was wanting was a sufficient inducement to seek distant fields of action and a development of the naval art that would permit them to be reached. The discovery of the New World supplied the first; the consequently increased length of voyages and of absence from the coast led to the second. The world had been moving onwards in other things as well as in navigation. Intercommunication was becoming more and more frequent. What was done by one people was soon known to others. It is a mistake to suppose that, because the English had been behindhand in the exploration of remote regions they were wanting in maritime enterprise. The career of the Cabots would of itself suffice to render such a supposition doubtful. The English had two good reasons for postponing voyages to and settlement in far-off lands. They had their hands full nearer home; and they thoroughly, and as it were by instinct, understood the conditions on which permanent expansion must rest. They wanted to make sure of the line of communications first. To effect this a sea-going marine of both war and commerce, and, for further expansion, stations on the way were essential. The chart of the world furnishes evidence of the wisdom and the thoroughness of their procedure. Taught by the experience of the Spaniards and the Portuguese, when unimpeded by the political circumstances of the time, and provided with suitable equipment, the English displayed their energy in distant seas. It now became simply a question of the efficiency of sea-power. If this was not a quality of that of the English, then their efforts were bound to fail; and, more than this, the position of their country, challenging as it did what was believed to be the greatest of maritime States, would have been altogether precarious. The principal expeditions now undertaken were distinguished by a characteristic peculiar to the people, and not to be found in connexion with the exploring or colonizing activity of most other great nations even down to our own time. They were really unofficial speculations in which, if the Government took part at all, it was for the sake of the profit expected, and almost, if not exactly, like any private adventurer. The participation of the Government, nevertheless, had an aspect which it is worth while to note. It conveyed a hint—and quite consciously—to all whom it might concern that the speculations were "under-written" by the whole sea-power of England. The forces of more than one State had been used to protect its maritime trade from the assaults of enemies in the Mediterranean or in the Narrow Seas. They had been used to ward off invasion and to keep open communications across not very extensive areas of water. In the 16th century they were first relied upon to support distant commerce, whether carried on in a peaceful fashion or under aggressive forms. This, naturally enough, led to collisions. The contention waxed hot, and was virtually decided when the Armada shaped course to the northward after the fight off Gravelines.

Extending sphere of sea-power.

The expeditions against the Spanish Indies and, still more, those against Philip II.'s peninsular territory had helped to define the limitations of sea-power. It became evident, and it was made still more evident in the next century, that for a great country to be strong it must not rely upon a navy alone. It must also have an adequate and properly organized mobile army. Notwithstanding the number of times that this lesson has been repeated Great Britain has been slow to learn it. It is doubtful if she has learned it even yet. English seamen in all ages seem to have mastered it fully; for they have always demanded—at any rate for upwards of three centuries—that expeditions against foreign territory over-sea should be accompanied by a proper number of land-troops. On the other hand, the necessity of organizing the army of a maritime insular State and of training it with the object of rendering effective aid in operations of the kind in question, has rarely been perceived and acted upon by others. The result has been a long series of inglorious or disastrous affairs, like the West Indies voyage of 1595–96, the Cadiz expedition of 1625, and that to the Île de Ré of 1627. Additions might be made to the list. The failures of joint expeditions have often been explained by alleging differences or quarrels between the naval and the military commanders. This way of explaining them, however, is nothing but the inveterate critical method of the streets by which cause is taken for effect and effect for cause. The differences and quarrels arose, no doubt; but they generally sprang out of the recriminations consequent on, not producing, the want of success. Another manifestation of the way in which sea-power works was first observed in the 17th century. It suggested the adoption of, and furnished the instrument for, carrying out a distinct maritime policy. What was practically a standing navy had come into existence. As regards England this phenomenon was now of respectable age. Long voyages and cruises of several ships in company had been frequent during the latter half of the 16th century and the early part of the 17th. Even the grandfathers of the men who sailed with Blake and Penn in 1652 could not have known a time when ships had never crossed the ocean, and squadrons kept together for months had never cruised. However imperfect it may have been, a system of provisioning ships and supplying them with stores, and of preserving discipline among their crews, had been developed, and had proved fairly satisfactory. The Parliament and the Protector in turn found it necessary to keep a considerable number of ships in commission, and make them cruise and operate in company. It was not till well on in the reign of Queen Victoria that the man-of-war's man was finally differentiated from the merchant seaman; but, two centuries before, some of the distinctive marks of the former had already begun to be noticeable. There were seamen in the time of the Commonwealth who rarely, perhaps some who never, served afloat except in a man-of-war. Some of the interesting naval families which were settled at Portsmouth and the eastern ports, and which—from father to son—helped to recruit the ranks of bluejackets till a date later than that of the launch of the first ironclad, could carry back their professional genealogy to at least the days of Charles II., when, in all probability, it did not first start. Though landsmen continued even after the Civil War to be given naval appointments, and though a permanent corps, through the ranks of which every one must pass, had not been formally established, a body of real naval officers —men who could handle their ships, supervise the working of the armament, and exercise military command—had been formed. A navy, accordingly, was now a weapon of undoubted keenness, capable of very effective use by any one who knew how to wield it. Having tasted the sweets of intercourse with the Indies, whether in the occupation of Portugal or of Spain, both English and Dutch were desirous of getting a larger share of them. English maritime commerce had increased and needed naval protection. If England was to maintain the international position to which, as no one denied, she was entitled, that commerce must be permitted to expand.

Limitations of sea-power.

Appearance of standing navies.

Sea-power and territorial expansion in the "New World."

The minds of men in western Europe, moreover, were set upon obtaining for their country territories in the New World, the amenities of which were now known. From the reign of James I. the Dutch had shown great jealousy of English maritime enterprise. Where it was possible, as in the East Indian Archipelago, they had destroyed it. Their naval resources were great enough to let them hold English shipping at their mercy, unless a grand effort were made to protect it. The Dutch conducted the carrying trade of most of the world, and the monopoly of this they were resolved to keep, while the English were resolved to share in it. The exclusion of the English from every trade-route, except such as ran by their own coast or crossed the Narrow Seas, seemed a by no means impossible contingency. There seemed also to be but one way of preventing it, viz., by war. The supposed unfriendliness of the Dutch, or at least of an important party amongst them, to the regicide Government in England helped to force the conflict. The Navigation Act of 1651 was passed and regarded as a covert declaration of hostilities. So the first Dutch war began. It established England's claim to compete for the position of a great maritime commercial power.

Sea-power of the Dutch.

The rise of the sea-power of the Dutch, and the magnitude which it attained in a short time, and in the most adverse circumstances, have no parallel in history. The case of Athens was different, because the Athenian power had not so much been unconsciously developed out of a great maritime trade, as based on a military marine deliberately and persistently fostered during many years. Thirlwall believes that it was Solon who "laid the foundations of the Attic navy" (*Hist. Greece*, ii. p. 52), a century before Salamis. The great achievement of Themistocles was to convince his fellow-citizens that their navy ought to be increased. Perhaps the nearest parallel with the power of the Dutch was presented by that of Rhodes, which rested largely on a carrying trade. The Rhodian undertakings, however, were by comparison small and restricted in extent. Motley declares of the Seven United Provinces that they "commanded the ocean" (*United Netherlands*, ii. p. 132), and that it would be difficult to exaggerate the naval power of the young Commonwealth. Even in the days of Spain's greatness English seamen positively declined to admit that she was stronger than England on the sea; and the story of the Armada justified their view. The first two Dutch wars were, therefore, contests between the two foremost naval States of the world for what was primarily a maritime object. The identity of the cause of the first and of the second war will be discerned by any one who compares what has been said about the circumstances leading to the former, with Monk's remark as to the latter. He said that the English wanted a larger share of the trade enjoyed by the Dutch. It was quite in accordance with the spirit of the age that the Dutch should try to prevent, by force, this want from being satisfied. Anything like free and open competition was repugnant to the general feeling. The high road to both individual wealth and national prosperity was believed to lie in securing a monopoly. Merchants or manufacturers who called for the abolition of monopolies granted to particular courtiers and favourites had not the smallest intention, on gaining their object, of throwing open to the enterprise of all what had been monopolized. It was to be kept for the exclusive benefit of some privileged or chartered company. It was the same in greater affairs. As Mahan says, "To secure to one's own people a disproportionate share of the benefits of sea commerce every effort was made to exclude others, either by the peaceful legislative methods of monopoly or prohibitory regulations, or, when these failed, by direct violence." The apparent wealth of Spain was believed to be due to the rigorous manner in which foreigners were excluded from trading with the Spanish over-sea territories. The skill and enterprise of the Dutch having enabled them to force themselves into this trade, they were determined to keep it to themselves. The Dutch East India Company was a powerful body, and largely dictated the maritime policy of the country. We have thus come to an interesting point in the historical consideration of sea-power. The Elizabethan conflict with Spain had practically settled the question whether or not the expanding nations were to be allowed to extend their activities to territories in the New World. The first two Dutch wars were to settle the question whether or not the ocean trade of the world was to be open to any people qualified to engage in it. We can see how largely these were maritime questions, how much depended on the solution found for them, and how plain it was that they must be settled by naval means.

Effect on ocean trade.

Mahan's survey.

Mahan's great survey of sea-power opens in 1660, midway between the first and second Dutch wars. "The sailing-ship era, with its distinctive features," he tells us, "had fairly begun." The art of war by sea, in its more important details, had been settled by the first war. From the beginning of the second the general features of ship design, the classification of ships, the armament of ships, and the handling of fleets, were to remain without essential alteration until the date of Navarino. Even the tactical methods, except where improved on occasions by individual genius, altered little. The great thing was to bring the whole broadside force to bear on an enemy. Whether this was to be impartially distributed throughout the hostile line or concentrated on one part of it depended on the character of particular admirals. It would have been strange if a period so long and so rich in incidents had afforded no materials for forming a judgment on the real significance of sea-power. The text, so to speak, chosen by Mahan is that, notwithstanding the changes wrought in naval *matériel* since about 1850, we can find in the history of the past instructive illustrations of the general principles of maritime war. These illustrations will prove of value not only "in those wider operations which embrace a whole theatre of war," but also, if rightly applied, "in the tactical use of the ships and weapons" of our own day. By a remarkable coincidence the same doctrine was being preached at the same time and quite independently by the late Vice-Admiral Philip Colomb in his work on *Naval Warfare*. As a prelude to the second Dutch war we find a repetition of a process which had been adopted somewhat earlier. That was the permanent conquest of trans-oceanic territory. Until the 17th century had well begun, naval, or combined naval and military operations against the distant possessions of an enemy had been practically restricted to raiding or plundering attacks on commercial centres. The Portuguese territory in South America having come under Spanish dominion in consequence of the annexation of Portugal to Spain, the Dutch—as the power of the latter country declined—attempted to reduce part of that territory into permanent possession. This improvement on the practice of Drake and others was soon seen to be a game at which more than one could play. An expedition sent by Cromwell to the West Indies seized the Spanish island of Jamaica, which has remained in the hands of its conquerors to this day. In 1664 an English force occupied the Dutch North American settlements on the Hudson. Though the dispossessed rulers were not quite in a position to throw

stones at sinners, this was rather a raid than an operation of recognized warfare, because it preceded the formal outbreak of hostilities. The conquered territory remained in English hands for more than a century, and thus testified to the efficacy of a sea-power which Europe had scarcely begun to recognize. Neither the second nor the third Dutch war can be counted amongst the occurrences to which Englishmen may look back with unalloyed satisfaction; but they, unquestionably, disclosed some interesting manifestations of sea-power. Much indignation has been expressed concerning the corruption and inefficiency of the English Government of the day, and its failure to take proper measures for keeping up the navy as it should have been kept up. Some, perhaps a good deal, of this indignation was deserved; but it would have been nearly as well deserved by every other Government of the day. Even in those homes of political virtue where the administrative machinery was worked by, or in the interest of speculating capitalists and privileged companies, the accumulating evidence of late years has proved that everything was not considered to be, and as a matter of fact was not, exactly as it ought to have been. Charles II. and his brother, the duke of York, have been held up to obloquy because they thought that the coast of England could be defended against a naval enemy better by fortifications than by a good fleet and, as Pepys noted, were "not ashamed of it." The truth is that neither the king nor the duke believed in the power of a navy to ward off attack from an island. This may have been due to want of intellectual capacity; but it would be going a long way to put it down to personal wickedness. They have had many imitators, some in our own day. The huge forts which stud the coast of the United Kingdom, and have been erected within living memory, are monuments, likely to last for many years, of the inability of people, whom no one could accuse of being vicious, to rate sea-power at its proper value. It is much more likely that it was owing to a reluctance to study questions of naval defence as industriously as they deserved, and to that moral timidity which so often tempts even men of proved physical courage, to undertake the impossible task of making themselves absolutely safe against hostile efforts at every point.

Misapplication.

Charles II. has also been charged with indifference to the interests of his country, or worse, because during a great naval war he adopted the plan of trying to weaken the enemy by destroying his commerce. The king "took a fatal resolution of laying up his great ships and keeping only a few frigates on the cruise." It is expressly related, that this was not Charles's own idea, but that it was urged upon him by advisers whose opinion probably seemed at the time as well worth listening to as that of others. Anyhow if the king erred, as he undoubtedly did, he erred in good company. Fourteen hundred years earlier the statesmen who conducted the great war against Carthage, and whose astuteness has been the theme of innumerable panegyrics since, took the same "fatal resolution." In the midst of the great struggle they "did away with the fleet. At the most they encouraged privateering; and with that view placed the war-vessels of the State at the disposal of captains who were ready to undertake a corsair warfare on their own account" (Mommsen, ii. p. 52). In much later times this method has had many respectable defenders. Mahan's works are, in a sense, a formal warning to his fellow-citizens not to adopt it. In France, within the last years of the 19th century, it found, and appears still to find, adherents enough to form a school. The reappearance of belief in demonstrated impossibilities is a recognized incident in human history; but it is usually confined to the emotional or the vulgar. It is serious and filled with menaces of disaster when it is held by men thought fit to administer the affairs of a nation or advise concerning its defence. The third Dutch war may not have settled directly the position of England in the maritime world; but it helped to place that country above all other maritime States—in the position, in fact, which Great Britain, the United Kingdom, the British Empire, whichever name may be given it, has retained up to the present. It also manifested in a very striking form the efficacy of sea-power. The United Provinces, though attacked by two of the greatest monarchies in the world, France and England, were not destroyed. Indeed, they preserved much of their political importance in the State system of Europe. The Republic "owed this astonishing result partly to the skill of one or two men, but mainly to its sea-power." The effort, however, had undermined its strength and helped forward its decline.

The war which was ended by the Peace of Ryswick in 1697 presents two features of exceptional interest: one was the havoc wrought on English commerce by the enemy; the other was Torrington's conduct at and after the engagement off Beachy Head. Mahan discusses the former with his usual lucidity. At no time has war against commerce been conducted on a larger scale and with greater results than during this period. England suffered "infinitely more than in any former war." Many of her merchants were ruined; and it is affirmed that the English shipping was reduced to the necessity of sailing under the Swedish and Danish flags. The explanation is that Louis XIV. made great efforts to keep up powerful fleets. The English navy was so fully occupied in watching these that no ships could be spared to protect England's maritime trade. This is only another way of saying that her commerce had increased so largely that the navy was not strong enough to look after it as well as oppose the enemy's main force. Notwithstanding her losses she was on the winning side in the conflict. Much misery and ruin had been caused, but not enough to affect the issue of the war.

The "Fleet in being."

Torrington's proceedings in July 1690 were at the time the subject of much angry discussion. The debate, still meriting the epithet angry, has been renewed within the last few years. The matter has to be noticed here, because it involves the consideration of a question of naval strategy which must be understood by those who wish to know the real meaning of the term sea-power, and who ought to learn that it is not a thing to be idly risked or thrown away at the bidding of the ignorant and the irresponsible. Arthur Herbert, earl of Torrington — the later peerage is a viscountcy held by the Byng family—was in command of the allied English and Dutch fleet in the English Channel. "The disparity of force," says Mahan, "was still in favour of France in 1690, but it was not so great as the year before." We can measure the ability of the then English Government for conducting a great war, when we know that, in its wisdom, it had still further weakened the fleet by dividing it. Vice-Admiral Killigrew had been sent to the Mediterranean with a squadron, and had neglected, and indeed refused when urged, to take the necessary steps to repair this error. The Government having omitted, as Governments sometimes do, to gain any trustworthy intelligence of the strength or movements of the enemy, Torrington suddenly found himself confronted by a considerably superior French fleet under Tourville, one of the greatest of French sea-officers. Since then the intentions of the French have been questioned; but it is beyond dispute that, in England at the time, Tourville's movements were believed to be preliminary to invasion. Whether

Tourville deliberately meant his movement to cover an invasion or not, invasion would almost certainly have followed complete success on his part; otherwise, his victory would have been without any valuable result. Torrington saw that as long as he could keep his own fleet intact, he could, though much weaker than his opponent, prevent him from doing serious harm. Though personally not a believer in the imminence of invasion, the English admiral knew that "most men were in fear that the French would invade." His own view was, "that whilst we had a fleet in being they would not dare to make an attempt." Of late years controversy has raged round this phrase, "a fleet in being" and the strategic principle which it expresses. Most seamen were at the time, have been since, and still are in agreement with Torrington. This might be supposed enough to settle the question. It has not been allowed, however, to remain one of purely naval strategy. It was made at the time a matter of party politics. This is why it is so necessary that in a notice of sea-power it should be discussed. Both as a strategist and as a tactician Torrington was immeasurably ahead of his contemporaries. The only English admirals who can be placed above him are Hawke and Nelson. He paid the penalty of his pre-eminence: he could not make ignorant men and dull men see the meaning or the advantages of his proceedings. Mahan, who is specially qualified to do him full justice, does not devote much space in his work to a consideration of Torrington's case, evidently because he had not sufficient materials before him on which to form a judgment. The admiral's character had been taken away already by Macaulay, who did have ample evidence before him. William III., with all his fine qualities, did not possess a military genius quite equal to that of Napoleon; and Napoleon, in naval strategy, was often wrong. William III. understood that subject even less than the French emperor did; and his favourites were still less capable of understanding it. Consequently Torrington's action has been put down to jealousy of the Dutch. There have been people who accused Nelson of being jealous of the naval reputation of Caracciolo! The explanation of Torrington's conduct is this:—He had a fleet so much weaker than Tourville's that he could not fight a general action with the latter without a practical certainty of a crushing defeat. Such a result would have laid the kingdom open: a defeat of the allied fleet, says Mahan, "if sufficiently severe, might involve the fall of William's throne in England." Given certain movements of the French fleet, Torrington might have manœuvred to slip past it to the westward and join his force with that under Killigrew, which would make him strong enough to hazard a battle. This proved impracticable. There was then one course left—retire before the French, but not to keep far from them. He knew that, though not strong enough to engage their whole otherwise unemployed fleet with any hope of success, he would be quite strong enough to fight and most likely beat it, when a part of it was trying either to deal with our ships to the westward or to cover the disembarkation of an invading army. He, therefore, proposed to keep his "fleet in being" in order to fall on the enemy when the latter would have two affairs at the same time on his hands. The late Vice-Admiral Colomb rose to a greater height than was usual even with him in his criticism of this campaign. What Torrington did was merely to reproduce on the sea what has been noticed dozens of times on shore, viz., the menace of the flanking enemy. In land warfare this is held to give exceptional opportunities for the display of good generalship, but, to quote Mahan over again, a navy "acts on an element strange to most writers, its members have been from time immemorial a strange race apart, without prophets of their own, neither themselves nor their calling understood." Whilst Torrington has had the support of seamen, his opponents have been landsmen. For the crime of being a good strategist he was brought before a court-martial, but acquitted. His sovereign, who had been given the crowns of three kingdoms to defend our laws, showed his respect for them by flouting a legally constituted tribunal and disregarding its solemn finding. The admiral who had saved his country was dismissed from the service. Still, the principle of the "fleet in being" lies at the bottom of all sound strategy.

Change in naval operations

Admiral Colomb has pointed out a great change of plan in the later naval campaigns of the 17th century. Improvements in naval architecture, in the methods of preserving food, and in the arrangements for keeping the crews healthy, permitted fleets to be employed at a distance from their home ports for long continuous periods. The Dutch, as allies of the Spaniards, kept a fleet in the Mediterranean for many months. The great de Ruyter was mortally wounded in one of the battles there fought. In the war of the Spanish Succession the Anglo-Dutch fleet found its principal scene of action eastward of Gibraltar. This, as it were, set the fashion for future wars. It became a kind of tacitly accepted rule that the operation of British sea-power was to be felt in the enemy's, rather than in British waters. The hostile coast was regarded strategically as the British frontier, and the sea was looked upon as territory which the enemy must be prevented from invading. Acceptance of this principle led in time to the so-called "blockades" of Brest and Toulon. The name was misleading. As Nelson took care to explain, there was no desire to keep the enemy's fleet in; what was desired was to be near enough to attack it if it came out. The wisdom of the plan is undoubted. The hostile navy could be more easily watched and more easily followed if it put to sea. To carry out this plan a navy stronger in number of ships or in general efficiency than that of the enemy was necessary. With the exception of that of American Independence, which will therefore require special notice, England's subsequent great wars were conducted in accordance with the rule.

Rise of Russia's sea-power.

In the early part of the 18th century there was a remarkable manifestation of sea-power in the Baltic. Peter the Great, having created an efficient army, drove the Swedes from the coast provinces south of the Gulf of Finland. Like the earlier monarchies of which we have spoken, Russia, in the Baltic at least, now became a naval State. A large fleet was built, and, indeed, a considerable navy established. It was a purely artificial creation, and showed the merits and defects of its character. At first, and when under the eye of its creator, it was strong; when Peter was no more it dwindled away and, when needed again, had to be created afresh. It enabled Peter the Great to conquer the neighbouring portion of Finland, to secure his coast territories, and to dominate the Baltic. In this he was assisted by the exhaustion of Sweden consequent on her endeavours to retain, what was no longer possible, the position of a *quasi*-great Power which she had held since the days of Gustavus Adolphus. Sweden had been further weakened, especially as a naval State, by almost incessant wars with Denmark, which prevented all hope of Scandinavian predominance in the Baltic, the control of which sea has in these days passed into the hands of another State possessing a quickly created navy—the modern German empire.

The war of the Spanish Succession left Great Britain a Mediterranean power, a position which, in spite of twice losing Minorca, she still holds. In the war of the Austrian

Succession, "France was forced to give up her conquests for want of a navy, and England saved her position by her sea-power, though she had failed to use it to the best advantage" (Mahan, *Influence on Hist.* p. 280). This shows, as we shall find that a later war showed more plainly, that even the Government of a thoroughly maritime country is not always sure of conducting its naval affairs wisely. The Seven Years' war included some brilliant displays of the efficacy of sea-power. It was this which put the British in possession of Canada, decided which European race was to rule in India, and led to a British occupation of Havana in one hemisphere and of Manila in the other. In the same war Great Britain learnt how, by a feeble use of sea-power, a valuable possession, like Minorca, may be lost. At the same time, the maritime trade and the general prosperity of the kingdom increased enormously. The result of the conflict made plain to all the paramount importance of having in the principal posts in the Government men capable of understanding what war is and how it ought to be conducted.

Seven Years' War.

This lesson, as the sequel demonstrated, had not been learned when Great Britain became involved in a war with the insurgent colonies in North America. Mahan's comment is striking: "The magnificence of sea-power and its value had perhaps been more clearly shown by the uncontrolled sway and consequent exaltation of one belligerent; but the lesson thus given, if more striking, is less vividly interesting than the spectacle of that sea-power meeting a foe worthy of its steel, and excited to exertion by a strife which endangered not only its most valuable colonies, but even its own shores" (*Influence on Hist.* p. 338). Great Britain was, in fact, drawing too largely on the *prestige* acquired during the Seven Years' war, and was governed by men who did not understand the first principles of naval warfare, and would not listen to those who did. They quite ignored the teaching of the then comparatively recent wars which has been alluded to already—that the enemy's coast should be looked upon as the frontier. A century and a half earlier the Dutchman Grotius had written—

First American War.

Quæ meta Britannis
Litora sunt aliis.

Though ordinary prudence would have suggested ample preparation, British ministers allowed their country to remain unprepared. Instead of concentrating their efforts on the main objective, they frittered away force in attempts to relieve two beleaguered garrisons under the pretext of yielding to popular pressure, which is the official term for acting on the advice of irresponsible and uninstructed busybodies. "Depuis le débût de la crise," says Captain Chevalier, "les ministres de la Grande Bretagne s'étaient montrés inférieurs à leur tâche." An impressive result of this was the repeated appearance of powerful and indeed numerically superior hostile fleets in the English Channel. The war—notwithstanding that, perhaps because, land operations constituted an important part of it, and in the end settled the issue—was essentially oceanic. Captain Mahan says it was "purely maritime." It may be true that, whatever the belligerent result, the political result, as regards the *status* of the insurgent colonies, would have been the same. It is in the highest degree probable, indeed it closely approaches to certainty, that a proper use of the British sea-power would have prevented independence from being conquered, as it were, at the point of the bayonet. There can be no surprise in store for the student acquainted with the vagaries of strategists who are influenced in war by political in preference to military requirements. Still, it is difficult to repress an emotion of astonishment on finding that a British Government intentionally permitted de Grasse's fleet and the French army in its convoy to cross the Atlantic unmolested, for fear of postponing for a time the revictualling of the garrison beleaguered at Gibraltar. Washington's opinion as to the importance of the naval factor has been quoted already; and Mahan does not put the case too strongly when he declares that the success of the Americans was due to "sea-power being in the hands of the French and its improper distribution by the English authorities." England's navy, misdirected as it was, made a good fight of it, never allowed itself to be decisively beaten in a considerable battle, and won at least one great victory. At the point of contact with the enemy, however, it was not in general so conspicuously successful as it was in the Seven Years' war, or as it was to be in the great conflict with the French republic and empire. The truth is that its opponent, the French navy, was never so thoroughly a sea-going force as it was in the war of American Independence; and never so closely approached the British in sea-experience as it did during that period. Great Britain met antagonists who were very nearly, but fortunately not quite, as familiar with the sea as she was; and she never found it so hard to beat them, or even to avoid being beaten by them. An Englishman would, naturally enough, start at the conclusion confronting him, if he were to speculate as to the result of more than one battle had the great Suffren's captains and crews been quite up to the level of those commanded by stout old Sir Edward Hughes. Suffren, it should be said, before going to the East Indies, had "thirty-eight years of almost uninterrupted sea-service" (Laughton, *Studies in Naval Hist.* p. 103). A glance at a chart of the world, with the scenes of the general actions of the war dotted on it, will show how notably oceanic the campaigns were. The hostile fleets met over and over again on the far side of the Atlantic and in distant Indian seas. The French navy had penetrated into the ocean as readily and as far as the British could do. Besides this, it should be remembered that it was not until the 12th April 1782, when Rodney in one hemisphere and Suffren in the other showed them the way, that British officers were able to escape from the fetters imposed on them by the *Fighting Instructions*—a fact worth remembering in days in which it is sometimes proposed, by establishing schools of naval tactics on shore, to revive the pedantry which made a decisive success in battle nearly impossible.

The mighty conflict which raged between Great Britain on one side and France and her allies on the other, with little intermission, for more than twenty years, presents a different aspect from that of the war last mentioned. The victories which the British fleet was to gain were generally to be overwhelming; if not, they were looked upon as almost defeats. Whether the fleet opposed to the British was or was not the more numerous, the result was generally the same—the enemy was beaten. That there was a discoverable reason for this is certain. A great deal has been made of the disorganization in the French navy consequent on the confusion of the Revolution. That there was disorganization is undoubted; that it did impair discipline and, consequently, general efficiency will not be disputed; but that it was considerable enough to account by itself for the French naval defeats is altogether inadmissible. Revolutionary disorder had invaded the land-forces to a greater degree than it had invaded the sea-forces. The supersession, flight, or guillotining of army officers had been beyond measure more frequent than was the case with the naval officers. In spite of all this the French armies were on the whole—even in the

Wars of the French Revolution and Empire.

early days of the Revolution—extraordinarily successful. In 1792 "the most formidable invasion that ever threatened France," as Alison calls it, was repelled, though the invaders were the highly-disciplined and veteran armies of Prussia and Austria. It was nearly two years later that the French and British fleets came into serious conflict. The first great battle, "The Glorious First of June," though a tactical victory for Great Britain, was a strategical defeat. Villaret Joyeuse manœuvred so as to cover the arrival in France of a fleet of merchant vessels carrying sorely-needed supplies of food, and in this he was completely successful. His plan involved the probability, almost the necessity of fighting a general action which he was not at all sure of winning. He was beaten, it is true; but the French made so good a fight of it that their defeat was not nearly so disastrous as the later defeats of the Nile or Trafalgar, and—at the most—not more disastrous than that of Dominica. Yet no one even alleges that there was disorder or disorganization in the French fleet at the date of any one of those affairs. Indeed, if the French navy was really disorganized in 1794, it would have been better for France—judging from the events of 1798 and 1805—if the disorganization had been allowed to continue. In point of organization the British navy was inferior, and in point of discipline not much superior to the French at the earliest date; at the later dates, and especially at the latest, owing to the all-pervading energy of Napoleon, the British was far behind its rival in organization, in "science," and in every branch of training that can be imparted without going to sea. Great Britain had the immense advantage of counting among her officers some very able men. Nelson, of course, stands so high that he holds a place entirely by himself. The other British chiefs, good as they were, were not conspicuously superior to the Hawkes and Rodneys of an earlier day. Howe was a great commander, but he did little more than just appear on the scene in the Revolutionary war. Almost the same may be said of Hood, of whom Nelson wrote, "He is the greatest sea-officer I ever knew" (Laughton, *Nelson's Lett. and Desp.* p. 71). There must have been something, therefore, beyond the meritorious qualities of the principal British officers which helped the navy so consistently to victory. The many triumphs won could not have been due in every case to the individual superiority of the British admiral or captain to his opponent. There must have been bad as well as good among the hundreds on the lists; and we cannot suppose that Providence had so arranged it that in every action in which a British officer of inferior ability commanded, a still more inferior French commander was opposed to him.

Importance of sea-experience.

The explanation of the nearly unbroken success is, that the British was a thoroughly sea-going navy, and became more and more so every month; while the French, since the close of the American war, had lost to a great extent its sea-going character and, because it had been shut up in its ports, became less and less sea-going as hostilities continued. The war had been for the British, in the words of President Roosevelt, "a continuous course of victory won mainly by seamanship." The British navy, as regards sea-experience, especially of the officers, was immensely superior to the French. This enabled the British Government to carry into execution sound strategic plans, in accordance with which the coasts of France and its allied countries were regarded as the British frontier to be watched or patrolled by British fleets.

Before the long European war had been brought to a formal ending we received some rude rebuffs from another opponent of unsuspected vigour. In the quarrel with the United States, the so-called "War of 1812," the great sea-power of the British in the end asserted its influence, and the Americans suffered much more severely, even absolutely, than their enemy.

Second American War.

At the same time the British might have learned, for the Americans did their best to teach it, that over-confidence in numerical strength and narrow professional self-satisfaction are nearly sure to lead to reverses in war, and not unlikely to end in grave disasters. The British had now to meet the *élite* of one of the finest communities of seamen ever known. Even in 1776 the Americans had a great maritime commerce, which, as Mahan says, "had come to be the wonder of the statesmen of the mother country." In the six-and-thirty years which had elapsed since then this commerce had further increased. There was no finer nursery of seamen than the then states of the American Union. Roosevelt says that "there was no better seaman in the world" than the American, who "had been bred to his work from infancy." A large proportion of the population "was engaged in sea-going pursuits of a nature strongly tending to develop a resolute and hardy character in the men that followed them" (*Naval War of 1812*, 3rd ed., pp. 29, 30). Having little or no naval protection, the American seaman had to defend himself in many circumstances, and was compelled to familiarize himself with the use of arms. The men who passed through this practical, and therefore supremely excellent training school were numerous. Very many had been trained in English men-of-war, and some in French ships. The State navy which they were called on to man was small; and therefore its *personnel*, though without any regular or avowed selection, was virtually and in the highest sense a picked body. The lesson of the war of 1812 should be learned by Englishmen of the present day, when a long naval peace has generated a confidence in numerical superiority, in the mere possession of heavier *matériel*, and in the merits of a rigidly uniform system of training, such confidence, as experience has shown, being often the forerunner of misfortune. It is neither patriotic nor intelligent to minimize the American successes. Certainly they have been exaggerated by Americans and even by the British. To take the frigate actions alone, as being those which properly attracted most attention, the captures in action amounted to three on each side, the proportionate loss to the Americans, considering the smallness of their fleet, being immensely greater than to the British. We also see that no British frigate was taken after the first seven months of a war which lasted two and a half years. Attempts have been made to spread a belief that British reverses were due to nothing but the greater size and heavier guns of the enemy's ships. It is now established that the superiority in these details, which the Americans certainly enjoyed, was not great, and not of itself enough to account for their victories. Of course, if superiority in mere *matériel*, beyond a certain well-understood amount, is possessed by one of two combatants, his antagonist can hardly escape defeat; but it was never alleged that size of ship or calibre of guns—greater within reasonable limits than the British had—necessarily led to the defeat of British ships by the French or Spaniards. In the words of Admiral Jurien de la Gravière, "the ships of the United States constantly fought with the chances in their favour." All this is indisputable. Nevertheless in any future war British sea-power, great as it may be, should not receive shocks like those that it unquestionably did suffer in 1812.

We have now come to the end of the days of the naval wars of the past. The subsequent period has been illustrated repeatedly by manifestations of sea-power, often of great interest and importance, though rarely understood

or even discerned by the nations whom they more particularly concerned. The British sea-power, notwithstanding the first year of the war of 1812, had come out of the great European conflict unshaken and indeed more pre-eminent than ever. The words used half a century before by a writer in the great French *Encyclopédie*, seemed more exact than when first written. "*L'empire des mers*," he says, is "le plus avantageux de tous les empires; les Phœniciens le possédoient autre fois et c'est aux Anglois que cette gloire appartient aujourd'hui sur toutes les puissances maritimes" (*Encyclopédie*, 7th January 1765, art. "Thalassarchie"). Vast outlying territories had been acquired or were more firmly held, and the communications of all the over-sea dominions of the British crown were secured against all possibility of serious menace for many years to come. Her sea-power was so ubiquitous and all-pervading that, like the atmosphere, Great Britain rarely thought of it and rarely remembered its necessity or its existence. It was not till a late date that the greater part of the nation—for there still are some exceptions—perceived that it was the medium apart from which the British empire could no more live than it could have grown up. Forty years after the fall of Napoleon she found herself again at war with a great Power. She had as her ally the owner of the greatest navy in the world except her own. Her foe, as regards his naval forces, came the next in order. Yet so overwhelming was the strength of Great Britain and France on the sea that Russia never attempted to employ her navy against them. Not to mention other expeditions, considerable enough in themselves, military operations on the largest scale were undertaken, carried on for many months, and brought to a successful termination on a scene so remote that it was two thousand miles from the country of one, and three thousand from that of the other partner in the alliance. "The stream of supplies and reinforcements, which in terms of modern war is called 'communications,'" was kept free from even the threat of molestation, not by visible measures, but by the undisputed efficacy of a real, though imperceptible sea-power. At the close of the Russian war there were, even in influential positions, men who, undismayed by the consequences of mimicking in free England the cast-iron methods of Frederick the Great, began to measure British requirements by standards borrowed from abroad and altogether inapplicable to British conditions. Because other countries wisely abstained from relying on that which they did not possess, or had only imperfectly and with elaborate art created, the mistress of the seas was led to proclaim her disbelief in the very force that had made and kept her dominion, and was urged to defend herself with fortifications by advisers who, like Charles II. and the duke of York two centuries before, were "not ashamed of it." It was long before the peril into which this brought the empire was perceived; but at last, and in no small degree owing to the teachings of Mahan, the people themselves took the matter in hand and insisted that a great maritime empire should have adequate means of defending all that made its existence possible.

Russian War, 1854-56.

In forms differing in appearance, but identical in essentials, the efficacy of sea-power was proved again in the American Civil War. If ever there were hostilities in which, to the unobservant or short-sighted, naval operations might at first seem destined to count for little they were these. The sequel, however, made it clear that they constituted one of the leading factors of the success of the victorious side. The belligerents, the Northern or Federal states and the Southern or Confederate states, had a common land frontier of great length. The capital of each section was within easy distance of this frontier, and the two were not far apart. In wealth, population, and resources the Federals were enormously superior. They alone possessed a navy, though at first it was a small one. The one advantage on the Confederate side was the large proportion of military officers which belonged to it and their rare excellence as soldiers. In *physique* as well as in *morale* the army of one side differed little from that of the other; perhaps the Federal army was slightly superior in the first, and the Confederate, as being recruited from a dominant white race, in the second. Outnumbered, less well equipped, and more scantily supplied, the Confederates nevertheless kept up the war, with many brilliant successes on land, for four years. Had they been able to maintain their trade with neutral States they could have carried on the war longer, and—not improbably—have succeeded in the end. The Federal navy, which was largely increased, took away all chance of this. It established effective blockades of the Confederate ports, and severed their communications with the outside world. Indispensable articles of equipment could not be obtained, and the armies, consequently, became less and less able to cope with their abundantly furnished antagonists. By dominating the rivers the Federals cut the Confederacy asunder; and by the power they possessed of moving troops by sea at will, perplexed and harassed the defence, and facilitated the occupation of important points. Meanwhile the Confederates could make no reply on the water except by capturing merchant vessels, by which the contest was embittered, but the course of the war remained absolutely unaffected. The great numbers of men under arms on shore, the terrific slaughter in many battles of a war in which tactical ability, even in a moderate degree, was curiously uncommon on both sides, and the varying fortunes of the belligerents, made the land campaigns far more interesting to the ordinary observer than the naval. It is not surprising, therefore, that peace had been re-established for several years before the American people could be made to see the great part taken by the navy in the restoration of the Union; and what the Americans had not seen was hidden from the sight of other nations.

Later manifestations of sea-power.

In several momentous wars in Europe waged since France and Great Britain made peace with Russia sea-power manifested itself but little. In the Russo-Turkish war the naval superiority of the Turks in the Black Sea, where the Russians at the time had no fleet, governed the plans, if not the course, of the campaigns. The water being denied to them, the Russians were compelled to execute their plan of invading Turkey by land. An advance to the Bosphorus through the northern part of Asia Minor was impracticable without help from a navy on the right flank. Consequently the only route was a land one across the Danube and the Balkans. The advantages, though not fully utilized, which the enforcement of this line of advance put into the hands of the Turks, and the difficulties and losses which it caused the Russians, exhibited in a striking manner what sea-power can effect even when its operation is scarcely observable.

Russo-Turkish War, 1877-78.

This was more conspicuous in a later series of hostilities. The civil war in Chile between Congressists and Balmacedists was specially interesting, because it threw into sharp relief the predominant influence, when a non-maritime enemy was to be attacked, of a navy followed up by an adequate land-force. At the beginning of the dispute the Balmacedists, or President's party, had practically all the army, and the Congressists, or Opposition party, nearly all the Chilian navy. Unable to remain in the principal province of the republic, and expelled from the waters of Valparaiso by

Chilian Civil War, 1891.

the Balmacedist garrisons of the forts—the only and doubtful service which those works rendered to their own side—the Congressists went off with the ships to the northern provinces, where they counted many adherents. There they formed an army, and having money at command, and open sea communications, they were able to import equipment from abroad, and eventually to transport their land-force, secured from molestation on the voyage by the sea-power at their disposal, to the neighbourhood of Valparaiso, where it was landed and triumphantly ended the campaign.

It will have been noticed that, in its main outlines, this story repeated that of many earlier struggles. It was itself repeated, as regards its general features, by the story of the war between China and Japan in 1894–95. Every aspect of the war, says Colomb, is interesting to Great Britain, "as Japan is to China in a position similar to that which the British Islands occupy to the European continent" (*Naval Warfare*, 3rd ed., p. 436). It was additionally interesting because the sea-power of Japan was a novelty. Though a novelty, it was well known by British naval men to be superior in all essentials to that of China, a novelty itself. As is the rule when two belligerents are contending for something beyond a purely maritime object, the final decision was to be on land. Korea was the principal theatre of the land war; and, as far as access to it by sea was concerned, the chief bases of the two sides were about the same distance from it. It was possible for the Chinese to march there by land. The Japanese, coming from an island State, were obliged to cross the water. It will be seen at once that not only the success of the Japanese in the struggle, but also the possibility of its being carried on by them at all, depended on sea-power. The Japanese proved themselves decisively superior at sea. Their navy effectually cleared the way for one army which was landed in Korea, and for another which was landed in the Chinese province of Shantung. The Chinese land-forces were defeated. The navy of Japan being superior on the sea, was able to keep its sister service supplied or reinforced as required. It was not, however, the navy, but the army, which finally frustrated the Chinese efforts at defence, and really terminated the war. What the navy did was what, in accordance with the limitations of sea-power, may be expected of a navy. It made the transport of the army across the sea possible; and enabled it to do what of itself the army could not have done, viz., overcome the last resistance of the enemy.

War between China and Japan, 1894-95.

The issue of the Spanish-American war, at least as regards the defeat of Spain, was a foregone conclusion. That Spain, even without a serious insurrection on her hands, was unequal to the task of meeting so powerful an antagonist as the United States must have been evident even to Spaniards. However that may be, an early collapse of the Spanish defence was not anticipated, and however one-sided the war may have been seen to be, it furnished examples illustrating rules as old as naval warfare. Mahan says of it that, "while possessing, as every war does, characteristics of its own differentiating it from others, nevertheless in its broad analogies it falls into line with its predecessors, evidencing that unity of teaching which pervades the art from its beginnings unto this day" (*Lessons of the War with Spain*, p. 16). The Spaniards were defeated by the superiority of the American sea-power. "A million of the best soldiers," says Mahan, "would have been powerless in face of hostile control of the sea." That control was obtained and kept by the United States navy, thus permitting the unobstructed despatch of troops—and their subsequent reinforcement and supply—to Spanish territory, which was finally conquered, not by the navy, but by the army on shore. That it was the navy which made this final conquest possible happened, in this case, to be made specially evident by the action of the United States Government, which stopped a military expedition on the point of starting for Cuba until the sea was cleared of all Spanish naval force worth attention.

Spanish-American War, 1898.

The events of the long period which we have been considering will have shown how sea-power operates, and what it effects. What it involves will have appeared from this narrative more clearly than would have been possible from any mere definition. Like many other things, sea-power is composed of several elements. To reach the highest degree of efficacy it should be based upon a population naturally maritime, and on an ocean commerce naturally developed rather than artificially enticed to extend itself. Its outward and visible sign is a navy, strong in the discipline, skill, and courage of a numerous *personnel* habituated to the sea, in the number and quality of its ships, in the excellence of its *matériel*, and in the efficiency, scale, security, and geographical position of its arsenals and bases. History has demonstrated that sea-power thus conditioned can gain any purely maritime object, can protect the trade and the communications of a widely-extended empire, and while so doing can ward off from its shores a formidable invader. There are, however, limitations to be noted. Left to itself its operation is confined to the water, or at any rate to the inner edge of a narrow zone of coast. It prepares the way for the advance of an army, the work of which it is not intended, and is unable to perform. Behind it, in the territory of which it guards the shores, there must be a land-force adjusted in organization, equipment, and numbers to the circumstances of the country. The possession of a navy does not permit a sea-surrounded State to dispense with all fixed defences or fortification; but it does render it unnecessary and indeed absurd that they should be abundant or gigantic. The danger which always impends over the sea-power of any country is that, after being long unused, it may lose touch of the sea. The revolution in the constructive arts during the latter half of the 19th century, which has also been a period of but little-interrupted naval peace, and the universal adoption of mechanical appliances, both for ship-propulsion and for many minor services—mere *matériel* being thereby raised in the general estimation far above really more important matters—makes the danger mentioned more menacing in the present age than it has ever been before. (C. A. G. B.)

Seattle, a city and seaport of Washington, U.S.A., capital of King county. It is situated in 47° 36′ N. and 122° 20′ W., on the east shore of Elliott Bay, an arm of Puget Sound. Its site rises steeply from the water to a summit and descends eastwards to Lake Washington. On this site the city is laid out with much regularity on the whole, and is divided into nine wards. It has an excellent water-supply and is well sewered, but few of the streets are paved. Among its fine buildings are Providence hospital, the court house, opera house, high school, and many business blocks. It has seven public parks, besides Lake Washington, behind the city, a sheet of water 25 miles long, with very wild, picturesque shores. Seattle is the largest city of Washington and one of the busiest and most active of the North-West. It is an important commercial port of Puget Sound, having lines of steamers to Asiatic ports, to San Francisco, and to Alaska. It has also a large trade with other Puget Sound ports by small steamers. Here is the Pacific coast terminus of the

Great Northern Railway, and one of the termini of the Northern Pacific Railway. The Columbia and Puget Sound and the Seattle and International railways also enter the city. Seattle has also large manufacturing interests. In 1900 it contained 953 manufacturing establishments, with a total capital of $10,131,651. These employed 8480 hands, and their product was valued at $26,373,402. Of the various products, lumber, including planing-mill products, had a value of $2,846,558; slaughtering and meat-packing, a value of $3,072,195; foundry and machine-shop, and flouring and grist mill products, canning and preserving fish, and the products of the building trades were also large. This city is the seat of the state university, a non-sectarian institution, opened in 1862, which in 1899 had a faculty of 27 and was attended by 264 students, 122 of whom were women. The assessed valuation of real and personal property was, in 1900, $40,148,265, the net-debt was $5,410,755, and the rate of taxation was $25.50 per $1000. Seattle was founded in 1852, receiving the name of an Indian chief, and for many years had a slow growth, having in 1880 a population of only 3533. The rapid development of the lumber industry in this part of the state was mainly responsible for the tremendous stride which the city took in the ten years following, resulting in a population in 1890 of 42,837. In 1900 the population was returned as 80,671, of whom 22,003 were foreign-born and 3856 coloured, including 406 negroes. Of 39,503 males 21 years of age and over, 598 were illiterate (unable to write). In 1889 the business part of the city was almost entirely burned.

Sebastopol, a district town and military seaport of Russia, in the government of Taurida, in the south-west of the Crimea, in 44° 37′ N. and 33° 31′ E., 947 miles by rail from Moscow. Since it was connected with the Russian railway system, a new town has rapidly grown on the ruins which were left after the famous siege it sustained during the Crimean war, and in 1897 it contained 50,710 inhabitants, of whom only 18,661 were women. The town is well built and is becoming a favourite watering-place on account of its sea-bathing and numerous sanatoria. It has three libraries, two newspapers, gymnasia for boys and girls, and two navigation schools. It was at one time hoped that it would become an important commercial seaport; its exports rapidly grew from 1885 to 1889, when they totalled as much as 370,000 tons, but in the year 1890 Sebastopol was made a fortress of the third class, and the commercial port has been transported to Theodosia.

Sebenico, a coast town on the Adriatic, in the Austrian province of Dalmatia, in about 43° 44′ N., nearly midway between Zara and Spalato. Population of town (1890), 7014, and of commune, 20,360, chiefly Serbo-Croatian; (1900), 24,751. It is the seat of a Catholic and a Greek bishop, is a steamship station, has trade with Turkey, and considerable quantities of wine, oil, corn, and honey are produced in the neighbourhood, a further important resource of the inhabitants being fishing and seafaring.

Sedalia, a city of Missouri, U.S.A., capital of Pettis county. It is situated in 38° 43′ N. and 93° 14′ W., a little north and west of the centre of the state, at an altitude of 982 feet. It has an elevated prairie site. Three railways intersect here, the Missouri, Kansas and Texas, the Missouri Pacific, and the Sedalia, Warsaw and South-Western, making it a centre of importance. Locomotive and car works are situated here, besides which the city has manufactures of flour, wool, iron and steel, and agricultural implements. Population (1890), 14,068; (1900), 15,231, of whom 972 were foreign-born and 1725 negroes.

Sedan, chief town of arrondissement, department of Ardennes, France, 12 miles east-south-east of Mézieres on the railway from Mézieres to Nancy. There is a municipal school of weaving, but the value of the textile production has declined, being estimated in 1898 at only 25,000,000 francs. Population (1891), 17,023; (1901), 19,349.

Sedgley, a parish and urban district, Staffordshire, England, 3 miles south and included in the parliamentary borough of Wolverhampton, 1½ miles from Deepfields Station. Part of the parish is under an urban district council, the remainder being in the urban district of Coseley. The district abounds in coal, lime, and ironstone. Nails, rivets, chains, fire-irons, locks, and safes are made here. Population (1891), 14,961; (1901), 15,951.

Seeley, Sir John Robert (1834–1895), English essayist and historian, was born in London in 1834. His father, R. B. Seeley, was a publisher and author of several religious books and of *The Life and Times of Edward I.*, which was highly esteemed by historians. From his father Seeley doubtless derived his taste for religious and historical subjects. He was educated at the City of London School and at Christ's College, Cambridge, where he was head of the classical tripos and senior chancellor's medallist, was elected fellow and became classical tutor of his college. For a time he was a master at his old school, and in 1863 was appointed professor of Latin at University College, London. His essay *Ecce Homo*, published anonymously in 1866, and afterwards owned by him, was widely read, and called forth many replies, being held to be an attack on Christianity. Dealing only with Christ's humanity, it dwells on His work as the founder and king of a theocratic state, and points out the effect which this society, His church, has had upon the standard and active practice of morality among men. Some who condemned the book seem to have forgotten that it was avowedly "a fragment," and that the author does not deny the truth of doctrines which he does not discuss. Its literary merit is unquestionable; it is written with vigour and dignity; its short and pointed sentences are never jerky, and there is a certain stateliness in the admirable order of their sequence. His later essay on *Natural Religion*, which, premising that supernaturalism is not essential to religion, maintains that the negations of science tend to purify rather than destroy Christianity, satisfied neither the Christian nor the scientist, and though well written excited far less interest than his earlier work. In 1869 he was appointed professor of modern history at Cambridge. His influence as a teacher was stimulating; he prepared his lectures carefully and they were largely attended. In historical work he is distinguished as a thinker rather than a scholar. Avoiding research and disliking all attempts at a picturesque representation of the past, he valued history solely in its relation to politics, as the science of the State. He maintained that it should be studied scientifically and for a practical purpose, that its function was the solution of existing political questions. Hence he naturally devoted himself mainly to recent history, and specially to the relations between England and other States. His *Life and Times of Stein*, a valuable narrative of the anti-Napoleonic revolt, led by Prussia mainly at Stein's instigation, was written under German influence, and shows little of the style of his short essays. Its length, its colourlessness, and the space it devotes to subsidiary matters render it unattractive. Far otherwise is it with his *Expansion of England*. Written in his best manner, this essay answers to his theory that history should be used for a practical purpose; it points out how and why Great Britain gained her colonies and India, the character of her empire, and the

"PLOUGHING IN THE ENGADINE." By GIOVANNI SEGANTINI.

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light in which it should be regarded. As a historical essay the book is a fine composition, and as a defence of the empire is unanswerable and inspiring. It appeared at an opportune time, and did much to make Englishmen regard the colonies, not as mere appendages, but as an expansion of the British state as well as of British nationality, and to remind them of the value of Great Britain's empire in the East. Seeley was rewarded for this public service by being made K.C.M.G., on the recommendation of Lord Rosebery. His last book, *The Growth of British Policy*, written as an essay and intended to be an introduction to a full account of the expansion of Great Britain, was published posthumously. Seeley died on 13th January 1895. He married in 1869 Miss Mary Agnes Phillott, who survived him.

See G. W. Prothero. *Memoir* prefixed to *Growth of British Policy.* London, 1895. (W. Hu.)

Segantini, Giovanni (1858–1899), Italian painter, was born at Arco in the Trentino on 15th June 1858. His mother, who died in 1863, belonged to an old family of the mountain country. His father, who was a man of the people, went to Milan, whence he set forth with another son to seek his fortune, leaving Giovanni behind. At the age of seven the child ran away; he was found perishing of cold and hunger, and was obliged to earn his bread by keeping the flocks on the hills. He spent his long hours of solitude in drawing everything he saw. Owing to the fame of the boy-prodigy having reached the ears of a syndic, the child was sent back to Milan; but, unable to endure domestic life, he soon escaped again, and led a wandering life till he met at Arco with his half-brother, who offered him the place of cashier in his provision shop. After more flights and more returns, Segantini remained at Milan to attend classes at the Brera, earning a living meanwhile by giving lessons and painting portraits. His first picture, "The Choir of Sant Antonio," was noticed for its powerful quality. After painting this, however, he shook himself free by degrees of academical teaching, as in his picture "The Ship." He subsequently painted "The Falconer" and "The Dead Hero," and then, thirsting once more for liberty, settled in Brianza, near Como. There he gave himself up to the study of mountain life, and became in truth the painter of the Alps. At this time he painted the "Ave Maria," which took a gold medal at the Amsterdam Exhibition (1883), "Mothers," "After a Storm in the Alps," "A Kiss," and "Moonlight Effect." Deeply impressed by Millet, whose influence may be traced in some of Segantini's drawings, the artist nevertheless quickly strove to reassert his individuality, as may be seen in "The Drinking-place," which gained a gold medal in Paris (1889), "In the Sheep-fold," "By the Spinning-wheel," and "Ploughing in the Engadine" (see Plate), for which he was awarded a gold medal at the Turin Exhibition (1892). Besides those works in which he studied simple effects of light and Alpine scenery, such as "Mid-day on the Alps" and "Winter at Savognino," he also painted symbolical subjects: "The Punishment of Luxury," and the "Unnatural Mothers" (in the Walker Art Gallery, Liverpool). Segantini died at Maloja in October 1899. An exhibition of his works was held in London, and afterwards at Brussels in 1899, and at Milan in 1900. Seven important pictures and nine drawings by Segantini were exhibited with success at the Paris Exhibition in 1900.

Authorities.—H. Zimmern, *Magazine of Art* (London), 1897; W. Ritter, *Gazette des Beaux-Arts* (Paris), 1898; Robert de la Sizeranne, *Revue de l'Art* (Paris), 1899; and *Revue des Deux Mondes* (Paris), 1900. (H. Fr.)

Segovia, a province of Spain, in Old Castile. Area, 2670 square miles. Population (1887), 154,443; (1897), 156,086. The birth-rate is 4·16 per cent., the death-rate 3·41 per cent., and the proportion of illegitimate births 1·80. Few of the inhabitants emigrate. Segovia is connected with Madrid and Medina del Campo by rail. This railway has not, however, stopped much of the traffic that still goes on through the passes of Nava Cerrada and Somosiera. Another line is in construction between Aranda de Duero and Segovia. The province is divided into 5 districts and 275 parishes.

The industries of Segovia have much decayed, especially porcelain and woollen stuffs. There are manufactures of coarse porcelain, dyes, chalk, paper, alcohol, rosin, hats, pins and needles, beer, flour, oil. It is estimated that more than 256,000 acres are covered with forests. In 1897 wheat was grown on 121,550 acres, rye, oats, barley, maize on 77,805 acres, pod fruit on 37,742 acres, and vines on 23,595 acres. In the same year the live stock in Segovia included 4714 horses, 12,645 mules, 18,062 asses, 26,687 cattle, 345,302 sheep, 14,063 goats, and 13,119 pigs.

Segovia, capital of the above province, on the railway from Villalba to Medina del Campo, near the river Eresma. It is still a walled city, and all its fine monuments of the Roman occupation as well as its mediæval buildings are kept in good state of preservation. Outside the older parts of the city modern suburbs have sprung up on all sides. The woollen industry has decayed, and its place has been taken by paper and flour mills, dyeing, foundries, earthenware, and some coarse porcelain. Segovia has a botanical garden, a savings bank, two public libraries, and two remarkable archive depots. Public education is well taken care of in the institute, a dozen primary schools, normal school for teachers, and arts and handicraft schools. Segovia has been for more than a century the royal artillery school of Spain. Population (1877), 11,318; (1897), 14,738.

Sehore, a town of Central India, with British cantonment, within the native state of Bhopal, situated in 23° 11′ N. and 77° 7′ E., with a station on the Bhopal–Ujain railway, 24 miles west of Bhopal. It is the residence of the political agent for the Bhopal agency, and headquarters of the Bhopal battalion. Population (1881), 15,595; (1891), 16,232. The number of police is 53 men. There are a high school, dispensary, and jail.

Seiche. See Tides.

Seidl, Anton (1850–1898), Hungarian operatic conductor, was born at Budapest, 7th May 1850. He entered the Leipzig Conservatorium in October 1870, and remained there until 1872, when he was summoned to Bayreuth as one of Wagner's copyists. There he helped to make the first fair copy of *Der Ring des Nibelungen*. Thoroughly imbued with the Wagnerian spirit, it was natural that he should assist in the first Bayreuth Festival in 1876. His chance as a conductor came when, on Wagner's recommendation, he was appointed to the Leipzig Stadt-Theater, where he remained until, in 1882, he went on tour with Angelo Neumann's *Nibelungen Ring* company. To his conducting critics attributed much of such artistic success as attended the production of the Trilogy at Her Majesty's Theatre in June of that year. In 1883 Seidl went with Neumann to Bremen, but two years later was appointed successor to Leopold Damrosch as conductor of the German Opera in New York, and in the same year he married Fraulein Kraus, the distinguished singer. In America Seidl's orchestra became famous. In 1886 he was one of the conductors at Bayreuth, and in 1897 he filled a similar position at Covent Garden, London. He died in New York, 28th March 1898. Seidl was essentially a "modern" conductor of very considerable ability. (R. H. L.)

Seine, a river of France, rising in the Côte d'Or, and flowing generally north-west and west to the English Channel, at Havre. At Chatillon (Côte d'Or), 38 miles from its source, it has an altitude of only 705 feet, more than half its total descent having been accomplished. Its breadth on entering Paris is about 182 yards, and, on leaving, 149 yards. At Clichy, 1 mile north of the fortifications, the great sewer, into which practically the whole drainage system of Paris is directed, is discharged into the Seine. The tide begins to make itself felt at Poses, 11 miles above Elbeuf, and between Caudebec and Villequier the *mascaret*, or bore, has its greatest development. In 1878 it was decided, in order to facilitate the navigation of the river below Paris, that between the capital and Rouen several additional locks should be constructed and other improvements effected, so as to divide this part of its course into ten easy stretches. The work was completed in 1886. The head of the estuary is now found near Quillebeuf, and four miles lower down, between the lighthouses of Tancarville on the north-north-east, and Pointe de la Roque on the south-south-west, the width is 3½ miles. A canal 14 miles in length is carried across the alluvial plains north of the bay, between Tancarville and Havre. (See River Engineering.)

The Seine is classed as navigable from Méry to the sea, a length of 337 miles, and divided into nine sections. The navigation statistics here given are those for 1900. The total tonnage includes wood floated.

1. Méry to Marcilly, 16 miles. In this section navigation is purely nominal.
2. Marcilly to Montereau, 46 miles, mean depth 5·25 feet, crossed by 35 bridges; number of boats, 998 (of which 661 in descent); total tonnage, 103,355.
3. Montereau to the limits of the departments Seine-et-Marne and Seine-et-Oise, 36 miles, mean depth 5·5 feet, 35 bridges; 11,307 boats (6935 in descent); total tonnage, 1,945,287.
4. From preceding limits to Paris fortifications, 25 miles, mean depth 6·5 feet, 20 bridges; number of boats, 29,316 (16,685 in descent); total tonnage, 6,496,304.
5. Across Paris, 7½ miles, mean depth 10·5 feet, crossed by 37 bridges; number of boats, 32,633 (17,872 in descent); total tonnage, 7,494,037.
6. Paris fortifications to Briche, 13 miles, mean depth 10·5 feet, crossed by 13 bridges; number of boats, 16,461 (6357 in descent); total tonnage, 4,308,548.
7. Briche to confluence of Oise, 26 miles, mean depth 10·5 feet, 15 bridges; number of boats, 19,382 (4723 in descent); total tonnage, 4,966,029.
8. Confluence of Oise to Rouen, 106 miles, mean depth 10·5 feet, bridges 23; number of boats, 8634 (3184 in descent); total tonnage, 2,054,284.
9. Rouen to Havre, 78 miles, mean depth 22 feet; number of boats, 1808 (772 in descent); total tonnage, 328,614.

(E. J. H.)

Seine, a department of France, having Paris for its capital, watered by the Seine and the Marne, which unite at Charenton.

Area, 185 square miles. The population, 2,799,329 in 1881, had increased in 1901 to 3,599,870, of whom 939,311 were settled outside of Paris. The births in 1899 were 77,010, of which 19,054 were illegitimate; deaths, 73,219; marriages, 32,105. There were in 1896, 1807 schools, with 351,000 pupils, not more than 1 per cent. of the population being illiterate. The area cultivated was in 1896 estimated at 66,339 acres, of which 43,485 were arable and 1198 under vines. The wheat grown in 1899 was valued at £104,000; rye, £8000; oats, £43,000; potatoes, £92,000; vines, £29,000. The live stock in 1899 comprised 17,000 horses, 13,000 cattle, 1600 sheep, 2700 pigs, and 411 goats. There is no coal nor other minerals, except quarries of stone and plaster of Paris. There is, however, an active industry in metals, yielding in 1898, 34,000 metric tons of iron, 2300 tons of steel, and several tons of other metals, giving a total value of £282,000. Excluding those of the capital, the important industries are spinning, leather-dressing, chemical products, paper, &c. The chief places outside of Paris are St Denis, Boulogne, Puteaux, Choisy, Ivry, Montreuil, Vincennes, Suresnes, and Sceaux.

Seine-et-Marne, a department of northern France, watered by the Seine and the Marne.

Area, 2273 square miles. The population, 348,991 in 1881, had grown in 1901 to 355,638. The births in 1899 were 7226, of which 441 were illegitimate; deaths, 7815; marriages, 2679. With 927 primary schools (1896), attended by 52,000 pupils, there was but 1 per cent. of the population illiterate. The land under cultivation in 1896 comprised 1,388,140 acres, of which 992,940 acres were plough-land and 11,115 acres under vines. The harvest of 1899 yielded in wheat the value of £1,801,000; rye, £91,800; barley, £43,200; oats, £1,593,000; potatoes, £160,000; mangold-wurzel, £132,000; green crop (trefoil, lucerne, and sainfoin), £585,000; vines, £61,000. The live stock of 1899 included 43,960 horses, 92,050 cattle, 439,800 sheep, and 14,200 pigs. The milk produced in 1899 was valued at £1,193,300. With the exception of clay and building stone, Seine-et-Marne produced in 1898, in the way of minerals, only 80 metric tons of peat, and the industry in metals was represented by only 87 tons of iron, valued at £607. The distilleries, on the other hand, produced 1,541,000 gallons of alcohol, while the production of sugar exceeded 913,000 cwt. Melun, the capital, had in 1901, 10,820 inhabitants.

Seine-et-Oise, a department of northern France, watered by the two rivers naming it.

Area, 2185 square miles. The population, 577,798 in 1881, had increased to 700,405 in 1901. The births in 1899 were 14,427, of which 1164 were illegitimate; deaths, 15,849; marriages, 5234. There were in 1896, 1419 schools, with 95,000 pupils, 2 per cent. of the population being illiterate. Out of 1,286,870 acres under cultivation in 1896, 886,730 acres were plough-land, 41,990 acres garden land, and 14,820 acres vineyards. This department has a larger area laid out in gardens than any other department of France. The wheat grown in 1899 was valued at £1,204,400; rye, £93,000; barley, £49,000; oats, £853,000; potatoes, £47,000; natural pastures, £91,200; vines, £104,000; beetroot, £122,000. The live stock included (1899) 48,690 horses, 3312 asses, 95,700 cattle, 311,200 sheep, and 20,500 pigs. In the way of minerals this department yielded, in 1896, only 260 metric tons of peat. Nor is there any important industry in metals, only 3700 tons of iron having been manufactured in 1898. Only the industries connected with agriculture are on a scale of importance. The distilleries manufactured in 1898, 2,854,000 gallons of alcohol, and the sugar output amounted to 338,000 cwt. Versailles, the capital, numbered in 1901, 44,563 inhabitants.

Seine-Inférieure, a department of the north of France, washed by the English Channel and watered by the Seine.

Area, 2448 square miles. The population, 814,068 in 1881, had increased to 843,928 in 1901. The births in 1899 were 23,588, of which 3017 were illegitimate; deaths, 23,481; marriages, 6738. There were in 1896, 1479 schools, with 126,000 pupils, 7 per cent. of the population being illiterate. The land under cultivation in 1896 comprised 1,416,545 acres, of which 837,330 acres were plough-land, 14,820 acres in gardens, 148,200 acres in woods, and about 414,960 acres in natural pastures and grass lands, the vine not being cultivated in this department. One of the richest agricultural departments of France, Seine-Inférieure produced in 1899 wheat valued at £1,204,000; rye, £73,000; barley, £40,000; oats, £800,000; potatoes, £88,100; mangold-wurzel, £92,000; colza, £191,000; beetroot, £53,000; apples, £410,000. The live stock of 1899 included 71,650 horses, 279,010 cattle, 172,800 sheep, and 70,500 pigs. The milk produce of 1899 was valued at £1,402,000. The mining of the department yielded in 1898 only 350 metric tons of peat, silica, and ashlar. The metallurgic production of the copper foundries of Rouen, however, exceeded £190,000. The principal industry is that of cotton carried on in Rouen, Darnétal, Sotteville, Le Havre, and Yvetot, which maintains 1,600,000 spindles and more than 16,000 looms. The woollen industry is also very active in Elbeuf and its environs. The distilleries produced (1898) 1,437,000 gallons of alcohol. A good deal is done in the refining of sugar and the manufacture of glass and paper. The chief towns are Rouen, the capital, with 110,717 inhabitants; Le Havre, the second port of France, with 127,639, the special commerce of which in 1899 was valued at £54,400,000, and its general commerce at £68,300,000; Elbeuf, with 18,164 inhabitants.

Seismograph. See Earthquakes.

Seismometer. See Earthquakes.

Sĕlângor. See Malay States (Federated).

Selborne, Roundell Palmer, Earl of (1812–1895), English lawyer and statesman, was born at Mixbury, in the county of Oxford, on 27th November 1812. His father was rector of the parish: his grandfather and great-grandfather were merchants in the City of London, where their descendants for a long while continued to be influential people; his mother belonged to the family of Roundell, which had been settled for four centuries in the West Riding of Yorkshire. He was educated at Rugby and at Winchester, and in 1830 went into residence in the University of Oxford as a scholar of Trinity College. Here he lived in intimacy with many friends, especially Claughton and Charles Wordsworth. He soon joined the Union Debating Society, of which Gladstone was at that time president; and there Palmer first tried his powers in debate. In 1834 he took his degree in the first class of the school of *Literæ Humaniores;* he won the Eldon scholarship and was elected to a fellowship at Magdalen College; and after a year, spent chiefly in private tuition, partly in Lord Winchilsea's house and partly in the University, he removed to London (November 1835) and commenced reading for the Bar. In London he found himself surrounded by members of his own family, and through their influential position, as well as through his own and his father's friends, he obtained a freer access to much good society than is usually the lot of a young man coming to London from a university. Meanwhile events had happened which were felt by Palmer, when he looked back in after life, to have been turning points in his mental history. In 1832 his mother had been affected by a very distressing illness, which continued for years, and in the winter of 1834–35 his brother Henry was lost at sea.

Palmer was called to the Bar on 7th June 1837, the same day on which John Rolt, a man of very different antecedents, but afterwards a worthy rival of Palmer, was also called. Through his family connexions in the City of London, clients soon came to Palmer's chambers, and his business at the Chancery bar increased rapidly. Meanwhile his interests were not wholly confined to law: for some time (1840–43) he wrote for *The Times* and the *British Critic;* he made a plunge into patristic learning, from which he soon recoiled; he was much interested in the controversies which distracted the Church on the subject of Tract 90; in the treatment of the Episcopal Church in Canada by the Canadian Government and the Colonial Office; in the establishment by the Crown, in conjunction with the king of Prussia, of the Jerusalem bishopric; and in the contest for the professorship of poetry at Oxford on Mr Keble's retirement.

In 1847, and again in 1853, Palmer was returned as member of Parliament for Plymouth, as a Peelite, and in the House of Commons he took an active and independent part. He advocated the admission of Jews to Parliament; he opposed Lord John Russell's measure to repel the so-called papal aggression; he opposed the admission of Dissenters into the University of Oxford; and he was hostile to the action of the Government in the Crimean war. On the question of the reform of the University of Oxford, he sympathized with the reformers, but felt himself prohibited, by the oaths which he had taken, from assuming any active part in the promotion of change. In 1855 he supported Gladstone in the efforts to bring about peace with Russia before the capture of Sebastopol; in 1856 he opposed the opening of museums on Sunday; in the following year he supported Cobden in his disapproval of the second opium war with China. At the general election on March 1857, Palmer, finding that the independent part he had taken, especially in reference to the Chinese question, had alienated from him many of his constituents in Plymouth, abandoned the prospect of re-election for that borough, and did not seek for election elsewhere. In 1848 he married Lady Laura Waldegrave, daughter of Earl Waldegrave. In 1849 he had become a Q.C.; and in 1851 he took his seat in the Rolls Court, where he soon obtained a leading and very lucrative practice, and was engaged in many of the most important cases in the Court of Chancery. In July 1861 he accepted from Lord Palmerston the office of solicitor-general, a knighthood, and a safe seat for the borough of Richmond in Yorkshire, secured for him through the friendly action of Lord Zetland, and thus began the second spell of Palmer's membership of the House of Commons, which continued till his elevation to the woolsack and the peerage. In September 1863 he become attorney-general, and so continued till the Government of which he was a member resigned in 1866.

The Civil War in America, and the questions which arose from the relations of Great Britain with both belligerents, rendered the duties of the law officers of the Crown more than usually onerous, and Palmer was called upon to take part, as adviser of the ministry, in the Courts, and in the House, in the questions which arose in respect of the *Trent* and the *Peterhoff*, the cruisers *Alabama* and *Florida*, and the *Alexandra*, a ship which was seized by the Government, and other matters. In 1865 he took a large part in the passing of the Act under which all the law courts were gathered together in the Strand. In 1866 he expressed himself favourable to the making of household suffrage the basis of representation, an expression of opinion which probably influenced the Reform Bill of the following year—in the discussions on which Palmer took a prominent part, and especially in opposition to the so-called "fancy franchises" originally proposed by its authors. In the same year he took part in supporting the measure for the abolition of compulsory Church rates.

In 1868 occurred an event of great importance in his career. In April of that year Gladstone proposed his resolutions with reference to the Irish Church on which the Bill for its disestablishment was subsequently based. This measure was opposed to many of the dearest beliefs and feelings of Palmer, who was a strong and conscientious Churchman, and he evidenced his disapproval of his chief's measure by abstaining from voting on the resolutions. At the election of November 1868 Palmer was again returned for Richmond, and Gladstone offered him the office of lord chancellor or the office of a lord justice with a peerage; both offers were declined by Palmer, and he assumed a position of independent opposition to the measure relative to the Irish Church. On the 22nd March 1869 he delivered a very powerful speech against the second reading of the Bill, and during its later stages exercised a considerable influence in modifying the severity of its provisions. The position of Palmer at this time was very remarkable. The foremost advocate at the Bar, he was known to have declined the highest prize in the profession rather than promote a measure of which he disapproved; a very prominent member of the House of Commons, whose action had been more than usually independent of party, he had separated himself from his political friends and maintained a position as the dignified and forcible opponent of Disestablishment. Without office and without combination with the Conservative Opposition, he exercised great influence within and without the walls of St Stephen's. What made his position the more remarkable was that he was frequently consulted by the Government which he had declined to join, and that on some occasions

they invoked the assistance which his great influence in the House enabled him to afford to them.

In 1869 he sought to modify rather than to oppose the Bill for the abolition of tests in the universities. In 1870 he gave a qualified support to Gladstone's first Irish Land Act, and in the same year he supported Forster's Education Act. In 1872 he undertook the defence of his friend Lord Chancellor Hatherley, when attacked for his appointment of Sir Robert Collier to the Judicial Committee of the Privy Council, and, by a line of argument more ingenious than convincing, secured a majority for the Government.

The Treaty of Washington was the means of casting a great duty upon Palmer. After the conclusion of the Civil War in America very large claims were preferred against Great Britain for alleged breaches of her duty as a neutral Power; and after long negotiations, England and the United States agreed to arbitration. Palmer, who had been advising the British Government during these negotiations, and who (4th August 1871) had defended the treaty in the House of Commons, was briefed on behalf of Great Britain. In the end the Geneva tribunal made an award requiring the payment by Great Britain to the United States of a sum of about £3,000,000. To those who, in order to promote the cause of international arbitration, are desirous of acquiring a knowledge of the dangers and difficulties which beset this mode of settling disputes, the account which Palmer has left of his part in this arbitration may be commended.

In September 1872 Gladstone again offered him the Great Seal, which Lord Hatherley had resigned; and he also for the first time took up his residence in his newly erected house at Blackmoor, in the parish of Selborne, in the county of Hampshire, from which he took his new title as a peer. In the following year (1873) Lord Selborne carried through Parliament the Judicature Act. The foundations of this measure were laid so long ago as February 1867, when Palmer had moved for a Royal Commission on the constitution of the courts, and had taken an active part in the work of that Commission, of which the first report was made in 1869. The result of this Act of 1873 was to effect a fundamental change in the judicature system. By the operation of the Judicature Act one supreme court with several divisions was constituted; each division could administer the whole law; the conflict of divergent systems of law was largely overcome by declaring that when they were at variance, the principles of equity should prevail over the doctrines of the common law. The details of this great change were embodied in a code of general rules prepared by a committee of judges, over which Lord Selborne for two years presided week by week, with unfaltering attention to the minutest detail. If, wrote Lord Selborne in his memoirs, speaking of the Judicature Act of 1873, "I leave any monument behind me which will bear the test of time, it may be this." It is impossible to separate this fusion of law and equity, this union of all the higher courts into one supreme tribunal, from the construction of a single home for this great institution; and the opening of the Royal Courts in the Strand in the year 1882, when Queen Victoria personally presided in her one supreme court, and handed over the care of the building to Lord Selborne, as her chancellor and as the head of this great body, was impressive as an outward and visible sign of the silent revolution, which owed more to Lord Selborne than to any other individual. To the student of the natural history of jurisprudence the fusion of the two systems of law and equity may well recall a similar result brought about in Imperial Rome; to the student of British institutions, the supreme court, for once presided over in person by the sovereign, could not but recall the Aula Regia, where the Norman kings sat amid their counsellors before equity had arisen to correct law, and before the separation between the three great common law courts had begun. A small incident may illustrate the novelty of the assemblage of the one great court on that day. The Queen, on the prayer of the attorney-general, ordered that the proceedings of the day should be recorded, an order which caused a momentary embarrassment to the lord chancellor, as the court had no existing registrar, and no existing book in which the record should be made. On the occasion of the opening of the Royal Courts Lord Selborne received an earldom.

The year 1885 was marked in Lord Selborne's life by the death of his wife, and by his final separation from the party of which Gladstone was the acknowledged leader. That statesman had in the latter part of the year indicated his leaning towards the disestablishment of the Church of England, and towards Home Rule for Ireland. Both these leanings were opposed to the deepest convictions of Lord Selborne; and it was an inevitable result that when in January 1886 Gladstone resumed office as premier, Lord Selborne should not be again his chancellor: on the 30th January in that year they parted for ever; and Lord Selborne felt that his public life, except so far as he might serve his country by voice or pen, was now over, and that his "idols were broken." But neither his courage nor his industry forsook him; and he found, in opposing the new views of his old colleague, ample scope for both voice and pen; and as a member of the House of Lords he continued almost to the last to take part in hearing and deciding appeals, and sometimes in the ordinary business of the House.

In addressing the electors of Midlothian in September 1885, Gladstone had suggested the severance of the Church of England from the State as a subject on which the foundation of discussion had already been laid, and he averred the existence of "a current almost throughout the civilized world, slowly setting in the direction of disestablishment." Such an utterance from such a man greatly excited the hopes of Nonconformists, who had previously published a manifesto under the title of "The Case for Disestablisment." This stirring of the question deeply moved Lord Selborne, who was strongly opposed alike to disestablishment and disendowment, and in the following year, 1886, he published a work entitled *A Defence of the Church of England against Disestablishment*, with an introductory letter addressed to Gladstone. In the introductory letter he criticized Gladstone's pronouncement on the subject, and especially examined the allegation of a general tendency towards disestablishment in the civilized world at large, and arrived at a negative conclusion. In the body of the book the learned author treated of the history of the English Church, its endowments, and the case of the advocates of disestablishment. The work is throughout characterized by an abundant supply of learning and of information as to the history and the state of the Church of England at that time, and by great dialectical acuteness. It is a powerful defence as well as a valuable summary of the history of the Established Church in England. In 1888 Lord Selborne published a second work on the Church question, entitled *Ancient Facts and Fallacies concerning Churches and Tithes*, in which he examined more critically than in his earlier book the developments of early ecclesiastical institutions, both on the Continent and in Anglo-Saxon England, which resulted in the formation of the modern parochial system and its general endowment with tithes. A second edition of this

work, embodying the result of its author's subsequent researches in the Vatican Library and elsewhere, was published in the year 1892. A perusal of these books will show with how wide a range of investigation and with what care Lord Selborne prepared himself for the discussion of these ecclesiastical questions which deeply stirred him. But Lord Selborne did not carry on his opposition to Gladstone's proposals only in his library or by his pen; in the year 1886–87 he travelled to many parts of the country, and addressed influential public meetings in defence of the union between the Church and State and against Home Rule; and in September 1893, in his eighty-first year, he addressed a powerful speech to the House of Lords in opposition to the Home Rule Bill.

Lord Selborne's health had, with the exception of two collapses in 1883 and 1888, which appear to have been due to overwork, continued excellent till February 1895, when he was attacked by influenza. He died 4th May 1895 at his seat in Hampshire, full of years and honours.

To the subject of university education Lord Selborne at different times in his life gave much time and attention. As a fellow of Magdalen College, he had been desirous of changes which he felt himself bound by his oath from advocating; and he had taken part in the discussions on the abolition of tests in the old universities.[1] He gave much time and attention to his duties as chairman of the second Oxford commission under the Act of 1876; in 1878 he filled the office of lord rector of the university of St Andrews; and in the following year he presided over a commission on the subject of university education in London. Lord Selborne's literary labours included the publication in 1862 of a selection of hymns, under the title of *The Book of Praise*, a work in which he was greatly assisted by Mr Daniel Sedgwick, a bookseller and publisher in the City of London. The work was characterized by the great pains taken to ascertain the true authorship of hymns which were either anonymous or attributed to those who had not composed them, and by a like effort to exclude all variations grafted on the original language, and to give the hymns "in the genuine uncorrupted text of the authors themselves." In the course of his labours as editor of this volume he was struck by the unity which was presented by Christian hymnody, "binding together by the force of a common attraction, more powerful than all causes of difference, times ancient and modern, nations of various race and language, Churchmen and Nonconformists, Churches reformed and unreformed" (Preface). In the same field of literature Lord Selborne further laboured by the publication of another collection called *The Book of Praise Hymnal*; a contribution to an edition of Bishop Ken's hymns; a paper on English Church Hymnody at a Church Congress; an article in the *Encyclopædia Britannica* on the hymns of the Latin and Oriental Churches, as well as those of Germany and Great Britain, which was republished as a separate volume in 1892.

During the last few years of his life Lord Selborne engaged in the composition, for the benefit of his children, of memorials of his own life and of the lives of many members of his family. These *Memorials, Part I., Family and Personal*, in 2 vols., which were published in 1896, *Memorials, Part II., Personal and Political*, also in 2 vols., were edited by Lady Sophia Palmer and published in 1898. In the years 1880–81 Lord Selborne wrote to his son a series of letters on religious subjects, dealing in an elementary way with natural and revealed religion, the inspiration of the Bible, and Biblical criticism. These were published in 1898, under the title of *Letters to His Son on Religion, by Roundell, First Earl of Selborne.*

In person Lord Selborne was of about the average height: his manners when among strangers were somewhat reserved; his style, both in speaking and writing, was fluent, tending to diffuseness; his oratory was marked by uniform good sense and lucidity, both of arrangement and language; and if he never reached the highest level of oratorical excellence, he never descended to what was commonplace or irrelevant. As a judge, whether in the Supreme Court or in the House of Lords, he displayed high qualities: he was patient, courteous, logical, and learned, and his judgments contain many valuable expositions of the principles of law. The fusion of law and equity, the reorganization of the whole judicial system of England, and the association of all the supreme tribunals in one common home were works of no ordinary magnitude or importance, and give a character of unusual importance to his chancellorship.

That Lord Selborne was a truly religious man it is impossible to doubt: his whole life was regulated and inspired by a sense of his duty towards God and his fellowmen, and a long life spent amid the temptations of legal and public life left not the faintest stain on his memory. He was a devout member of the Church of England, to which he looked up with unstinted affection and reverence; and he found in its service and formularies an adequate satisfaction for all his religious feelings. He belonged to the High Church school, which was influenced by the teaching of Newman and Pusey and the Oxford teachers of their day; but he by no means slavishly followed them. With the later High Church movement, usually described as Ritualism, he had less sympathy.

His life was prosperous, for from his first prize at the university till his acquisition of an earldom, he went on a course of almost unbroken success. He had the double dignity of having refused the highest prize in his profession for conscience' sake, and of having accepted that dignity without loss of consistency; in his life he acquired a high reputation and the sincere admiration of his fellowmen, as well as an abundant fortune and ample titular distinctions. His life was also happy, for he had pleasure in his work, he loved and was loved by his wife and children; he had a strong constitution, and retained his bodily and mental powers to the last; his faith in the religion of his youth was unshaken to the end; and he lived throughout his long life with the consciousness of rectitude. (E. F.)

Selenghinsk, Old and New, two towns of East Siberia, in the province of Transbaikalia, on opposite banks of the Selenga. The latter, on the left bank, is a district town, but both are small; formerly important centres of trade with China, they lost their importance with the growth of Kiakhta. A colony of English missionaries is close by. It was here that the Treaty of 1688 was concluded by Russia with the Mongol princes, who swore allegiance to their northern neighbour. The population of the district town in 1897 was 1076.

Selkirk, a royal and parliamentary burgh (Border group) and the county town of Selkirkshire, Scotland, on the river Ettrick, 37 miles south-south-east of Edinburgh by rail. There are fourteen woollen factories; also, engineering and millwright works. Modern erections include a United Free church, a public hall, and a free library. Population (1891), 6397; (1901), 5701.

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[1] In 1867 he founded an association for the improvement of legal education, in the hope of bringing about the establishment or the restoration of "a general school of law in London on a scale worthy of the importance of the law and of the resources of the Inns of Court." This enterprise was not successful. The opposing forces were too strong to permit Lord Selborne to succeed.

Selkirk Mountains. See CANADA.

Selkirkshire, an inland lowland county of Scotland, bounded on the N. by Midlothian, on the N. and W. by Peebles, on the S. by Dumfries, and on the E. by Roxburgh.

Area and Population.—In 1891 Innerleithen and Peebles parishes were placed wholly in Peebles; Lyne and Megget was divided, and Lyne was restricted to Peebles, while Megget was added to the Selkirk parish of Yarrow. Part of Yarrow was given to the Peebles parish of Traquair. Selkirk, Ashkirk, and Galashiels were placed wholly in Selkirk, Roberton was placed wholly in Roxburgh, and part of Melrose was transferred to the Selkirk parish of Galashiels. The area of the county is 172,426 acres, or about 269 square miles. The population was, in 1881, 25,564; in 1891, 27,353; in 1891, on the above area, 27,712; in 1901, 23,371, of whom 10,680 were males and 12,691 females. On the old area, taking land only (164,545 acres, or 257·1 square miles), the number of persons to the square mile in 1901 was 90·8, and the number of acres to the person 7·4. In the registration county the population increased between 1881 and 1891 by 6·6 per cent. Between 1881 and 1891 the excess of births over deaths was 3833, and the increase of the resident population 1781. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimates.
1880	450	163	927	8·6
1890	474	176	757	6·74
1899	365	160	473	5·3

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881-90.	1890.	1891-98.	1899.
Birth-rate . .	37·00	29·78	27·09	23·14	16·21
Death-rate . .	17·47	14·69	16·96	13·98	12·51
Marriage-rate .	6·33	5·45	6·30	5·49	5·47

In 1891 there were 78 Gaelic-speaking persons in the county, and 24 foreigners. Valuation in 1889–90, £63,061; 1899–00, £63,806.

Administration.—The county unites with Peebles to return a member to Parliament, and contains two burghs of the Border parliamentary group, Selkirk and Galashiels. Selkirk (5701), the county town, is the only royal burgh, and Galashiels (13,598) is the only other place above the rank of village. There are six civil parishes, and the number of paupers and dependents in September 1899 was 432. Selkirk forms a sheriffdom with Roxburgh and Berwick, and a resident sheriff-substitute sits at Selkirk and Galashiels.

Education.—Nine school boards manage 17 public schools, which had an average attendance of 3729 in 1898–99, and 5 voluntary schools (2 Roman Catholic and 1 Episcopal) had 533. There are high schools at Galashiels and Selkirk, and 3 other schools in the county earned grants in 1898 for giving higher education. Part of the "residue" grant is spent in supporting short courses of instruction in dairying, and Selkirk Town Council subsidizes popular science classes in the burgh school.

Agriculture.—Oats cover all but a few hundred acres of the corn land. The percentage of cultivated area in 1898 was 17·4. Of the 226 holdings in 1895 the average size was 134 acres. The percentage under 5 acres was 17·70, between 5 and 50 acres 38·50, and over 50 acres 43·80. The number of farms between 50 and 100 acres was 19; between 100 and 300, 42; between 300 and 500, 18; and over 500, 20. The following table gives the principal acreages at intervals of five years from 1885:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	23,820	4656	3013	7598	8,045	14
1890	24,209	4495	2982	7420	9,291	9
1895	30,392	5279	3410	9545	12,065	28
1899	30,054	5239	3296	9116	12,391	...

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1885	567	2748	1043	164,314	495
1890	609	3088	1109	163,724	469
1895	738	3418	1343	181,031	509
1899	714	3223	1323	184,957	373

The area under wood in 1895 was 4942 acres. At the census of 1891, 1084 men and 98 women were returned as being engaged in agriculture.

Industries and Trade.—Galashiels and Selkirk produce a large output of woollen yarn, tweeds and tartans, besides hosiery. Galashiels has also iron foundries, engineering works, and dye-works. There are large market vineries at Clovenfords. In 1891 the industrial population numbered 6004 men and 3600 women, of whom 3434 men and 3048 women were engaged in the manufacture of textiles.

See Sir GEORGE DOUGLAS. *History of the Border Counties.* Edinburgh, 1899.—GEORGE REAVELY. *History of Galashiels.* Galashiels, 1875.—*Proceedings of Society of Antiquaries of Scotland.*—C. ROGER. *Ettrick Forest.* Edinburgh, 1860.—WILLIAM ANGUS. *Ettrick and Yarrow.* Selkirk, 1894.—GEORGE BUIST. "Geology of Selkirkshire" (*Transactions of Highland and Agricultural Society*). Second series, vol. xiii.—W. S. CROCKETT. *In Praise of Tweed.* Selkirk, 1899.—J. RUSSELL. *Reminiscences of Yarrow.* 2nd edition. Selkirk, 1894. (W. WA.)

Sella, Quintino (1827–1884), Italian statesman and financier, was born at Mosso, near Biella, on 7th July 1827. After studying at Turin and Paris, he was appointed to the chair of geometry at Turin University in 1852, and in 1860 was elected deputy. A year later he was selected to be secretary-general of public instruction, and in 1862 received from Rattázzi the portfolio of finance. The Rattazzi cabinet fell before Sella could efficaciously provide for the deficit of £17,500,000 with which he was confronted; but in 1864 he returned to the ministry of finance in the Lamarmora cabinet, and dealt energetically with the deficit of £8,000,000 then existing. Persuading the king to forego £120,000 of his civil list, and his colleagues in the cabinet to relinquish part of their ministerial stipends, he effected savings amounting to £2,400,000, proposed new taxation to the extent of £1,600,000, and induced landowners to pay one year's instalment of the land tax in advance. A vote of the Chamber compelled him to resign before his preparations for financial restoration were complete; but in 1869 he returned once more to the ministry of finance in a cabinet formed by himself, but of which he made over the premiership to Lanza. By means of the grist tax (which he had proposed in 1865, but which the Menabrea cabinet had passed in 1868), and by other fiscal expedients necessitated by the almost desperate condition of the national exchequer, he succeeded, before his fall from power in 1873, in placing Italian finance upon a sound footing, in spite of the fiercest attacks and persistent misrepresentation of his aims. In 1870 his great political influence turned the scale against the proposed alliance with France, and in favour of an immediate occupation of Rome. From 1873 until his premature death on 14th March 1884, he acted as leader of the Right, and was more than once prevented by an ephemeral coalition of personal opponents from returning to power as head of a Moderate Conservative cabinet. A man of the utmost integrity and moral courage, Sella combined with both an intelligence and an ability rare among Italian statesmen. As a scientist he was scarcely less eminent than as a politician. Since his death the amplest homage has been rendered to his merits by those who during his lifetime were most active in attempting to thwart his patriotic activity. (H. W. S.)

Sellar, William Young (1825–1890), Scottish classical scholar, was born at Morvich, Sutherlandshire, 22nd February 1825. Educated at the Edinburgh Academy and afterwards at the University, he passed to Balliol College, Oxford, of which he became a scholar. Graduating first class in classics, he was elected fellow of Oriel, and after holding assistant professorships at Durham and Glasgow, was appointed professor of Greek at St Andrews. After filling that office for six years, he was elected in 1863 to the professorship of humanity at

Edinburgh University, and occupied that chair down to his death at his residence, Kenbank, near Dalry, Galloway, on 12th October 1890. Sellar was one of the most brilliant of modern classical scholars, and was remarkably successful in his endeavours to reproduce the spirit rather than the letter of Roman literature. *The Roman Poets of the Republic* (1863), *The Roman Poets of the Augustan Age* (1877), and *Horace and the Elegiac Poets* (1892), are his most prominent works, and are recognized as standard authorities on the subjects with which they deal. Professor Sellar also contributed to the 9th edition of the *Encyclopædia Britannica* a series of brilliant articles on the Roman poets.

Selma, a city of Alabama, U.S.A., capital of Dallas county. It is situated in 32° 25′ N. and 87° W., on the right bank of the river Alabama, near the centre of the state, at an altitude of 126 feet. The river is navigable to this point, and this with the four railways centring here, the Birmingham, Selma, and New Orleans, the Louisville and Nashville, the Southern and the Western of Alabama, give Selma a large trade. This is principally in cotton, the chief crop of the surrounding country, and in lumber from the great pineries. The city contains railway shops and manufactures and large cotton warehouses. Population (1890), 7622, of which 3914, or more than one-half, were coloured; (1900), 8713, of whom 214 were foreign-born and 4429 negroes.

Selwyn, George Augustus (1809–1878), bishop of New Zealand, was born at Church Row, Hampstead, 5th April 1809, and was the second son of William Selwyn, a distinguished legal writer. He was educated at Eton. Proceeding to Cambridge, he became scholar and afterwards fellow of his college. He was also famous as an athlete, having rowed in the University boat. He took his degree (second in the classical tripos) in 1831. He then returned to Eton as private tutor, was ordained deacon in 1833, and devoted himself with characteristic energy to work in the parish of Windsor. His vigour, determination, and ability soon marked him out for preferment; but when it arrived, it was hardly in a form expected or altogether approved by his friends. In 1841 it was proposed that he should go out as first bishop to New Zealand, which was just beginning to be colonized. The well-known *mot* of Sydney Smith embodied the opinion of London society on the unpromising nature of the career thus offered him. Selwyn, nevertheless, accepted the offer without hesitation. He started at once for his diocese, studying Maori on the voyage out, and threw himself into his work with all his heart. He lived a life of continual strain and hardship. He was days and sometimes nights in the saddle. He swam broad rivers; and having provided himself with a sailing vessel, soon became as much an expert in navigation as the most experienced sailor in the colony. Unfortunately, when by his devoted labours he had gained the confidence of the natives, his ascendancy was rudely shaken by the first Maori war. Selwyn endeavoured to mediate; but the only apparent result for the time was that he incurred the hostility of both parties. He went to the battlefield to minister to the bodily and spiritual needs of the sick and wounded in both camps; but the Maoris were persuaded that he had gone out to fight against them, and years afterwards one of them pointed out a scar on his leg to an Anglican bishop, which he declared had been inflicted by Bishop Selwyn's own hands. Still, the bishop persevered, through evil report and good report, but he was long before he could regain the confidence he had forfeited by his strict adherence to the line of his duty. In 1854 he returned to England for a short period of rest and refreshment; but he spent much of it in pleading the needs of his diocese, and there are those still who remember the scene when, in impassioned tones, and with eagle eye glancing round the crowded church, he advocated the cause of missions in his Ramsden Sermon at St Mary's, Cambridge, and bid those present to "fill up the void" then existing, an appeal which drew Bishop Mackenzie to the mission field, and to a virtual martyrdom by the river Zambezi. Selwyn returned to New Zealand with a band of able associates, and henceforth set himself to divide the single diocese he had hitherto endeavoured to administer into sees of more manageable proportions. By degrees he met with the appreciation his lofty character and high sense of duty deserved. The colonists came to respect his uprightness, and the Maoris learned to regard him as their father. In 1868 Bishop Selwyn paid another visit to England to attend the first General Conference of Bishops of the Anglican Communion. While in England, the bishopric of Lichfield became vacant, and it was offered to him, and unhesitatingly declined. A difficulty, however, having arisen about filling up the see, it was once more offered to him, with the intimation that his appointment, and his only, would put an end to the deadlock which had occurred. He then considered that it was his duty to accept it. In his new sphere of work he displayed the same unselfish activity as before, and in the "Black Country" portion of his diocese he won the hearts of the working classes by his frank and hearty sympathy. He called his clergy and laity together for consultation in the diocesan conference, a part of the working of his colonial see of the value of which he had become convinced by experience. This was at first resisted as an innovation; but its usefulness was proved by the fact that a similar conference is now a feature in the working of every diocese in England and Wales. The health of the bishop soon began to suffer from the change from the freer life in the open air to which he had been accustomed. His splendid vitality slowly declined, and he died 11th April 1878.

The Anglican communion has reason to be grateful to him for the constitution for the Church under his care, which he elaborated in conjunction with Sir George Grey, the bishop and layman working in brotherly accord. This constitution has served as a model for the organization of many other non-established branches of the Anglican Church. (J. J. L*.)

Selwyn, John Richardson (1844–1898), bishop of the Melanesian Islands, the son of George Augustus Selwyn, first bishop of New Zealand and afterwards bishop of Lichfield, was born in New Zealand, 20th May 1844. He was educated at Eton and at Trinity College, Cambridge. He intended at first to follow the profession of the law; but fired by the example of the privations cheerfully endured by his father for the sake of the Church, he ultimately offered himself for holy orders. His ordination to the diaconate took place in 1869, after his father had accepted the bishopric of Lichfield. At first he laboured with energy and tact in his father's English diocese; but the news of the martyrdom of Bishop Patteson in Melanesia led him to volunteer for service in the Australasian Archipelago. After a period of three years, during which the bishopric remained vacant, he was nominated as Bishop Patteson's successor. This was in 1877. For twelve years he threw himself with intense energy into his most arduous work; and then his health entirely broke down, and he returned to England a hopeless cripple, but found a most appropriate sphere in the headship of Selwyn College, Cambridge, an institution founded in memory of his father's remarkable

work in New Zealand. He was appointed in 1893, and until his death, 12th February 1898, he employed such strength as remained to him in inspiring the undergraduates committed to his care with the spirit of unselfish heroism which had characterized his life. (J. J. L*.)

Semaphore, a town, South Australia, in the county of Adelaide, 9½ miles by rail from the town of Adelaide. It is one of the chief watering-places of the state, with a pier 1800 feet long. Its population is about 8000.

Semendria (Servian, *Smederevo*), an important commercial town in the kingdom of Servia, on the Danube, between Belgrade and the Danubian Cataracts. It is believed to stand on the site of the Roman settlement *Mons aureus*, and there is a tradition that its famous vineyards—supplying Budapest and Vienna with some of the finest table grapes—were planted by the Roman Emperor Probus in the 3rd century of the Christian era. At the eastern end of the town, close to the river, there is a picturesque triangular castle with 24 square towers, built by the Servian Prince Gyuragy Brankovich in 1430, on the model of the Constantinople walls of that time. Semendria was the residence of that Servian ruler and the capital of Servia from 1430 to 1459. It is the seat of the district prefecture and a tribunal, and has a garrison of regular troops. Besides the special export of grapes and white wine, a great part of the Servian export of pigs, and almost all the export of cereals, passes through Semendria. Since 1886 the town has been connected with the Belgrade-Nish Railway by a branch line. Population (1900), 6912.

Semenovka, or SEMIONOVKA, a town of Russia, in the government of Chernigov, 14 miles by rail from Gomel. Its industries comprise manufactures of leather, sheepskins, boots, pottery, and oil, and it is a centre for trade in bristles, and for pedlars; it also has several fairs of local importance. Population (1897), 15,125.

Semipalatinsk, a province of Russian Central Asia belonging to the General-Governorship of the Steppes, bounded on the N. and N.E. by Tomsk, on the S.E. and E. by the Chinese province of Chuguchak, on the S. by the Russian provinces Syr-Daria and Semiryechensk, and on the W. by Akmolinsk. Its area is 184,631 square miles, and in 1897 its domiciled population was 685,197 (688,639 according to other reports), of whom 320,358 were women, and 55,093 lived in towns. Only 6 per cent. of the population was settled, the remainder, chiefly Kirghiz, being nomads. 555,259 were Mussulmans and 65,718 belonged to the Russian Orthodox Church. The province is divided into 5 districts, the chief towns of which are: Semipalatinsk (26,353), Pavlodar (7730), Kokbekty (2908), Karkaralinsk (4455), and Ust Kamenogorsk (8958). The standard of education is low; in 1895 there were only 100 primary schools, attended by 3115 boys and 675 girls, and two gymnasia, one for boys (57), and one for girls (182). The Kirghiz have their own schools, which they are very eager to found, and for which they collect their own funds. Agriculture is the chief occupation of the Russians and of part of the Kirghiz. It is impossible to carry it on without irrigation; but it is nevertheless widely spread, and the average yield in the years 1895 to 1899 was: rye 72,800 cwt., wheat 1,237,800 cwt., oats 408,300 cwt., barley 41,400 cwt., millet 159,500 cwt., and potatoes about 100,000 cwt. Flax and hemp are also grown, and melons are cultivated in fields; tobacco is widely grown. Cattle-breeding is the chief pursuit of the Kirghiz, and there were in 1895, 549,840 horses, 291,400 horned cattle, 1,700,000 sheep, and 61,600 camels. Bee culture is widely spread, especially among the Cossacks, and more than 15,000 beehives were registered in 1895. Fishing, which is carried on on Lakes Zaisan, Balkhash, and others, as also on the Black Irtysh, is of considerable importance. Gold is extracted, to the amount of 464 kilogrammes per annum, by nearly 4500 workers; also silver (896 kilogrammes), copper (850 cwt.), salt (42,000 tons) from the salt lakes, and coal (1500 tons in 1897), which has only begun to be extracted. There are two iron-works, but industry remains in its infancy, and the only other industrial establishments of any size are a large steam flour-mill and a distillery; the annual aggregate return of all factories is only £33,000. A considerable amount of trade is carried on, however, within the province, in which twenty fairs are held every year. The trade with China is chiefly in cattle, hides, wool, and felt, imported; and cottons and other manufactured goods, exported.

Semipalatinsk, the capital of the above province, on the right bank of the Irtysh, and on the highway from Central Asia to Omsk, 481 miles south-east of that city. It carries on a considerable trade, especially with the Kirghiz, and has one flour-mill, one distillery, and several tanneries. It has also a library and museum, two gymnasia, for boys and girls, and schools for the Kirghiz. Steamers ply on the Irtysh to Omsk and Lake Zaisan. Population (1881), 17,820; (1897), 26,353.

Semiryechensk, a province of Russian Turkestan, bounded on the N. by Semipalatinsk, on the E. and S. by the Chinese provinces of Chuguchak, Kulja, Aksu, and Kashgar, and on the W. by the Russian provinces of Fergana, Syr-Daria, and Akmolinsk, with an area of 152,280 square miles. Its climate is thoroughly continental. In the Balkhash Steppes the winter is very cold; the lake freezes every year, and the thermometer falls to 13° F. In the Alakul Steppes the winds blow away the snow. The passage from winter to spring is very rapid, and the prairies are rapidly covered with vegetation, which, however, is soon dried up by the sun. The average temperatures are: at Vyernyi (2430 feet high), for the year 46° F., for January 17°, for July 74°; at Prjevalsk (altitude 5800 feet), for the year 44°, for January 23°, for July 63°; still higher in the mountains, at Naryn (altitude 6640 feet) the average temperatures are only, for the year 37°, for January 1°, for July 64°. The yearly rainfall at these three places is 21·6, 16·0, and 11·8 inches respectively. The population, which was estimated at 671,880 in 1891, in 1897 was found to be 990,107 (domiciled only), of whom 458,744 were women, and 59,659 lived in towns. Kirghiz formed 76 per cent. of the population, Taranchis 7 per cent., Russians 14 per cent., and Dungans most of the remainder. Of the Russians, 26,500 were Cossacks, about 15,000 were numbered in the military forces serving in the province, and 53,110 were peasants and artisans in towns. The province is divided into 6 districts, the chief towns of which are: Vyernyi, capital of the province (22,982), Jarkent (16,372), Kopal (2842), Pishpek (6622), Prjevalsk (7987), which has superseded Tokmak, and Sergiopol (1044). The standard of education is low; in 1899 there were only 82 primary schools, attended by 8817 boys and 2473 girls. The chief occupation of the Russians, the Taranchis, and the Dungans, and partly also of the Kirghiz, is agriculture. In an average year the crops yield about 137,500 cwt. of wheat, 47,500 cwt. of barley, 103,750 cwt. of oats, 61,250 cwt. of millet, 3075 cwt. of rice, and 5250 cwt. of potatoes—a supply which more than satisfies the needs of the population. A variety of oil-bearing plants and

green fodder, as also hemp, flax, poppies, &c., are grown. Cattle-breeding is very extensively carried on by the Kirghiz, there being in 1899, 755,000 horses, 425,000 horned cattle, 4,274,000 sheep, 100,000 camels, 282,000 goats, and 15,000 pigs. Orchards and fruit gardens are well developed; the Crown maintains two model gardens. Bee culture is also widely spread, nearly 6700 cwt. of honey being obtained every year. Hunting in the mountains still retains its importance. The factories consist of a few flour-mills, distilleries, tanneries, and tobacco works; but a great variety of domestic trades, including carpet-weaving and the making of felt goods, saddlery, and iron goods, are carried on, both among the settled inhabitants and the nomad Kirghiz. Exports to China are valued at about 2,600,000 roubles annually, imports at a little over 1,000,000 roubles.

Semmelweiss, Ignatius Philippus (1818–1865), Hungarian physician, was born at Buda 17th July 1818, and was educated at the universities of Pest and Vienna. At first he intended to study law, but soon abandoned it for medicine; and such was his promise that, even as an undergraduate, he attracted the attention of men like Skoda and Rokitansky. He graduated M.D. at Vienna 4th April 1844, and in the following June was appointed assistant professor in the maternity department, under Professor Klein. In Klein's time the deaths in this department became portentous, the ratio being rarely under 5·03 and sometimes exceeding 7·45 per cent. Between October 1841 and May 1843, of 5139 parturient women 829 died; giving the terrible death-rate of 16 per cent., not counting those of patients transferred to other wards. It was observed that this rate of mortality prevailed in the students' clinic; in the midwives' clinic it ruled much lower. Mothers, finding themselves in that dreaded quarter, would fall on their knees and pray to be allowed to return to their homes. Profoundly moved by pity and sorrow, Semmelweiss found no satisfactory explanations in such causes as overcrowding, fear, mysterious atmospheric influences, or even contaminated wards; yet that the cause lay in some local conditions he felt certain. The patients would die in rows, others escaping; and women delivered before arrival, or prematurely, would escape. At last, he tells us, the death of a colleague from a dissection wound "unveiled to my mind an identity" with the fatal puerperal cases. The students often came to the lying-in wards from the dissecting-room, their hands cleansed with soap and water only. In May 1847 Semmelweiss prescribed ablutions with chlorinated lime water: in that month the mortality stood at 12·24 per cent.; before the end of the year it had fallen to 3·04, and in the second year to 1·27; thus even surpassing the results in the midwives' clinic. Skoda and other eminent physicians were convinced by these results (*Zeitschrift d. k. k. Gesellschaft der Aerzte in Wien*, J. vi. B. i. p. 107). Klein, however, apparently blinded by jealousy and vanity, supported by other reactionary teachers, and aided by the disasters which then befell the Hungarian nation, drove Semmelweiss from Vienna, and silenced him. Fortunately, at Pest Semmelweiss was appointed obstetric physician in the maternity department, then as terribly afflicted as Klein's clinic had been; and during his six years' tenure of office he succeeded, by antiseptic methods, in reducing the mortality to 0·85 per cent. Semmelweiss was slow and reluctant as an author, or no doubt his opinions would have obtained an earlier vogue; moreover, he was not only tender-hearted but also irascible, impatient, and tactless. Thus it cannot be said that the stupidity or malignity of his opponents was wholly to blame for the tragical issue of the conflict which brought this man of genius within the gates of an asylum 20th July 1865. Strange to say, he brought with him into this retreat a dissection wound of the right hand; and on the 17th of the following August he died of the very disease for the relief of which he had sacrificed health, fortune, and even life itself. For the relations in the order of discovery of Semmelweiss to Lister the reader is referred to the article on LISTER (vol. xxx.). A brief biography of Semmelweiss by Dr Duka was published at Hertford (Austin and Sons) in 1892. (T. C. A.)

Senaar. See SUDAN: *Anglo-Egyptian*.

Seneca Falls, a village of Seneca county, New York, U.S.A. It is situated in 42° 55′ N. and 76° 45′ W., on the river Seneca, and the New York Central and Hudson River and the Lehigh Valley railways, at an altitude of 463 feet. The falls in the river, from which the village derives its name, are 50 feet in height and furnish ample water-power, which has been put to use in the manufacture of woollen goods, machinery, and other articles. Population (1890), 6116; (1900), 6519, of whom 801 were foreign-born.

Senegal, a river of West Africa, entering the Atlantic in 16° N. after a course of about 1000 miles. Explorations have improved our knowledge of the source-region of the river, showing that the Bafing, its chief upper branch, rises in 10° 28′ N., 12° 5′ W., and is joined in about 11° 10′ N. by the Tene, formerly supposed to be the headstream of the Faleme. A little south of 12° the Bafing is a large stream 250 yards wide, and is here separated from the sources of the Faleme by a line of hills 2600 feet high, which send to the latter river four important streams rising in about 12° N. The rise of the Lower Senegal is due to the rains in this source-region, the flood water passing down the Faleme more quickly than down the Bafing owing to its shorter course. From July to October the level of the Senegal shows a series of fluctuations, with, however, a general increase till the end of August or beginning of September, when the maximum occurs. Boats drawing from 1 foot to 2 feet 6 inches can ascend to Kayes from the beginning of June to the middle of November; steamers drawing 4 feet 3 inches, from July to October inclusive; and ocean steamers, lightened so as to draw 11–13 feet, during August and September.

Senegal, a French colony in West Africa, situated between the Gambia on the S., the French Sudan on the E., and the Sahara on the N. It covers about 80,000 square miles and presents no prominent orographic feature. The coast is low and bordered with sandhills. The only important river is the Senegal, which is formed by the confluence at Bafulabe of the Bafing and the Bakhu, the former rising in Futa Jallon, belonging to French Guinea, and the latter in French Sudan. It passes, within the government of Senegal, the towns of Bakel, Matam, Saldé, Podor, and St Louis; near Bakel it receives the Faleme, which flows from south to north.

Senegal is placed under the immediate authority of the governor-general of West Africa, and comprises: (1) four communes with full communal powers (St Louis, Dakar, Goree, and Rufisque), containing a population of about 39,000; (2) nine circles, or territories administered directly, with a population of 61,000; (3) twenty-two countries on the middle and lower river, under the immediate protectorate of France, with about a million inhabitants; (4) autonomous countries north of the Senegal, under the political protectorate (the Moorish tribes Trarza, Brakna, and Duaish), with a population of 80,000. To these districts have to be added the western portion of the Sudan, now in

administrative connexion with Senegal, which has an area of about 120,000 square miles and a population exceeding 2,000,000. Senegal produces, above all, oil-seeds, castor, earth-nut, sesame, and cocoa-nut. The earth-nut, since 1888, has yielded about 30,000 tons a year. Millet, maize, and rice occupy about two-thirds of the cultivated land. On the Lower Senegal there are a model farm and a nursery. Worthy of mention among the products of the country are acacia gum, which the Moors gather in the northern region; the kola-nut; and especially caoutchouc, which is collected in increasing quantities (350 tons in 1898) in the outlying district of Casamance, which projects between Portuguese Guinea and British Gambia. The herds tend to increase: in 1898 there were about 90,000 cattle, 50,000 sheep, 40,000 goats, 3000 camels, besides asses and horses. Gold, iron, quicksilver, and copper are found. Industry is not organized, but the natives carry on weaving, pottery, brickmaking, and the manufacture of trinkets. The total trade, which in 1882 amounted to the value of £1,920,000 sterling, and in 1889 to £2,400,000, had fallen in 1898 to £1,840,000, but by the year 1900 had increased to £3,182,000. The imports from France consisted of tissues and clothing (£120,000), rice (£76,000), wines (£74,000), implements, sugar, hides, and toys; the exports to France were chiefly earth-nuts (£340,000), gums (£160,000), caoutchouc, and feathers. The vessels entered and cleared, with cargo only, at Dakar, Rufisque, and Goree, exceed 100,000 tons annually. Dakar is fortified and classed among the supports of the French navy. Goree is also fortified. Communication along the coast from Dakar to St Louis (160 miles) is by a railway constructed between 1882 and 1885. Inland, there is a river service from St Louis to Podor (3 days), extended in the rainy season as far as Kayar in the Sudan (6 days). Dakar is in regular communication with Marseilles (10 days) and Bordeaux (8 days). The chief towns in French Senegal are: St Louis, the capital, with 20,173 inhabitants, Bakel (3000), Dakar (1200), Goree (2000), and Rufisque (8000).

Senekal. See Orange River Colony.

Senendij. See Kurdistan.

Senussi.—Mohammad El-Mahdi (born in the Cyrenaica 1847, died in Kanem near Lake Chad 1902), son of Es-Seyyid Mohammad Es-Senussi, was a pious Moslem sheikh of North Africa, whose career has been rendered especially remarkable owing to the exaggerated importance attached to his spiritual and secular influence by certain French writers of the past generation. At one time it used to be seriously stated that he flourished as a veiled and awful Moslem pontiff away in the craggy fortress of Siwa, in the oasis of Jupiter Ammon; that he was at the head of a large army, and possessed arsenals filled with unlimited supplies of modern guns and ammunition; that his emissaries, with their secret passwords of the "Rose," were intriguing throughout Turkey as well as in India; and that the day might come when, declaring himself the true Mahdi, or forerunner guided by Allah, he might raise all North Africa against Christianity. These legends of phantom armies, arsenals, and emissaries have come to nought, and there is no proof of gigantic combinations of Islam under his leadership against Great Britain or France. His father, Seyyid Mohammad, of Oran, escaping from the French during the war in Algeria, went to Mecca, and eventually settled in the province of Benghazi, where he built his white hermitage, the Záwia Baidá. Here, in 1847, a son was born, whom he called El-Mahdi (*i.e.*, "He who is led by Allah"), a name not uncommon among the Arabs of North Africa, held both by individuals and families, and meaning nothing more than many names from the Old Testament which are bestowed on Christian children. In 1853 Seyyid removed to Jaghbub (a small oasis some 30 miles west of the Egyptian town of Siwa), where he died in 1857, leaving the young Mahdi to the care of his friends, Amran, Reefi, and others. The peculiarity of the position lay in this: throughout Islam, in every town may be found a Shereef or noble, a Seyyid or lord, claiming descent from the Prophet and recognized as a local leader of society. Senussi El-Mahdi in the desert had no followers; greater lords than he lived in Algeria, and even in Benghazi itself he was of small account. His spiritual influence was, therefore, confined to the camel-men of the caravans across the Sahara, who slowly spread his reputation for quietism and holiness along the string of oases, Ojila-Jalo, Kufra, Borku, into Wadai and Kanem, and continued his work as a reviver of Islam in the central Sudan states. For more than forty years he lived in seclusion at Jaghbub, loyal to the sultan and keeping free from intrigues; but in 1889 he was visited by the pasha of Benghazi at the head of some troops, an incident which showed Senussi that he was no longer safe from intrusion. In 1894 he abandoned North Africa and removed to Borku, and thence to Wadai, where he was welcomed with veneration. The great fact which stands to the credit of Senussi is connected with Wadai, when, in 1888, he urged its sultan to oppose the march westwards of the Mahdi's followers from Khartum. He himself scornfully rejected the Mahdi's overtures, showing the same nobility and sound statesmanship as his fellow shereefs, Abu Fatma and Mirghani, in the eastern Sudan. Whatever was seriously known of Senussi was to his advantage; and just as Wahhabi-ism implies aggressive fanaticism, so does Senussi's name suggest a policy of peace, quietism, and loyalty to constituted authority. Thus, if during the last years of his life he may have enjoyed any slight influence over the wild negro races beyond the Sahara, that influence was for good, in the form of piety and wise counsel. In Egypt he had no followers, nor was there ever a question of his intriguing against the British occupation. In like manner, it is important to understand that the so-called sect of Senussiyeh, if genuine disciples of Senussi, can in no way be hostile to any civilizing mission of trade and prosperity in Nigeria. Senussi was the victim of much slander during his lifetime; and it may be discovered later, when falsehood and exaggeration shall have ceased, that he really tried to live up to his birth-name of El-Mahdi, the servant of Allah, by leaving the savage Beduin and Sudanese, among whom his lot was thrown, a little better for his presence among them. (D. A. C.)

Seoni, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is 2043 feet above the sea, half-way on the road between Nagpur and Jubbulpore. Population (1891), 11,976. The district of Seoni is part of the Satpura tableland, containing the headwaters of the Wainganga. It is still largely covered with forest, and 42 per cent. of the inhabitants belong to aboriginal tribes. Area, 3198 square miles. Population (1891), 370,767; (1901), 327,217, showing a decrease of 12 per cent., due to the effects of famine. The density in 1901 was 102 persons to the square mile. The land revenue is Rs.1,64,000, the incidence of assessment being less than two annas per acre; cultivated area (1897–98), 574,339 acres, of which 19,268 were irrigated from tanks; number of police, 285; boys at school (1896–97), 3489, being 12·5 per cent. of the male population of school-going age; death-rate (1897), 65·92 per thousand. The principal crops are wheat, rice, millet, pulse, and oil-seeds.

There is another town called SEONI in the Central Provinces, a railway station in Hoshangabad district, situated in 22° 28′ N. and 77° 29′ N. Population (1891), 6779.

Sepsiszentgyörgy, a corporate town of south-eastern Hungary, chief place of the county of Háromszék, 20 miles from Brassó, with 5753 inhabitants in 1891, and 7131 in 1901. It has a normal school, a Calvinist upper gymnasium, a female industrial school, a "Székely" national museum, an orphanage and asylum, a textile factory, &c. In its vicinity are many medicinal baths, the most important being that of Elöpatak.

Seraing, a town of Belgium, in the province, and 5 miles south-west of the city, of Liége by rail. It has acquired a European reputation on account of its vast iron-works (Societé Cockerill) and manufactories, in which more than 10,000 hands are employed. Population (1890), 33,495; (1900), 37,845.

Serajevo, or BOSNIA SERAÏ, the capital of the province of Bosnia, in Austria-Hungary, and the seat of a Roman Catholic bishopric, situated in a narrow valley—closed on the east by a semicircle of rugged hills—on the river Miliatchka, and on the Bosnia Railway, 167 miles south of Bosnisch-Brod and 111 north-north-east of Metkovic. A great part of the town has been rebuilt in the European fashion, and extensive drainage works have been carried out. A telephone service was introduced in 1899. The chief public buildings are the Husref Bey mosque, dating from the 16th century; the Catholic cathedral (1889); the *konak*, or official residence of the governor; the town-hall (1895); the *bezesten*, or market-hall; the museum, containing specially fine antiquarian and natural history collections; the castle, on a rocky eminence commanding a magnificent view of the town and neighbourhood; the Roman Catholic seminary; the school-masters' college; the hospital; and the "association" buildings (1898), with a large hall for public entertainments. The town is famous for its native industries in metals. There are also large potteries, and silk-weaving is carried on. A brewery produces about 900,000 gallons annually. The Government tobacco factory has a large output, and employs over 2000 workpeople. At the mineral baths of Ilidže, near the town, a hydropathic establishment was opened in 1899. Population (1885), 26,268; (1895), 37,713.

Serampur, a town of British India, in the Hooghly district of Bengal, on the right bank of the river Hooghly, opposite Barrackpur; station on the East Indian Railway, 12 miles from Howrah. Population (1881), 25,559; (1891), 35,952. Formerly a Danish settlement, it was sold to the British in 1845. It was the home of the Baptist mission founded by Carey. A jute mill, with 354 looms and 7260 spindles, employs 2700 hands. Paper is manufactured. There is a public library. The famous Baptist mission press has been transferred to Calcutta, but a training college is still maintained by the mission.

Serapion. See SACRAMENTARY OF SERAPION.

Serdobsk, a district town of Russia, in the government, and 129 miles north-west of the town, of Saratoff, on a branch of the railway from Ryazañ to the Urals. It has trade in grain and flour, of both of which over 32,000 tons are exported every year. Population (1897), 12,721.

Serena, a town of Chile, capital of the province of Coquimbo and of the department of Serena, 9 miles east-north-east of Coquimbo, on the Pacific. Population (estimated), 17,230. It has a court of appeal, with jurisdiction in the provinces of Atacama and Coquimbo, and is the residence of a bishop. It has a large hospital, an orphan asylum, lazaretto, and poorhouse.

Séres, SERROS, or SIROS, chief town of a sanjak in the vilayet of Macedonia, European Turkey, situated on Lake Talhino, an expansion of the Strouma, in one of the most fertile districts of the empire, 43 miles north-east of Salonica. It consists of the old town, *Varoch*, situated at the foot and on the slope of the hill crowned by the old castle, and of the new town built in the European fashion on the plain, and forming the commercial centre. The town is the main entrepôt of the Turkish cotton trade, and has also manufactures of cloth and carpets. There is a large trade in rice and cereals, and the other exports include tobacco and hides. Population, 30,000, of whom about half are Bulgarians (one-third of them being Mussulmans), nearly one-fourth Greeks, about one-seventh Turks, and the remainder Jews.

Serghinsk, Upper AND **Lower,** two towns of East Russia, in the government of Perm, 43 miles west-south-west of Ekaterinburg. They are noted for their important iron-works, which deal with the production of as many as eighteen mines. UPPER SERGHINSK, which had a population of 8000 in 1897, yields annually over 8050 tons of pig iron and 12,100 tons of steel. LOWER SERGHINSK, with 14,000 inhabitants, yields about 7250 tons of pig iron and 14,500 tons of steel. The latter is well built, has a monument to Alexander II., and is well provided with schools. Mineral waters (sulphurous) are found close by.

Sergipe, a state of Brazil, for the most part situated between 9° 5′ and 11° 28′ S. and 36° 17′ and 38° 7′ W. Area, 15,000 square miles. Population in 1872, 176,243, and in 1890, 461,307; but in 1900 it was estimated at less than 400,000, of whom three-fourths were negroes and half-castes. Europeans numbered only 500 to 600. The capital, Aracajú, has 20,000 inhabitants (1900). Amongst other towns are Estancia, Itabaiana, Lagarto, Larangeiras, Maroim, S. Christovao, Capella. Sugar, cotton, manioc, maize, tobacco, beans, and indiarubber are the crops chiefly grown. The exports (two-thirds sugar) were valued at £454,000 in 1900, and the imports (by sea) at £353,000. There is a railway extending north from Aracajú as far as Capella, and west as far as Simão Diaz.

Serpa Pinto, Alexandre Alberto de la Rocha (1846-——), Portuguese explorer, was born at the castle of Polchras, on the Douro, 10th April 1846. After accompanying his father to America, he was sent in 1858 to the military school at Lisbon. Entering the army in 1864, he served in the colony of Mozambique, and being promoted major was given the command of an important expedition into South Africa. Starting from Benguela on the 12th November 1877, he explored the basins of the Kwando and Zambesi, and followed the latter river to Victoria Falls, and then went southwards to Shoshong, Pretoria, and Durban, 1879. He was thus the fourth explorer who traversed the African continent from west to east, and was rewarded in 1881 with the large gold medal of the Geographical Society of Paris. The account of his travels appeared in English under the title *How I Crossed Africa*, 2 vols., London, 1881. In 1884 he attempted, with less success, the exploration of the regions between the Mozambique and Lake Nyasa. Appointed governor of Mozambique in 1889, he endeavoured to bring the Matabele territory under the jurisdiction of Portugal, but his Government, finding that it could not support his pretensions against the veto of Great Britain, yielded to the ultimatum of 12th January 1890, and recalled him.

Serrano y Dominguez, Francisco, DUKE DE LA TORRE AND COUNT OF SAN ANTONIO (1810–1885), Spanish marshal and statesman, was born in the island of Leon at Cadiz 17th December 1810. His father was a general officer and a Liberal. Serrano began his studies at Vergara in the Basque provinces, became a cadet in 1822, cornet in 1833 in the lancers of Sagunto, passed into the carabineers in 1829, and when the Carlist agitation began in 1833 he exchanged into the cuirassiers. He formed part of the escort which accompanied Don Carlos, the first pretender and brother of Ferdinand VII., to the frontier of Portugal. As aide-de-camp of Espoz y Mina, then under the orders of Generals Cordoba and Espartero, in the armies of Queen Isabella, Serrano took such an active part in the Carlist war from 1834 to 1839 that he rose from the rank of captain to that of brigadier-general. His services obtained for him the Cross of San Fernando and many medals. In 1839 he was elected a member of Cortes for the first time by Malaga, and in 1840 he was made a general of division and commander of the district of Valencia, which he relinquished to take his seat in congress. From that day Serrano became one of the chief military politicians of Spain. In 1841 he helped Espartero to overthrow the regency of Queen Christina; in 1843 at Barcelona he made a *pronunciamiento* against Espartero; he became minister of war in the Lopez Cabinet, which convoked the Cortes that declared Queen Isabella of age at fifteen, served in the same capacity in an Olozaga cabinet, sulked as long as the Moderados were in office, was made a senator in 1845, captain-general of Granada in 1848, and from 1848 to 1853 lived quite apart from politics on his Andalusian estates or travelling abroad. He assisted Marshal O'Donnell in the military movements of 1854 and 1856, and was his staunch follower for twelve years. O'Donnell made him marshal in 1856 and captain-general of Cuba from 1859 to 1862; and Serrano not only governed that island with success, and did good service in the war in Santo Domingo, but he was the first viceroy who advocated political and financial reforms in the colony. On his return to Spain, he was made duke de la Torre, grandee of the first-class, and minister of foreign affairs by O'Donnell. Serrano gallantly exposed his life to help O'Donnell quell the formidable insurrection of 22nd June 1866 at Madrid, and was rewarded with the Golden Fleece. At the death of O'Donnell, he became the chief of the Union Liberal, and as president of the senate he assisted Rios Rosas to draw up a petition to Queen Isabella against her Moderado ministers, for which both were exiled. Nothing daunted, Serrano began to conspire with the duke of Montpensier, Prim, and Sagasta; and on 7th July 1868 Gonzalez Bravo had Serrano and other generals arrested and taken to the Canary Isles. There Serrano remained until Admiral Topete sent a steamer to bring him to Cadiz on 18th September of the same year. On landing he signed the manifesto of the revolution with Prim, Topete, Sagasta, Martos, and others, and accepted the command of the revolutionary army, with which he routed the troops of Queen Isabella under the orders of the marquis of Novaliches at the bridge of Alcolea. The queen fled to France, and Serrano, having entered Madrid, formed a Provisional Government, convoked the Cortes Constituyentes in February 1869, and was appointed successively president of the executive and regent. He acted very impartially as a ruler, respecting the liberty of action of the Cortes and cabinets, and bowing to their selection of Amadeus of Savoy, though he would have preferred Montpensier. As soon as Amadeus reached Madrid, after the death of Prim, Serrano consented to form a coalition Cabinet, but it kept together only a few months. Serrano resigned, and took the command of the Italian king's army against the Carlists in North Spain. He tried to form one more cabinet under King Amadeus, but again resigned when that monarch declined to give his ministers dictatorial powers and sent for Ruiz Zorilla, whose mistakes led to the abdication of Amadeus on 11th February 1873. Serrano would have nothing to do with the federal republic, and even conspired with other generals and politicians to overthrow it on 23rd April 1873; but having failed, he had to go to France until General Pavia, on the eve of his *coup d'état* of 3rd January 1874, sent for him to take the head of affairs. Serrano assumed once more the title of president of the executive; tried first a coalition Cabinet, in which Martos and Sagasta soon quarrelled, then formed a Cabinet presided over by Sagasta, which, however, proved unable to cope with the military and political agitation that brought about the restoration of the Bourbons by another *pronunciamiento* at the end of December 1874. During the eleven months he remained in office Serrano devoted his attention chiefly to the reorganization of finance, the renewal of relations with American and European powers, and the suppression of revolt. After the Restoration Serrano spent some time in France, returned to Madrid in 1876, attended palace receptions, took his seat as a marshal in the senate, coquetted a little with Sagasta in 1881, and finally gave his open support to the formation of a dynastic Left with a democratic programme defended by his own nephew, General Lopez Dominguez. He died in Madrid 26th November 1885, twenty-four hours after Alphonso XII. (A. E. H.)

Servia, an independent kingdom in the Balkan Peninsula, lying between Austria-Hungary on the N. (from which empire it is divided by the rivers Sava and Danube), the Turkish province Kossovo and a part of Macedonia on the S., Bosnia on the W., and Bulgaria on the E. Previous to the Treaty of Berlin (1878) it was an autonomous principality, vassal to the sultan of Turkey; after that treaty it became an independent principality, and was proclaimed a kingdom in 1883. According to the measurements and computation of the Servian General Staff, the area of Servia is 4,858,940 hectares (or 18,782 square miles). Of this area, 3,418,768 hectares, or 70·36 per cent. of the total area, are considered as productive, and 1,440,172, or 29·64 per cent., as unproductive. In 1897 there were 1,805,935 hectares under actual cultivation. The forests (mostly oak and beech) occupied in that year 481,214 hectares.

Population.—Official censuses were taken in the years 1884, 1890, 1895, and 1900, giving the following results:—

	Male.	Female.	Total.
1884	972,973	928,763	1,901,736
1890	1,109,885	1,052,076	2,161,961
1895	1,186,594	1,125,890	2,312,484
1900	1,282,625	1,211,145	2,493,770

At the date last quoted the rural population numbered 2,035,364, or 81·6 per cent. of the total, and the urban population 458,406, or 18·4 per cent. of the whole. The population increased from the beginning of 1885 to the end of 1900 by 592,034 inhabitants, which gives an annual increase of 1·83 per cent.

The number of foreigners, or inhabitants belonging to other nationalities, was found to be 206,017 in 1890 and 229,002 in 1895. Their number therefore increased by 11·6 per cent. in the period 1890–95. In the last-named year Jews numbered 5048, Germans 6451, Gypsies 46,212, Rumanians (Wallachians) 160,187. There were then only 14 Englishmen settled in Servia. According to religion there were in 1895: Orthodox (Eastern Church) 2,281,018, Mahommedans 14,414, Roman Catholics 10,410, Jews 5102, Protestants 1002. For the period of ten years from 1881 to 1890 (inclusive), for every 1000 inhabitants there were born annually, on an average, 44·10 boys and 43·93 girls. For the same period the number of deaths among every 1000 inhabitants was annually, on an average, 25·15 males and 24·89 females, which figures give

an average of 50 per 1000 inhabitants. From the year 1885 to 1891 the average surplus of the births over the deaths was 18·15 per 1000 inhabitants. During the five years 1893–98 the annual average surplus of births over deaths amounted to 16 per 1000. In the year 1900 the birth-rate was 42 per 1000, the death-rate 23·3 per 1000, and the marriage-rate 12·5 per 1000, of the population. Although Servia is one of the most thinly populated countries in Europe, having only 133 inhabitants to the square mile, the density of its population is greater than in the other Balkan States.

Education.—Education is free, the teachers and professors being paid either by the municipalities or the State. Government gives numerous bursaries to poor but gifted students in the middle and higher schools, and also to young men who have distinguished themselves in the higher schools and wish to complete their education by study at foreign universities. Attendance at elementary schools is compulsory for boys and girls from their seventh to their twelfth year, but in the villages, with their scattered houses and sparse population, it has been found impossible to insist on the strict execution of the law. In 1899 there were over 1100 elementary schools in Servia, giving one school to every 2270 inhabitants. Girls and boys in the villages go to the same school, but in towns they have separate schools. About 85,000 children are enrolled at the commencement of every school year. Besides the elementary schools, there are some 30 middle schools, mostly gymnasia with more or less classical instruction. There are also several special schools: 1 theological, 2 training schools for teachers, 2 commercial, 1 agricultural, 1 for viniculture, and 2 for weavers. There is an excellent military academy in Belgrade. The highest scientific instruction is given in the so-called *Velika Shkola* ("the Great School") at Belgrade, which is practically a university with 463 students in 1899, but only three faculties: law, philosophy, technical science. In 1899 a Royal Commission was appointed to propose the ways and indicate the means by which the Belgrade Velika Shkola might be transformed into a regular university on the German model. At the census of 1895 it was found that there were 268,759 males and 52,463 females who could read and write. Deducting the number of children up to the sixth year from the rest of the population, only 280·5 men and 58·3 women per 1000 inhabitants could read and write. It has been found that the present system of education furnishes only candidates for employment in the State and municipal services, and barristers and solicitors. As the opportunity for employment in these services is limited, every year a considerable number of young men are without occupation; therefore the Government, since 1897, has been trying to render the system of education less classical and more practical.

Church.—The Servian Church belongs to the group of the Eastern Orthodox (Greek) Churches, but is otherwise independent and self-governing. The highest Church authority is the Bishops' Council or Synod, presided over by the Metropolitan of Servia. There are altogether five dioceses or bishoprics: Belgrade, Schabatz, Nish, Zicha, and Timok. The Archbishop of Belgrade is the Metropolitan of Servia. There are 48 monasteries in Servia, of which Studenitza, built in the 13th, and Manassiya, built in the 15th century, are by far the most interesting.

Finance.—Up to the proclamation of independence, in virtue of the Berlin Treaty (1878), Servian finances were in a somewhat primitive, but, on the whole, healthy condition. The principal revenues were derived from the customs, excise, and a sort of poll tax. The Government required the town and village communities to pay into the State Treasury 30 dinars per head of the able-bodied citizens living in the community, and the municipal board made repartition of the total amount, due to the Government, from its citizens according to their estimated wealth or earnings. That system yielded without the slightest difficulty about £750,000 annually. The State revenue from all sources was in 1879 19,780,929 dinars (£791,235), while the expenditure did not exceed 20,206,410 dinars (£808,256). But among the conditions on which the Congress of Berlin granted independence and accession of territory to Servia, were that she should construct her part of the international railway to Constantinople and to Salonica, and pay the Turkish landowners an indemnity for the estates which had been taken from them and divided among their old tenants. This and the necessity of indemnifying the people from whom, during the wars with Turkey (1876 and 1878), requisitions had been taken and money borrowed, forced the Government to enter the European financial markets. Up to that time (1881) Servia had practically no public foreign debt, although it owed Russia about 6 million dinars lent privately for war preparations, and to its own people about 8 million dinars taken by a forced internal loan for war purposes. The first public loans were made in 1881 by French banks at 71¾ for 5 per cent. bonds, and the expenditure had to be immediately increased to 31 million dinars. The introduction of new taxes and the reorganization of the financial administration of the country could not keep pace with the increase of public expenditure, chiefly because the National Assembly was for some time reluctant to replace the old system of direct taxation by a more modern system. When in 1884 the new law of taxation was adopted, it failed to realize the expectation of largely increased revenue, because the financial administration could not be speedily reorganized. The situation became so serious that the three principal banks—the Imperial Ottoman Bank of Paris, the Berliner Handels-Gesellschaft of Berlin, and the Länderbank of Vienna—which were financing the Servian loans on the Continental markets, thought it necessary to consult with the Government about the best means to place the finances on a healthy basis. The result of the conferences (held in Carlsbad in June 1895) was the adoption of a new scheme by which the Government gave to the bondholders additional securities and two seats on the Board of Administration of Revenues, the bondholders at the same time accepting the new 4 per cent. Unified Bonds in exchange for their old 5 per cent. bonds. Since this conversion operation, the finances have rapidly improved.

Very few countries have to show such a rapid increase of State expenditure and revenue as Servia during the last 20 years of the 19th century, as will be seen from the following table:—

	1871.	1881.	1891.	1900.
	£	£	£	£
Expenditure . .	550,132	945,647	2,290,450	2,931,060
Revenue . . .	520,448	829,785	2,332,069	2,934,340

The king's civil list amounts to £48,000. The expenditure on national education rose from £58,522 in 1871 to £183,863 in 1899. The expenditure on the sanitary service increased from £3730 to £63,597 in 1899. The military expenditure rose from £147,372 in 1871 to £800,000 in 1900. The interest on the national debt, which in 1881 did not exceed £375,000, rose gradually every year, until in 1900 it amounted to £808,000.

On the 31st December 1899 the National Debt amounted to a total of 420,295,000 dinars (£16,812,000), and was composed of the following items:—

	Dinars.
2 per cent. Premium Loan, 1881	29,445,000
Tobacco Lottery bonds, 1888	9,600,000
4 per cent. Unified (Conversion) Loan, 1895 .	351,250,000
5 per cent. Railway Exploitation Loan, 1899 .	30,000,000

Besides this, the Government owes the National Bank of Servia £400,000, which temporary loan is to be repaid in instalments of 1,000,000 dinars a year.

Defence.—There are no modern fortresses, the citadels of Belgrade, Smederevo, Nish, and Pirot being mediæval

constructions. But some strategic points on the Bulgarian frontier were between 1889 and 1899 fortified by earthworks. Servia's defensive force comprises the standing army and the national army. The former consists of 60 battalions, divided into 5 divisions, every man between 20 and 25 being obliged to serve in the barracks for 2 years (reduced to 1½ year by law of 1st February 1901). The national army consists of two classes: the first class is composed of men between 30 and 40 who have served in the standing army, and the second class is formed of men between 40 and 47 years of age. The first class of the national army gives 60 and the second 40 battalions. In the time of peace there are not more than 20,000 men of the standing army serving with the colours. On the war footing Servian forces consist of some 160 battalions of infantry, 6 regiments of cavalry, and 120 batteries of 6 field guns each. In 1899 the Government ordered 120,000 Mauser magazine rifles from Germany.

Agriculture.—Servia is essentially an agricultural and cattle-producing country. Nearly 90 per cent. of the whole population are occupied in agricultural pursuits. The characteristic feature of the country is the almost utter lack of large farms, the arable land being divided in small holdings, not exceeding, on an average, 20 acres. The small holdings are in themselves a hindrance to modern agricultural progress, inasmuch as small farmers are not in a position to buy the latest and most improved implements. But there is an additional impediment in the fact that generally the lots of ground belonging to one household or family do not lie together, but are dispersed in different, very often distant, parts of the village land. From ancient times the Servians have had a special institution called "Zadruga," which is an association of all the near and distant members of the same family into one co-operative organization under one chief (generally the oldest or otherwise most experienced member of the family). Usually all the members of the Zadruga lived within the same enclosure, in small wooden houses built around the central house inhabited by the "stareshina" (chief). Under the direction of the stareshina all the members of the association used to work together, the products of their joint labour belonging to the whole Zadruga and not to the individual members. Zadrugas were very prosperous, as they had always a sufficient number of hands at command, and were able to obtain better implements and cattle. But with the establishment of order and security, the Zadrugas began rapidly to disappear, and at the end of the 19th century very few remained. Of course this breaking up involved still greater parcelling of the ground. During the five years 1894–99 a new stimulus was given to agriculture by the encouragement which King Alexander personally extended to the establishment of agricultural associations, or rural co-operative associations on the Raiffeisen principles. The object of these associations is principally to facilitate the acquisition of improved implements and better breeds of cattle. In 1899 there were 187 such associations. Another serious drawback to the economic position is that Servia has no seaboard, and that it is at some distance from the nearest export harbours (Galatz, Salonica, Fiume). Still, agriculture made unmistakable progress, especially during the last ten years of the 19th century. The following tables, compiled from official statistics and showing in hectares (hectare = 2·47 acres) the area under cultivation, will give confirmation to this statement:—

	1867.	1889.	1897.
Maize	340,606	302,700	448,334
Wheat	...	319,820	500,321
Meadows	254,722	358,164	355,051
Vineyards	32,855	43,304	68,330
Orchards	56,011	59,461	97,971

The following two tables will give an idea of the prosperity of Servia as an agricultural country:—

	1890.	1895.
Number of households (families)	348,257	375,196
Number of households possessed of landed property	257,280	300,275
Number of households without landed property	90,977	74,921
Number of households which possessed cattle	267,466	284,065
Hectares under cultivation	1,140,088	1,805,935

Live Stock.	1890.	1900.
Horses	163,391	180,871
Oxen and cows	819,251	942,087
Sheep	2,963,904	3,013,644
Pigs	908,603	940,609
Goats	502,738	425,565
Beehives	124,600	1895. 167,765

The live stock of Servia represented the following value in dinars in the years specified:—

	1890.	1895.
	Dinars.	Dinars.
Horses	12,285,608	24,610,174
Cattle	61,015,365	78,434,045
Buffaloes	1,453,690	395,272
Pigs	10,105,698	14,497,018
Sheep	20,374,668	19,467,912
Goats	3,466,213	2,925,602
Beehives	794,310	1,763,764
Total value	109,495,552	142,093,787

Commerce.—The movement of Servian commerce will be seen from the following table, compiled from official statistics, values being given:—

Year.	Imports.	Exports.
	£	£
1879	1,652,680	1,555,240
1889	1,393,720	1,562,240
1899	1,857,144	2,629,775
1900	2,161,100	2,661,000

Of the total imports, fully 59 per cent. come from Austria-Hungary, 12¼ per cent. from Great Britain, and 10¾ per cent. from Germany. The principal articles of import are: cotton and linen textiles (£388,996 in 1899), wool and woollen textiles (£181,104), iron, copper, brass manufactures (£201,094), sugar, coffee (£136,749). The direct import of cotton yarn and textile from Great Britain does not exceed £110,000 per annum. Of the total exports, about 85 per cent. go to Austria-Hungary. There is no direct export to Great Britain, but it is generally believed that some of the Servian wheat and maize, exported down the Danube to Galatz, finds its way to England, as well as that prunes, which are exported to Germany, find buyers in London. The exports consist principally (42 per cent.) of agricultural produce and live stock, the value in 1899 being £1,177,043, of which £658,466 was for cereals, chiefly wheat and maize, and £447,912 was for prunes. Next in point of value come hides (£126,291), bacon, cordage, copper and other metals.

Railways.—In 1879 Servia possessed no railway. In 1881 it began the construction of its part of the great line connecting central and western Europe with Constantinople and Salonica, and finished it in 1886. In 1899 Servia had 332 miles of railways belonging to the nation and worked by the Government. For the construction of these railways she expended £4,206,080, and an extra amount of £566,480 for rolling-stock. The total receipts from the railway traffic in 1898 were £247,705, while the total expenditure amounted to £162,863, giving a net revenue of £84,842; in 1900 the gross receipts amounted to £255,900. For the construction of a network of 600 miles of light railways connecting all parts of the country with the principal (international) line, Belgrade Nish, the Government granted in 1899 a concession to an English syndicate. One of the aims of this railway programme was to connect the Servian railways on one side with the Bosnian network (and through that with Dalmatia and the Adriatic), and on the other side with the Rumanian railways, and through them with the Russian. A convention between Rumania and Servia concerning the building of a railway bridge across the Danube, connecting the two systems, was signed in 1898.

Banks.—In 1879 Servia had only three joint-stock banks. In 1883 the National Bank of the Kingdom of Servia was created, with a nominal capital of £400,000 (of which £200,000 has been paid up), with power to increase it to £800,000, and with a privilege of issuing notes secured by at least 33 per cent. in cash (gold and silver). The annual turn-over of the National Bank reached £10,000,000 in 1898. In the beginning of December 1899 the

bank had notes in circulation to the value of £1,440,000, covered by £700,000 in gold and silver. Besides the National Bank, 72 small local joint-stock banks have been created in the period between 1880 and 1899. The total paid-up capital of the three banks existing in 1879 did not exceed together £72,000, whereas the total paid-up capital of the banks existing in 1899 reached the amount of £800,000. In addition to this, about £300,000 has been invested in a few industrial enterprises since 1890. The total annual turnover of the three banks existing in 1879 did not exceed £1,400,000, whereas the total of the annual business of the 75 banks existing in 1898 amounted to £65,665,000.

HISTORY.

The kingdom of Servia is only one part of the territory inhabited by the Servians, the other parts being northern and north-western parts of Macedonia, the Turkish province of Kossovo, Bosnia, Herzegovina, Montenegro, Dalmatia, Croatia, Syrmia, and the Hungarian districts between the river Tisza and the Danube. Servia lost its independence in 1462, and became a Turkish vilayet under the direct rule of Turkish pashas. Servia remained a Turkish pashalik until the rising under Tzrni Gyorgyé, otherwise Kara-Gyorgyé (Black George) in 1804, who succeeded in driving away the Turks and in organizing self-government. This partial independence, however, was completely lost, and Servia was reconquered by the Turks, when Russia concluded with the Porte the Peace of Bucharest in 1812 without making sufficient provision for the safety of its ally Servia. Voyvode (military chieftain) Milosh Obrenovich, who remained in the country after Kara-George and other voyvodes left Servia, headed a new national rising against the Turks on Palm Sunday 1815. By victories in the field and by clever negotiations Milosh succeeded in obtaining from the Sultan Mahmud II. the grant of internal autonomy as early as in 1820. This important result, obtained by the Servians without any foreign support, was placed on an international foundation by Russia in the Treaty of Adrianople, 1829. When in 1839 Prince Milosh Obrenovich I., and (after the death of his elder son, Milan Obrenovich II.) in 1842 his younger son, Prince Michael Obrenovich III., were obliged to leave the country, the Servians elected Alexander Karageorgevich (the younger son of Kara-George) to be prince of Servia. But in 1859 he was dethroned by the National Assembly, and the old Milosh Obrenovich I. recalled. It is a noteworthy fact that Milosh as early as in 1836 made efforts to enter into political and commercial relations with England. One of the causes of his dethronement in 1839 was his attempt to obtain British support against Russia's encroachments in the internal affairs of Servia. Prince Michael Obrenovich III. (whose wife, Princess Julia, *née* Countess Hunyady, spent in 1863 and 1864 a considerable time in London on a political mission) also appealed to England when he grew impatient of the Russian treatment of Servian interests. But Prince Milan Obrenovich IV., who succeeded to the Servian throne (on the assassination of his cousin, Prince Michael, by the partisans of the Kara-George dynasty, 10th June 1868), was educated in the political school favourable to Russia, and faithfully and unhesitatingly followed the Russian lead up to the conclusion of the San Stefano preliminary treaty. By that treaty Russia, desiring to create a great Bulgaria, took within its limits districts inhabited by Servians, and considered by the Servian politicians and patriots as the natural and legitimate inheritance of their nation. This act of Russia created great dissatisfaction in Servia, and became the starting-point for a new departure in Servian politics. At the Berlin Congress the Servian plenipotentiary, M. Ristich, in vain appealed to the Russian representatives to assist Servia to obtain better terms. The Russians themselves advised him to appeal to Austria and to try to obtain her support. The utter neglect of the Servian interests by Russia at San Stefano, and her evident inability at the Berlin Congress to do anything for Servia, determined Prince Milan to change the traditional policy of his country, and instead of continuing to seek support from, and to follow exclusively, Russia, he tried to come to an understanding with Austria-Hungary concerning the conditions under which that Power would give its support to Servian interests. This new departure was considered by the Russians—especially by those of the Panslavonic party—almost as an apostasy, and it was decided to oppose King Milan and his supporters, the Progressives.

Milosh Obrenovich I.

Milan IV.

Relations with Russia and Austria.

The political history of Servia from 1879 to the abdication of King Milan on 3rd March 1889 was an uninterrupted struggle between King Milan and the Progressives on one side, and Russia with her adherents, the Servian Radicals, on the other. In that incessant struggle King Milan and his Government were badly handicapped by several unfortunate circumstances. To fulfil the engagements accepted in Berlin and the conditions under which independence had been granted to Servia, railways had to be constructed within a certain time, and the Government had also to pay to the Turkish landlords in the newly-acquired districts an equitable indemnity for their estates, which were divided among the peasants. These objects could not be attained without borrowing a considerable amount of money in the European markets. To pay regularly the interest on the contracted loans the Government of King Milan had to undertake the unpopular task of reforming the entire financial system of the country and of increasing the taxation. The expenditure increased more rapidly than the revenue. Deficits appeared, which had to be covered temporarily by new loans, and which forced the Government to establish monopolies on salt, tobacco, matches, mineral oils, &c. Every such step increased the unpopularity of the Government and strengthened the Opposition. An attempt on the life of King Milan was made in 1882, and an insurrection in the south-eastern districts was started in 1883. But the majority of the people, and especially the regular army, remained loyal to the king, and the revolt was quickly suppressed. Then, unfortunately, the union of Bulgaria and Eastern Rumelia inspired King Milan and his Government with the notion that either that union must be prevented, or that Servia should obtain some territorial compensation, so that the balance of power in the Balkan Peninsula might be maintained. This view, which did not find support anywhere outside Servia, led to the war between Servia and Bulgaria (November 1885), in which the Servians were defeated at Slivnitza and had to abandon Pirot, whilst the further advance of the Bulgarian army on Nish was stopped by the intervention of Austria-Hungary. An honourable peace was concluded between the two contending Powers in March 1885. All these misfortunes, however, failed to upset King Milan and his Government. Then came the unhappy events connected with Milan's domestic trouble and his divorce from Queen Natalie. That domestic misfortune was cleverly exploited by King Milan's enemies in the country and abroad, and did him more harm than all other political mistakes together. He tried to retrieve his position in the country, and succeeded in a great measure, by granting a very liberal Constitution (December 1888) at a time when all agitation for a new Constitution had been given up. Then, to the great astonishment of the Servians and of his Russian enemies, King Milan voluntarily abdicated, placing the Government of the country in the hands of a regency during the minority of his only son Alexander, whom he proclaimed king of Servia on 6th March 1889.

The Progressive régime.

War with Bulgaria.

King Alexander.

The leading man of the regency was Yovan Ristich, a man of great experience and ability, who had already been regent during the minority of King Milan (1868–71). Although he had been since 1868 the leader of the Liberal party, he showed himself, as regent, extremely Conservative. The new Constitution was the embodiment of Radical principles, and the numerically strongest party in the country was Radical. The National Assembly was composed, therefore, almost exclusively of Radicals, and the Government was Radical likewise. From the very beginning the Conservative regency and the Radical Government distrusted each other. The Government was not strong enough to resist the clamour of their numerous partisans for participation in the spoils of party warfare. Political passions, which had been stirred up by the long struggle against King Milan's Progressive régime, could not be allayed so quickly; and as the anarchical element of the Radical party obtained the ascendancy over the more cultured and more moderate members, all sorts of political excesses were committed. The old system of borrowing money to cover the yearly deficits was continued, and the budget of expenditure went on increasing from year to year. The administration lost all authority, and was demoralized by the precariousness of the position of the officials, who might be transferred or even dismissed at any moment at the instance of local politicians. The police also became paralysed and brigandage became rife. It was evident that the country was financially and politically in a worse plight than before. The Radical Government thought to strengthen their position by letting the National Assembly vote a law prohibiting the return of the king's father to Servia, and expelling by force from Belgrade the king's mother, Queen Natalie. But such laws and such acts only embittered political passions and greatly encouraged the adherents of Prince Peter Karageorgevich, who, having married the eldest daughter of Prince Nicholas of Montenegro and living at Cettigne, was supposed to enjoy the support of Russia. The political situation became still more confused when on the death of the third regent, General Kosta Protich, the Government tried to force the regency to accept in his stead M. Pashich, the leader of the Radical party. The regents thereupon dismissed the Radical Cabinet and called the Liberals to the Government (August 1892). The Liberal Cabinet dissolved the Radical National Assembly, and at the general elections used very great pressure to secure a Liberal majority. In this they did not succeed, and the situation became hopelessly entangled by the fact that the National Assembly was Radical, the Government Liberal, and the regency practically in all its tendencies Conservative. The legislative machinery as well as the administration of the country was thus completely paralysed. Then the young king Alexander, who was supposed to be occupied

The Regency.

exclusively with his studies and to take no interest in the political turmoil, suddenly stepped in, proclaimed himself of age (although at that time only in his seventeenth year), dismissed the regents and the Liberal Cabinet, and formed his first Cabinet from among the moderate Radicals (13th April 1893).

The King's Administration.

The moderate Radicals quickly showed themselves unable to do any serious work. They were fettered by the dissatisfaction of the Left wing of their own party. To satisfy the extreme Radicals they had to impeach the members of the last Cabinet. This increased the bitterness of the Liberals, who, though not so numerous as the Radicals, included in their ranks more men of wealth and culture. Political passions were again in full blaze. The licentiousness of the press knew no bounds, and the king's parents and the king himself were constantly attacked. The anti-dynastic party raised its head again, and in many Radical prints the expulsion of the reigning dynasty and its replacement by the Karageorgevich were more than hinted at. At the same time reports were reaching King Alexander that Russia was discussing with the leaders of the extreme Radicals the conditions under which a Russian grand-duke was to be proclaimed king of Servia. In such circumstances King Alexander thought best to invite his father the ex-King Milan (who was living in Paris) to his side, and to use his great knowledge of men and his political experience. In the beginning of January 1894 King Milan arrived in Belgrade. The Radical Cabinet resigned and was replaced by a Cabinet composed of politicians standing outside the political parties. In June the Radical Constitution of 1888 was suspended, and in its place the Liberal (so-called, but in reality very Conservative) Constitution of 1869 was re-established.

Ex-King Milan's return.

Under that Constitution it became possible for the Government to infuse new confidence into the administration, and at the general election to obtain a majority of Conservative members in the National Assembly. The nation was evidently tired of the violent agitations of recent years. A natural reaction against the Radical excesses set in, and gave rise to Conservative, even somewhat reactionary, legislation. The duration of the legislature was extended from three to five years; the liberty of the press was curtailed by the enactment that proprietors of political papers must make a deposit of 5000 dinars (£200), and that the editors must have completed their studies at a university; the laws on *lèse-majesté* were made more severe. After the advent of the Cabinet of Dr Vladan Georgevich (October 1897) persistent and successful efforts were made to improve the country's financial and economic condition. The violent party strife which from 1880 to 1895 had absorbed the best energies of the country and paralysed every serious and productive work, ceased almost completely, and the nation as a whole turned to improve its agriculture and commerce. The sustained improvement in the political and commercial situation was not influenced materially by the temporary excitement in consequence of the attempt on the life of King Milan (6th July 1899), and of the State trial of several prominent Radicals accused of having conspired for the overthrow of the dynasty. One remarkable feature in the foreign policy of Servia in the last years of the 19th century was that after King Milan was appointed commander-in-chief of the Servian regular army (December 1897), Russia and Montenegro practically, although not formally, broke off their diplomatic relations with Servia, while at the same time the relations of that country with Austria-Hungary became more friendly than under the Radical régime. All this was suddenly and radically changed when in July 1900 King Alexander married Mme Draga Maschin, once lady-in-waiting to his mother Queen Natalie. He threw himself into the arms of Russia, forbade his father Milan to return to Servia, and followed faithfully Russian guidance in all questions of foreign policy. To strengthen his position in the country he gave a sufficiently liberal Constitution in April 1901, establishing for the first time in the history of Servia a Parliament with two Houses (Skupshtina and Senate).

Constitution of 1869 re-established.

King Alexander's marriage.

LITERATURE.

It cannot be said that in the last quarter of the 19th century the Servian nation produced either a great poet or a great artist. But when it is remembered that in the first quarter of that century Servians were only oppressed Turkish rayahs, absorbed in desperate attempts to obtain the simplest conditions for safety of life and property, it must be admitted that their intellectual activity towards the end of the 19th century is at least noteworthy. In Servia the centre of all scientific efforts in historical and archæological researches in the period from 1844 to 1883 was the Srpsko Ucheno Drushtvo (Servian Learned Society), Belgrade, with its periodical *Glasnik*. This society, which rendered valuable services by its collection of historical documents, has been merged into a new and more ambitious organization called The Royal Servian Academy, established in 1883 and reorganized in 1894. The essays and papers read before the Academy are published in its periodical *Glas* (*The Voice*), while historical and archæological materials are printed in another annual, the *Spomenik* (*Memoir*). Among the Servian Academicians, since the death of Dr Joseph Pancic (who was the first president of the Academy and was well known throughout Europe for his botanical researches in the Balkan Peninsula), M. Stoyan Novakovich took a prominent place by his philological and historical researches, and especially by his classical edition of, and learned commentaries on, the *Zakonik Tsara Dushana* (the *Code of Tsar Dushan*). Besides M. Novakovich, as historians within the last quarter of the 19th century the following deserve mention: Panta Sretkovich (for his *Istoriya Scpskoga Naroda*, 3 vols.); Chedomil Miyatovich (*Studies on Old Servian Commerce and Finances*, *Gyuragy Brankovich*, *The Fall of Constantinople*), Stoyan Boshkovich (*Servia under Tsar Dushan*), Lyuba Yovanovich and Lyuba Kovacevich, whose *History of the Servian People* has been adopted as the standard book for the higher schools. Serious scientific work has been done by two young academicians, Dr Yovan Zuyovich (*Geology of Servia*) and Dr M. Tzviyich (*Geographical Researches*, *Caverns of Servia*). The Servians have the reputation of being a poetical nation. Their national ballads—recited by men to the accompaniment of the monotonous sourdine of the *gusle* (a primitive instrument in which the cords are made of horse-tail hairs)—and the lyric impromptus, sung generally by peasant women, have been admired all over the world. Goethe himself translated one or two of the lyric songs into German; and Bowring gave a translation into English, as early as 1828, while in more recent times Owen Meredith freely translated several of them. The national ballads concerning the great battle of Kossovo (15th June 1389), when the Servian independent kingdom was supposed to have been lost, have been translated into English by Mme Miyatovich (London, 1881). The Servian Government bought the copyright of the classical collection of national ballads and songs made by Vuk Stefanovich Karadjich, the father of modern Servian literature, and between 1887 and 1895 published a popular edition of them. Among the modern Servian poets the first place belongs to the prince-bishop of Montenegro, Petar Petrovich Nyegush (d. 1851) with his poem "Gorsky Viyenatz" ("The Mountain's Wreath"), in which the sufferings and heroism of the Montenegrins were sung. Perhaps the best and most melodious lyrical poet is Branko Radicevich (d. 1853); but he is certainly surpassed in depth of thought and versatility of subjects, if not in purity of language and music of rhythm, by Dr Yovan Yovanovich, called "Zmay" (the "Dragon") whose 50 years' jubilee as poet and author was solemnly celebrated by the Servians in 1899. Other poets whom their countrymen hold in high esteem are: Dr Laza Kostich, Gyura Yakshich, Aberdar, Vladimir Vassich, Vladimir Yovanovich, and especially Voislav Ilich. Prince Nicholas of Montenegro has been one of the most popular poets among the Servians during the last quarter of the 19th century.

The Servians have as yet had no great novelist, but have had several excellent writers of short stories. Among them the first place belongs to Dr Laza Lazarevich, several of whose stories have been translated into foreign languages. Yanko Vesselinovich is well known as a writer of stories depicting Servian peasant life. In the same line, M. Vukicevich has also distinguished himself. M. Miyatovich has written some historical novels, which were well received (*Ikoniya, the Vizir's Mother*, *Rayko of Rassina*, &c.). But by far the most popular novelist among Servians is M. Stephen Srematz, whose works, *Ivkova Slava* and *Pop Spira i Pop Tyira*, have won for him amongst his countrymen the title of "the Servian Dickens." In dramatic literature the Servians have been more prolific. This is probably to be ascribed to the fact that a National Theatre, subventioned by the State, has existed at Belgrade for many years. The two best tragedies in the Servian language are considered to be *Meyreemah*, by Mathiya Ban, and *Maxim Tzrnoyevich*, by Dr Laza Kostich, the translator into Servian of Shakespeare's *Romeo and Juliet*. The patriotic drama *Balkanska Tsaritsa*, by Prince Nicholas of Montenegro, has been often played in the Servian theatres, but critics deny to it much dramatic value. The most successful and most productive of modern Servian dramatic authors has been M. Milosh Tsvetich, formerly one of the principal actors at the Belgrade National Theatre. His drama *Stephen Nemanya* and his tragedy *Theodor of Stalac* are ranked among the best Servian dramatic productions.

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(C. MI.)

Servo-Bulgarian War of 1885.—The Berlin Congress of 1878, by its revision of the Treaty of San Stephano, created two States in the Balkan Peninsula—the principality of Bulgaria owning a nominal suzerainty to Turkey, and the autonomous province of Eastern Rumelia, presided over by a Turkish governor-general, and apparently intended to remain in close relations with the Porte. Such a settlement, failing to satisfy the conditions, racial or geographical, and being specially distasteful to Russia, could not be expected to secure permanence. National forces, encouraged for a time by Russian influence, quickly brought about a movement in favour of a united Bulgaria, which culminated in September 1885 in a revolution at Philippopolis. Prince Alexander of Bulgaria, recognizing that the movement was irresistible and that unless directed by authority it might degenerate into anarchy and civil war, placed himself at its head, and, proceeding to the Rumelian capital, formally accepted the government of the united Bulgarian states. The standing army of Bulgaria, organized and commanded by Russian officers since the war of 1877–78, consisted of 9 squadrons of cavalry, 12 field batteries of 4 guns, and 8 infantry regiments of 3 battalions, with a reserve, on the German system, filling up the *cadres* to war strength and forming additional units. When fully mobilized the field army numbered about 55,000 men. The Rumelian forces, organized on a militia basis, consisted of 2 squadrons of cavalry, 1 field battery of 4 guns, and 12 battalions, on a peace footing, supplemented by an equal number on mobilization. The total strength amounted to about 35,000 men. Previous to the war, three battalions of Macedonian volunteers and a number of Mahommedans were added to the armed strength at the disposal of Prince Alexander. In the Bulgarian army the whole of the staff and superior officers, as well as about half the regimental captains, were Russians. When the mobilization of the Bulgarian and Rumelian forces was decreed by the Prince, the whole of the Russian officers were at once withdrawn, and the heavy task of creating a staff and selecting young officers for all the superior commands had to be undertaken. As it was assumed that the sultan would intervene to reassert his claim by force of arms, the Bulgaro-Rumelian forces were concentrated as rapidly as possible near the Turkish frontier, the main body between Tirnovo and Jamboli, 4000 men at Philippopolis, and a brigade near Küstendil, facing Macedonia. The railway bridge at Mustapha Pacha was destroyed. Prince Alexander, however, had taken the step of acknowledging the sultan's suzerainty; and the Turks, who had no troops ready to act, gave no sign. A conference of ambassadors met at Constantinople to adjust a situation which was widely misunderstood. The Bulgarians had no intention of submitting to a mandate from the conference not backed by adequate military force, and Turkey was not inclined to begin a war which would probably cause a revolt in Macedonia and might end by rendering Russian influence paramount in Bulgaria. While the conference vainly deliberated, and Great Britain (in 1878 the main supporter of the separation of the two Bulgarias) proved now favourable to their union, the Gordian knot was cut by the announcement that Servia, seeking compensation for the aggrandizement of Bulgaria, had constituted herself the champion of the Treaty of Berlin.

In the latter half of October a concentration of the Servian army on the frontier began, and small Bulgarian forces were moved to Küstendil, Tsaribrod, and Trn. On 14th November, after some minor violations of Bulgarian territory had occurred, King Milan declared war. It was now necessary for the young Bulgarian army, with its newly-appointed staff and superior officers, to counter-march to the west, followed by the Rumelian militia. The Servian army consisted of five divisions, with about 10,000 reserves, making a total of at least 70,000 men. One division was intended to act against Widdin, the rest to converge upon Sofia. A rapid succession of Servian victories were announced; but the Bulgarian troops, about 4500 strong, showed great tenacity and fell back slowly from the frontier. The invaders occupied the Dragoman Pass on 16th November, and Bresnik two days later. The whole question now was whether Prince Alexander would be able to concentrate enough force to stem the invasion at Slivnitza, the only defensible position astride of the Tsaribrod–Sofia road. The position, which was about three miles long, was roughly fortified, the right resting upon the mountains and the weak left being strengthened by lines of trenches bent back. On 17th November the Servians made their first attack against the Bulgarian right and centre, and were repulsed all along the line. Prince Alexander was reinforced in the evening by four Bulgarian battalions and one Rumelian battalion, the latter being sent on from Sofia, two men on each horse of a cavalry regiment. On the morning of 18th November the Servians unsuccessfully attacked the left flank, which was manned by the newly-arrived troops, and later they made a half-hearted advance against the centre. On the following day news arrived that the Servian right column was advancing on Sofia from Bresnik, and Prince Alexander hurried back to the capital to prepare for its defence. The danger was averted by three Bulgarian battalions, which had moved on the evening of the 18th from the left flank of the Slivnitza position in the direction of Bresnik, drove back the Servians, and followed them towards Trn. The prince returned to Slivnitza to find his army everywhere victorious and advancing towards the frontier. On the 22nd the Servians were attacked in front of the Dragoman Pass, which they evacuated, and on the 25th Prince Alexander at Tsaribrod received from King Milan a proposal for an armistice, which was not accepted. The Bulgarian main body, of about 30,000 men, followed by about 15,000, now moved across the frontier towards Pirot, which was occupied on the 26th. On the 27th the Servians attacked, and the Bulgarians evacuated the town: but Prince Alexander, now reinforced by 9000 men, drove the Servians from their positions on the surrounding hills, and was preparing to pursue their shattered forces, when, on the morning of the 28th, the Austrian minister at Belgrade arrived at headquarters and hostilities ceased. The intervention of Austria saved the Servian army, which was greatly demoralized, and was now threatened by the united Bulgarian force of nearly 55,000 men. On the same day the Servians were repulsed with heavy loss in an attack on Widdin, and would have been routed if the hands of the Bulgarians had not been effectually tied.

A more absolutely unjustifiable war than that begun by King Milan can hardly be conceived; but the Bulgarians, though completely victorious, were not permitted to reap the fruits of their success. Their young army, with its improvised staff and newly-appointed field officers, displayed admirable fighting qualities, and the Rumelian militiamen proved themselves to be excellent soldiers. The victory was, however, mainly due to the personal influence, the strenuous exertions, and the sound military judgment of Prince Alexander; and the brief but decisive campaign set the seal to Bulgarian unity. (G. S. C.)

Sestri Ponente, a town of the province of Genoa, Liguria, Italy, 4 miles west of Genoa, on the coast of the Gulf of that name. It has important shipbuilding yards and iron-works, with factories for macaroni, matches, and tobacco, tanneries, and saw-mills, and, in the vicinity, alabaster quarries. The parish church has frescoes by Ansaldo and others. There is a music school. The town is a seaside resort. Population (1881), 10,686; (1899), about 11,000.

Settle, a market-town in the Skipton parliamentary division of Yorkshire, England, on the Ribble, 14 miles north-west of Skipton by rail. The town stands at the foot of the steep limestone rock called Castleberg Cliff, and in the neighbourhood is Victoria Cave, where bones of extinct animals were found. There are an institute, assembly rooms, and a Victoria hall, cotton factories and a tannery. Area of township, 4490 acres. Population (1891), 2253; (1901), 2302.

Setubal, a city of Portugal, district Lisbon, on the right bank of the river Sado, 3 miles above its mouth and 19 miles south-east of Lisbon. It is the third port of the

kingdom, one of the constituents of the port of Lisbon, and the fourth largest town; and an important fishing-station, with some thirty sardine-curing factories. It also makes lace, carries on boat-building, and has factories of fish guano. There is a school of industrial design, and a lyceum. In 1899 the port was entered and cleared by 1161 vessels, of 247,095 tons. In 1898 Setubal possessed 468 fishing-boats, which employed 2131 men and boys; and the fish caught was valued at £41,550 (£90,900 in the combined ports of Setubal, Cezimbra, Sines, and Villa Nova de Milfontes). Marble and porphyry occur in the vicinity. Population (1890), 17,581; (1900), 21,819.

Sevenoaks, a market-town in the Sevenoaks parliamentary division of Kent, England, 22 miles south of London by rail. The neighbourhood contains many country residences. There is an orphanage and a public recreation ground. Knole Park, with its fine trees, is a popular resort. Area, 3273 acres. Population (1881), 6296; (1901), 8103.

Seville, a province of Spain, divided into 13 districts and 100 parishes. Population, 506,812 in 1887, and 547,020 in 1897. Birth-rate, 3·77 per cent.; death-rate, 3·40 per cent.; proportion of illegitimate births, 7·26 per cent. Area, 5429 square miles. Few provinces in Spain have so many railway lines as Seville. After a couple of centuries of decay, the industries increased considerably in the last quarter of the 19th century. The State foundries and manufactures of small-arms, shells, and gunpowder are important and conducted by royal artillery staffs. There are also iron and bronze works, tanneries, breweries, oil and flour-mills, distilleries, manufactures of soap, porcelain, hardware, cotton, linen, woollen, silk stuffs. The exports are valued at £1,000,000 annually, mostly going to England, France, and America. The coasting trade was represented in 1898 by 1700 vessels entered, with 155,500 tons, and 1600 cleared, with 140,000.

More than 2½ millions of acres are well cultivated, and some few districts well irrigated. In 1897 391,830 acres produced wheat, 285,735 acres rye, oats, barley, and maize, 82,038 acres pod fruit, 26,000 acres wine, 477,202 acres olives. There are 89 mines actually worked (6 of alum, 25 copper, 30 iron-ore, 28 coal), and there are 369 registered unproductive mines. The mines that are worked give employment to 1710 hands, and the output in 1898 was 503 tons of alum, 69,849 of copper, 383,864 of iron-ore, 121,074 of coal, and 75,623 tons of agglomerates.

Seville, capital of the above province, on the Guadalquivir. Population (1887), 143,182; (1897), 146,205. The township extends over nearly 30,000 acres. The surrounding country is very fertile and produces abundantly cereals, olive, wine, fruit, and vegetables. Modern embankments have been built on the river, and many other precautions taken by the municipal corporation to prevent floods. Seville is the terminus of three lines that put it into communication with Madrid, and of other lines to Cadiz, Almorchon, Ciudad Real, Huelva, Badajoz, and Lisbon. Three of these lines have branches down to the water-side on the quays, along which vessels of considerable size load and unload. The quay on the left bank is handsome, well paved, 4500 feet long, provided with powerful cranes, and sheds for merchandise. The late duchess of Montpensier gave a part of the grounds of the palace of San Telmo to the municipal corporation, and bequeathed the San Telmo residence to the archbishopric under certain conditions. The navigation up the Guadalquivir from its mouth to Seville is less dangerous for steamers than for sailing vessels, but is still uncertain. Nevertheless, Seville is one of the most important ports in Spain. In 1898, 487 sailing vessels, of which 4 were British and 464 Spanish, and 735 steamers, of which 246 were British and 443 Spanish, entered the port of Seville; and 488 sailing vessels, of which 4 were British and 466 Spanish, and 734 steamers, of which 247 were British and 442 Spanish, cleared. The principal exports in 1898 were iron-ore (381,593 tons, valued at £157,407), copper pyrites, lead and lead ore, corks, oranges, olives and olive oil, wine, and quicksilver. The exports to England in 1898 were valued at £862,366, the imports £162,769; exports to France, £293,200, and imports £75,420; the total exports of the port having been £1,479,529, the imports £486,606. The principal industries are iron, machinery, tobacco, chocolate, soap, porcelain, beer, liqueurs, brandies, corks, and silk in every shape. The royal artillery works and foundries are very important. The ceramic, porcelain and coarse ware manufactory in the ancient Carthusian convent in the *vega* of Triana, on the right bank of the Guadalquivir, is a prosperous industry that employs more than 2000 hands. Equally important is the great tobacco and cigar factory, where 6000 women are employed. At great expense and under careful management, though slowly, repairs of importance have had to be undertaken in the noble cathedral La Giralda; many of the columns had to be attended to urgently, as they were showing signs of decay. Seville is divided into 10 districts, subdivided into 35 *barrios*, with 612 streets, 57 squares. The outer *barrios* are: Los Humeros, La Macarena, San Roque and La Calzada, San Bernardo, La Cesteria, Carreteria, and Bataldlo, Triana, on the right bank of the Guadalquivir, with 50 streets and 15,000 souls, the favourite abode of the gypsies. Public education has progressed in Seville, which has numerous primary state and private schools, an institute, and the university now installed in the Jesuit college founded in the 16th century. The scientific and literary establishments are important. There is a seminary which was formerly the university of Seville.

Sèvres, Deux-, a department of western France, watered by the Sèvre Nantaise and the Sèvre Niortaise.

Area, 2338 square miles. The population, 350,103 in 1881, had decreased to 339,344 in 1901. There were in 1896 895 schools, with 56,000 pupils, the illiterate amounting to 4 per cent. of the population. Out of 1,373,320 acres under cultivation in 1896, 1,047,280 acres were plough-land and 22,230 acres vineyards. The wheat crop of 1899 was valued at £1,120,000; barley, £120,000; oats, £1,204,000; potatoes, £328,000; mangold-wurzel, £220,000; green crop (trefoil, lucerne, and sainfoin), £388,000; hemp, £14,200; vines, £81,000; walnuts, £16,200. Mining in 1898 turned out 18,418 metric tons of coal, but the department produced only 30 tons of steel. Distillation yielded 552,000 gallons of alcohol. Much also is done in refining sugar and in paper manufacture. Niort, the capital, had in 1901 20,962 inhabitants.

Sewage Disposal.—The collection of sewage was fully discussed in the earlier article on SEWERAGE in the 9th edition of this Encyclopædia; it remains to consider the various methods of dealing with it at the outfall in order to render it innocuous. We must, however, have a clear conception of the composition of the liquid to be dealt with, and also know all the circumstances in which it is delivered at the works. Domestic sewage is the fouled water-supply of a community. The water is brought into the household, and after serving its purpose is discharged into the sewerage system as sewage. The composition of this liquid is now fairly well known, and is generally reduced for the purposes of comparison to a standard; that is to say, ordinary sewage is that due to a water-supply of about 30 gallons per head per diem. If the supply is less, and there is no leakage of subsoil water into the drainage system, the sewage will be stronger; conversely, if there is leakage, &c., the sewage will be more dilute, but obviously, the quantity of impurities will, for any given population,

be the same in amount. The subjoined table shows the kind of sewage referred to:—

Average Domestic Sewage, in Grains per Gallon.

Total solids in solution.	Organic carbon.	Organic nitrogen.	Ammonia.	Chlorine.	Suspended.		
					Mineral.	Organic.	Total.
50·54	3·287	1·543	4·70	7·46	16·92	14·36	13·28

For all practical purposes we may say that average sewage contains two tons of suspended matters in each million gallons, one-half of which is mineral matter. When, however, we come to a consideration of trade waste, the question becomes difficult in the extreme, because of the great variety of trades, and the ever varying quantities added to the sewage. Generalizations are of no value in these cases, and each town must be considered on its merits. We may, however, enumerate some of the principal trade wastes; these are from dye-works, print-works, bleach-works, chemical works, tanneries, breweries, paper-makers, woollen-works, silk-works, iron-works, and many others. In some cases one only of these trade wastes finds its way to the sewers; in others, several of them may be found. In some instances, again, these trade wastes are of an alkaline nature, in others they are acid; the mixtures may be either, and of greatly varying character. Next comes the manner in which sewage is discharged at the works. The flow is variable throughout the entire 24 hours, but in the case of sewers discharging domestic sewage only, such sewage being of the standard strength, it will be a close approximation to the facts to say that about two-thirds is discharged between the hours of 7 A.M. and 7 P.M., one-half during during the eight hours of maximum flow, two-fifths during the six hours of maximum flow, and about 7½ per cent. per hour during the two hours of maximum flow. These data will be sufficient for the design of the works intended for dealing with the sewage. Separate calculations must be made if there is trade refuse, or much leakage of subsoil water. In very large systems, again, the maxima are rather less because of the time occupied by the sewage in travelling to the outfall from the more remote parts of the district. Rainfall is generally admitted to the sewers, either wholly or in part. In large cities like London, Glasgow, and many others, one system only is employed for both sewage and rainfall, and it is the best, because of the filthy condition of the street washings where there is much vehicular traffic. In these cases the sewage flow may be increased more than a hundredfold within the space of a few minutes by the occurrence of heavy rainstorms. Of course the sewage disposal works can only deal with a small proportion of such flow, and the balance is discharged into some convenient watercourse, or river, or other suitable place. Even when the separate system is employed, as in the case of the smaller towns, the flow may be increased ten to fifteen times by rain, because it is unusual to carry two sets of drains to the backs of the houses. In designing outfall works, therefore, all these circumstances must be carefully considered. Again, when the sewage is pumped, as is frequently the case, the size of the tanks must often be increased, because in the smaller installations the whole of the day's sewage is frequently pumped out in a few hours; this fact must also be remembered when designing filters.

Nearly every town upon the coast turns its sewage into the sea—a very proper course if the conditions are favourable. That the sea actually has a purifying effect must be obvious to anyone who will take the trouble to follow the sewage after it leaves the outfall. The object to be attained is its dispersion in a large volume of sea-water. As it is lighter than salt water it tends to rise after leaving the sewer; the outfall should, therefore, if practicable, terminate in deep water, so that the two liquids may become well mixed. The currents must be studied by means of floats, and in most cases the sewage must be discharged upon the ebb tide only, and then perhaps not throughout the entire period, the object being to prevent it from being carried towards the shore. That the purification is effected mainly by means of living organisms—with which sea-water teems—is now well established, and it has been urged by competent authorities that this system is not wasteful, since the organic matter forms the food of the lower organisms, which in turn are devoured by fish. Thus the sea is the richer, if the land is the poorer, by the adoption of this cleanly method of disposal. The next step is the partial purification of the sewage by means of a chemical process. When a town lies some distance up an estuary, as for example London, Glasgow, Rochester, and many others, the dilution may be insufficient to prevent a nuisance, or the suspended matters may be deposited upon the foreshore to be uncovered at low water. The first stage of purification is then employed, namely, clarification in tanks. There is some scope for good work here, because badly designed tanks may be costly to work, and may not even then give good results. Practice varies with regard to tank capacity, but as a general rule it should be at least equal to half a day's dry weather flow. This will enable the works manager to turn out a good effluent, even in wet weather, when the volume is much increased. With regard to the practical effect of any particular treatment, it is now recognized that the matters in solution are scarcely touched by any chemical process that can be employed, but the removal of the suspended matter is a great gain, as has been proved in the case of London. Briefly, a good chemical process will do about one-half of the work of purification; and in very many cases it is not necessary to go farther. With regard to the kind of chemical to use, lime, either alone or in conjunction with sulphate of alumina, or with proto-sulphate of iron, is most frequently employed; and its prolonged use is obviously a case of the survival of the fittest. When the resulting sewage sludge has to be filter-pressed, lime is almost essential for the primary treatment of the sewage, in order to destroy the glutinous nature of the sludge. In the case of large towns like London, Manchester, and Salford, the sludge is shipped in specially designed steamers, of 600 tons to 1000 tons burden, and discharged into the sea at a distance from the coast, experience having proved this to be the most economical course to pursue. In the case of towns situated on rivers above the range of tidal waters, the further purification is effected either on land, or by means of artificial filters, or a combination of the two. The question of land treatment is frequently considered from the standpoint of so many persons to the acre; but the best method is to ascertain how many gallons per day an acre of land will purify. As the quality of land varies greatly, the proper volume to be applied per acre can only be ascertained after a good deal of experience. The range lies between about 3000 gallons per acre per day in the case of poor land, to about 30,000 gallons in the same period in the case of the best. Let us assume an instance of the latter kind. The works have been designed on a basis of 1000 persons per acre, producing 30,000 gallons of sewage per day; the land being of a highly suitable character, and the sewage having been clarified, success is assured. But, conversely, through faulty construction of the sewers, the sewage amounts, say, to 60 gallons per head; the land, unable to deal with the liquid, quickly becomes water-logged and offensive, and the works are a failure. Precisely the same remarks apply to artificial filters, which are always designed upon the basis of so

many gallons per square yard of filtering material. Many failures of both land and filters have been due to the fact that the actual sewage flow was greatly in excess of the original estimates. We may say that clay soils lie at one end of the scale, and very porous sands or gravels at the other; obviously, therefore, each case must be considered on its merits. It should be remembered that when such moderate quantities as 3000 gallons per acre per day are applied to land, there is no necessity to remove the suspended matter; broad irrigation being resorted to, the land readily assimilates the solids, and thus one source of expense may be eliminated.

The artificial filters are now generally called bacteria beds; although filters have been in constant use in some cases, as for instance at Wimbledon, for a great number of years. The first filters constructed at these works were made in 1876, and were about 7000 yards in extent. With the growth of population additions have been made of at least five times that area. One of the original beds was used for crude sewage, but the mineral matter choked it completely, and experience pointed to the necessity of clarifying the sewage before filtration. Whether the treatment should be in open or in closed tanks, or whether chemicals should be added, is at present much debated; but seeing that ordinary sewage contains one ton of suspended mineral matter in each million gallons, it is clear that if this is not removed before filtration, it will be retained in the filters and ultimately choke them, as happened at Wimbledon. At the present time the common cesspool is being resuscitated and improved under the name of a septic tank. In this the disintegration of the suspended matter is brought about by anaërobic organisms, and the liquid in passing slowly through the tank absorbs most of the gases due to the breaking down of the organic matter. There is no oxidation at this stage. The liquid is next passed through artificial filters, of which there are many types. What is known as a "contact" filter was constructed, probably for the first time on a large scale, at the London (Barking) works. The object sought to be attained was that of making each cubic yard of filtering material perform the same amount of work, and the least expensive way was apparently to close the outlet, and charge the filter with liquid, allowing it to remain in contact for about two hours, and then drawing it off so that the bed could be thoroughly aërated. No doubt a better way would be to distribute the sewage in the form of a shower of liquid, and work the beds continuously, but this involves a good deal of expense for spreading appliances, and a fall is necessary in the works, which is not always obtainable. Probably the most complete installation of the kind last referred to is that at Salford. Iron pipes are led over the surface of the filters, and spraying nozzles are placed at short intervals, so that the sewage is applied in the form of a heavy shower. But whatever form the filters and appliances may assume, the final result is the same. If the beds are properly aërated, the aërobic organism establishes itself in prodigious numbers, and attacks the organic matter, breaking it down into harmless, soluble, and gaseous products. It is, of course, assumed that the filters are adequate in area, and are properly managed. With regard to the materials to be employed in making sewage filters, it is now well established that the size of the particles has a more important bearing than their composition. At the same time, it may be remarked that materials with very rough surfaces, as for instance coke breeze, are more effective than those with smooth surfaces. Doubtless the former classes afford, in the interstices, a lodging for the bacteria, and no doubt a given quantity of material with rough surfaces will harbour greater numbers than the same amount of smooth.

A reference must be made to the Manchester experiments. The experts' report suggested the provision of 60 acres of filters for dealing with the sewage of the city, which is said to average 30 million gallons per day in dry weather. But after inquiry into the merits of the proposal the officials of the Local Government Board recommended that the filters should be 92 acres in extent, and that the effluent should be finished on land. Storm water filters to take the excess after the sewage was diluted six times were also recommended, such filters being designed to pass 500 gallons per square yard per diem. In this case clarified sewage was to be dealt with on filters 3 feet 4 inches in depth, composed of clinkers broken to pass a sieve with meshes of $1\frac{1}{2}$ inches, but retained on one with meshes of $\frac{1}{8}$ of an inch. It will be observed, therefore, that the bacterial treatment of sewage has scarcely as yet emerged from the experimental stage, but it will certainly be adopted in many cases where it is impracticable to obtain good land in sufficient quantity for the purification of the sewage. With regard to the disposal of sewage-sludge in inland towns, until it has been fairly established by a long trial that bacteria will dispose of this material, the reduction of its bulk by means of filter-presses will be found to be the most satisfactory method of dealing with it. The practical effect is the conversion of 5 tons of offensive mud into 1 ton of hard cake, which may be readily handled and carted. The cost is usually about 2s. 6d. per ton of cake, and a million gallons of average sewage produce about 8 tons. (S. CR.)

Sewing Machines.—The machines and stitches described in vol. xxi. p. 719, of the *Ency. Brit.*, continue in use, and have been supplemented by important inventions for special kinds of work. In sewing carpets the great weights of material make feeding difficult, and therefore machines have been invented that move along the carpet, which itself remains stationary. The earlier forms of this machine were hand-worked. The two lengths of carpet were stretched across the room, and the machine, followed by the operator, who turned it by means of a hand-crank, travelled along the seam. One of these machines was capable of doing the work of eight or ten hand-sewers. The new Singer carpet sewing machine is operated by electricity or other power and runs along a track. The carpet is stretched and sewed so rapidly that one power machine does the work of eight or ten hand machines. A machine for quilting and similar operations has been invented in which two needles produce parallel rows of stitching. The distance of these may be varied by thirty-seconds, from $\frac{1}{16}$ to $\frac{5}{8}$ of an inch. As manufactured by the Singer Company, only one rotating hook is employed beneath the feed-plate to pick up the loops of both threads. Shoes are now sewn by machine, and the introduction of shoe sewing machines has revolutionized the shoe industry. Books are stitched by machine, the Brehmer wire sewing machine and Smyth thread sewing machine being prominent representatives. Button-hole sewing machines are another special type on the production of which years of experiment have been expended. A fast hand operative can produce in ordinary sewing fifty stitches a minute. A foot-driven machine can produce one thousand, and a power-driven machine three to four thousand stitches per minute. For a rate of seven hundred stitches per minute about $\frac{1}{20}$ horse-power is required.

Nearly three million sewing machines are produced annually, in about 150 factories, two-thirds of which are in Germany and the United States. Between 1880 and 1890 from 500,000 to 600,000 sewing machines were made in the United States. The number of factories decreased 50 per cent. in that period, but the same number

of employés were engaged. The labour cost represents 40 per cent. of the cost of a sewing machine. Over $67,000,000 worth of machines was exported from the United States between 1865 and 1895. At present about 150,000 machines are exported annually. (T. O'C. S.)

Sextant.—For astronomical observations on shore, the sextant mounted on a stand, in skilled hands, gives results which are but little inferior to those derived from the portable transit instrument; but in high latitudes the value of the sextant for time observations is somewhat diminished. It possesses the great advantage of being always ready for immediate use; little or no preparation of the ground is necessary, as in the case of the transit instrument. Messrs Troughton and Simm construct the double-frame or pillar form of sextant, while Messrs Cary and Porter adopt the edge-bar principle to secure strength and rigidity of frame. The former is certainly much lighter, but sextants by either maker give equally good results; and when a stand is used, weight is not of much consequence. Accuracy of graduation, small centring error, and superior workmanship can only be assured by makers of repute, and a first-class instrument is indispensable.

Telescopes are of two kinds: the direct, for the more ordinary sorts of observations; and the inverting, for astronomical work, one of the eyepieces of which should be of high magnifying power, not less than 15 diameters. To each eyepiece there are two pairs of wires, each pair perpendicular to the other, and dividing the field of view into nine divisions, of which the central is square. Contacts should be made as nearly as possible in the centre of this square. It is convenient if the telescope is fitted with an interrupted thread to screw into the collar of the up and down piece. *Shades.*—Both mirrors are supplied with coloured shades of different degrees of shade, and may be used either singly or combined for sea observations; they are subject to errors of refraction, due to non-parallelism of the sides of the glass. Coloured eyepieces of neutral glass of different intensities are fitted to slip on and off the conically ground surface of the eyepieces of the telescope; they are used for index error and for observations in the artificial horizon. Introducing no refraction error, they also ensure the suns being of the same brilliancy; a very important point. The up and down piece, when adjusted to equalize the suns, will bring the axis of the telescope nearly exactly in line with the edge of the silvered surface of the horizon glass, which is the best position for observing, and from this it must never be moved until the equal altitude or other observations are complete. *Vernier.*—An extended vernier, *i.e.*, a vernier whose divisions are twice the distance apart of those on the arc, will be found convenient for accurate observing.

Adjustments.—It is essential that the planes of both the index glass and the horizon glass should be perpendicular to the plane of the instrument, and they should also be parallel to one another when the vernier is set to zero. The line of collimation of the telescope must be parallel to the plane of the sextant. This adjustment, though less liable to alter than either of the others, should nevertheless be examined from time to time as follows:—With the sextant mounted on a stand, move the index so as to separate the direct and reflected images of a star by a distance nearly equal to the length of the parallel wires of the telescope, and turn the eyepiece until the direct image of the star coinciding with one extremity of the wire, the reflected image coincides with the other extremity; the wires will then be parallel to the plane of the sextant. Select two bright stars, 120″ or more apart, and make a coincidence of the reflected and direct images on the middle of one wire, and then on the middle of the other. If the two readings agree, the adjustment is correct; if not, the adjusting screws in the collar of the up and down piece must be moved until the coincidence is exact on both wires.

Centring error is a very important error, and is one that cannot be corrected. It may amount in an indifferent instrument to a quantity sufficient to vitiate the result of any observations on one side only of the zenith. It arises from the eccentricity of the centres of the index arm and of the arc, and varies with the angle measured, being generally greater as the angle increases; but the index arm becoming bent, or any part of the frame receiving a blow which alters its shape, the flexure of the instrument from varying temperature, and defective graduation, will all produce errors which it is generally impossible to disentangle, and they are all included in the one correction for centring. This correction is found by comparing the angle measured by the sextant (corrected for index error) with the true angle. The most accurate method, because it employs a large number of observations for the same or nearly the same angle, is by observations of pairs of circum-meridian stars in the artificial horizon at various altitudes. Double the difference between the resulting latitude by each star and the mean latitude will be the centring error for an angle equal to the double altitude of that star, that is, the angle actually measured by the sextant, index error being carefully ascertained and applied before working out. Careful measurement of the angles between stars, compared with their calculated apparent distance, is another method. At Kew Observatory the centring error was determined for certain angles by fixed collimators. Including, as it does, errors from so many causes, the correction does not remain perfectly steady, and it should be ascertained from time to time for any sextant which is to be employed for accurate determination of positions in circumstances which do not permit of the use of methods whereby it as well as other errors are eliminated. In a good sextant the error should not exceed one minute over the whole of the arc.

Sextant Stand.—For observations on shore the sextant should be mounted on a stand, in order to get the best results. In an improved form of stand, the bearing which carries the sextant is square, and the whole bearing revolving on a centre is controlled by a clamp and tangent screw. The counterpoise weights should exactly balance the sextant, and they may be fitted to slide in and out, thus allowing of adjustment.

Levels.—A small spirit-level fixed on one of the arms of the sextant stand, and another level pivoting round the pillar on the index bar of the sextant carrying the microscope, working in a plane parallel to that of the instrument, and fixed by means of a set screw, are of great assistance in placing the sextant exactly in the required position when observing faint stars. With the telescope pointing to the centre of the artificial horizon, the direct and reflected images of the sun at any convenient altitude are made to coincide. The levels are then adjusted and permanently fixed by their set screws. To observe a faint star, it is only necessary to set its double altitude on the sextant, turn the instrument and the stand to bring the bubbles of their respective levels in the centre of their runs, and move the stand until the telescope points to the centre of the artificial horizon and in the direction of the star, when the direct and reflected images will be seen in the field.

Electric Light.—A small electric light fitted on the arm carrying the microscope, and worked by a dry battery, enables the sextant to be read off at night with facility.

Artificial Horizon.—The glass in the roof should be of the best quality, and the faces of each pane accurately parallel. A new form of horizon has been introduced, with the object of diminishing the waves set up in the mercury by vibration. It consists of a shallow rectangular trough of metal gilt. This is amalgamated after getting the surface absolutely clean and free from grease by wetting it with a few drops of dilute sulphuric acid, and rubbing it with a drop of mercury until the whole surface is bright, when a very small quantity of amalgamated mercury added will flow evenly and form a horizontal surface. The dross is wiped off with a broad camel-hair brush. In this shallow trough waves are killed almost instantaneously. The trough should be thoroughly washed on each occasion before being used.

The horizon is placed upon a stand, consisting of two iron plates, the upper resting on the lower, supported by

three long large-headed screws, by means of which it can be levelled. If the stand is raised off the ground a foot or so, on a firm foundation, thus bringing the artificial horizon closer to the telescope, faint stars are more easily observed, and the movement of the sextant necessary to keep the star in the field, owing to its motion in the heavens, will be lessened. A lantern placed on the ground behind, or a little on one side of, the observer, and faintly showing on the artificial horizon, will sufficiently illuminate the wires of the telescope on a dark night.

(A. M. F*.)

Seychelles, an archipelago in the Indian Ocean, consisting of eighty islands—several of them mere islets —situated between 3° 38′ and 5° 45′ S. and 52° 55′ and 53° 50′ E. Of these, Mahé is the largest, most central, and has the greatest height above the sea (2998 feet). Only four others are inhabited, namely, Praslin, La Digue, Denis, and Bird. The islands are surrounded by coral reefs; their soil is most fertile, and the climate, although tropical, is very healthy. Like all the other Indian Ocean islands, the Seychelles have a peculiar fauna, represented by as many as 60 species of plants. The principal exports are cocoa-nut oil, soap, vanilla, tortoise-shell, guano, cocoa-nuts, and cacao. The following statistics show the trade and revenue of the group:—

	1884.	1889.	1894.	1900.
Imports	Rs.4,28,605	Rs.5,70,990	Rs.6,33,061	Rs.9,80,911
Exports	3,92,175	6,53,102	7,64,080	10,36,161
Revenue	1,30,047	2,00,096	2,35,410	3,99,312
Expenditure	...	1,69,083	2,78,470	2,96,920

Population in 1881, 14,081 (7179 males and 6902 females).
„ 1891, 16,440 (8302 „ „ 8138 „).
„ 1901 (estimated), 20,275.

These, as regards religion, consisted in 1891 of 2636 Protestants and 12,608 Roman Catholics, the rest being probably Hindu. In 1900 there were 27 Government schools with a total average attendance of 2037 children. In addition there are St Louis College, with about 100 pupils, and Victoria School with about 80. The rainfall in 1896 was 115·08 inches, considerably above the average fall for the previous five years, which was only 92·83 inches; since 1896 it has varied between 88·42 and 110·75. Temperature, maximum, in shade, 88·7°; minimum, 74·1°. Average temperature for year: maximum, shade, 83·0°; minimum, 76·8°.

Seymour, a city of Jackson county, Indiana, U.S.A. It is on the Baltimore and Ohio South-Western, the Southern Indiana, and the Pittsburg, Cincinnati, Chicago, and St Louis railways, in the southern part of the state, at an altitude of 607 feet. It contains the machinery works of the Baltimore and Ohio South-Western Railroad, and has varied manufactures. Population (1890), 5337; (1900), 6445, of whom 321 were foreign-born and 204 negroes.

Seymour, Horatio (1810–1886), American statesman, was born at Pompey, N.Y., 31st May 1810. His father was prominent in the Democratic party of the state. The son inherited his principles as well as his wealth, and from 1841, when he was first elected to the legislature, to 1854, when he was elected as governor, gradually rose to a commanding position. On national issues he was Conservative, and supported the administration policy of Pierce and Buchanan. In 1860–61 he strongly advocated compromise to avoid secession; but when war developed, he as strongly supported the maintenance of the Union. He remained, however, a Democratic partisan, and vigorously opposed the Administration's policy in respect to emancipation, military arrests, and conscription. In 1862 he was again elected governor of New York. His conduct in dealing with the great Draft Riots of July 1863 drew on him vehement but ill-founded charges of weakness and incompetence. In 1868 the Democratic Convention, while he was its presiding officer, and despite his peremptory refusal, pressed upon him the nomination for President. He reluctantly withdrew his refusal, but in the campaign was overwhelmingly defeated. Afterwards, though frequently urged to enter public life, he lived in retirement on his estate near Utica, where he died 12th February 1886.

Seyne-sur-Mer, La, town, arrondissement of Toulon, department of Var, France, 4 miles south-west of Toulon by rail. The shipbuilding yard now covers nearly 40 acres, has ten slips available for the building of large ships, and with the connected forges gives employment to about 4500 persons. Population (1891), 8836; (1901), 21,002.

Sgambati, Giovanni (1843– ——), distinguished Italian composer, was born in Rome, 28th May 1843, of an Italian father and an English mother. His early education took place at Trevi, in Umbria, and there he wrote some Church music, and obtained experience as a singer and conductor. In 1860 he settled in Rome, and definitely took up the work of winning acceptance for the best German music, which was at that time neglected in Italy. The influence and support of Liszt, who was in Rome from 1861, was naturally of the greatest advantage to him, and concerts of all sorts were undertaken, Sgambati conducting as well as playing the piano. His compositions of this period (1864–65) included a quartet, two piano quintets, an octet, and an overture. He conducted Liszt's *Dante* symphony in 1866, and made the acquaintance of Wagner's music for the first time at Munich, whither he travelled in Liszt's company. His first album of songs appeared in 1870, and his first symphony was played at the Quirinal in 1881; this, as well as a piano concerto, was performed in the course of his first visit to England in 1882; and at his second visit, in 1891, his *Sinfonia epitalamio* was given at the Philharmonic. His most extensive work, a Requiem Mass, was performed in Rome 1901. His many pianoforte works have won permanent success; but his influence on Italian musical taste has been perhaps greater than the merits of his compositions, which, though often poetical and generally effective, are often very thin and slight in style.

Shabatz, a town in Servia, on the right bank of the river Sava. It has a mediæval castle, built in 1470 by Sultan Mahommed II. to facilitate the incursion of the Turks into Croatia and Syrmia, which lie on the left bank of the river. It is the principal market and commercial town of north-western Servia, and exports to Hungary cereals, prunes, cattle, and pigs. It is well known for the excellent white honey which comes from its neighbourhood. The district is rich in lime-trees. Shabatz is the seat of a bishop, of the district prefecture, and of a tribunal. It has a college and a library, and a garrison occupies the old fort. The people of Shabatz have the reputation of being the wittiest people in Servia. Population (1895), 10,917; (1900), 12,072.

Shadrinsk, a district town of Russia, in the government and 383 miles south-east of the town of Perm, on the river Iset. It is a growing town, with several distilleries, and has become an important entrepôt for the export of corn, cattle, hides, skeep skins, woollen cloth, and tallow. Population (1897), 11,686, or 17,050 with the suburbs.

Shahabad, a district of British India, in the Patna division of Bengal. The administrative headquarters are at Arrah. Among other historic sites, it includes the fort of Rohtas, the tomb of Sher Shah at Sasseram, and the battlefield of Buxar.

Area, 4365 square miles. Population (1881), 1,952,647; (1891), 2,063,337. Classified according to religion, Hindus numbered 1,911,372; Mahommedans, 148,439; Christians, 277, of whom only one was a native; "others," 3249. In 1901 the population was 1,963,762, showing a decrease of 5 per cent., compared with an increase of 6 per cent. in the previous decade. The land revenue and rates in 1897–98 were Rs. 19,06,495; number of police, 614; boys at school (1896–97), 23,891, being 16 per cent. of the male population of school-going age; registered death-rate (1897), 35·5 per thousand. The district has been protected against drought by a system of canals from the Sone, some of which are navigable. In 1897–98 the gross receipts from these canals were Rs.12,54,790, and the net receipts Rs.6,36,648, on a total capital expenditure of Rs.2,67,91,549. The district is traversed by the East Indian Railway near the Ganges, and by a branch from Mogulsarai to Gaya, which follows the Grand Trunk Road, and crosses the Sone at Dehri-on-Sone, where are the workshops of the canal.

Shahjahanpur, a city and district of British India, in the Rohilkhand division of the North-Western Provinces. The city is on the left bank of the river Deoha or Garra, 507 feet above the sea; railway junction, 780 miles north-west of Calcutta. Population (1891), 78,522; (1901), 75,662; municipal income (1897–98), Rs.70,953, more than half derived from octroi; incidence of taxation, nearly 9 annas per head; registered death-rate (1897), 30 per thousand. There is a military cantonment. There are manufactures of sugar, but no great trade. There is an American Methodist mission. There are two printing-presses, issuing one vernacular periodical.

The district of SHAHJAHANPUR has an area of 1744 square miles. Population (1881), 856,946; (1891), 918,551, showing an increase of 7 per cent., compared with a decrease of 10 per cent. in the previous nine years; average density, 526 persons per square mile. In 1901 the population was 921,624. The land revenue and rates are Rs.11,08,165, the incidence of assessment being R.1.0.9 per acre; cultivated area (1896–97), 710,831 acres, of which 37,974 were irrigated from wells, &c.; number of police, 2761; vernacular schools, 105, with 4958 pupils; registered death-rate (1897), 43·45 per thousand. The principal crops are rice, wheat, pulse, millet, sugar-cane, and opium. There are no Government canals. The district suffered very severely from the famine of 1877–79. It is now traversed by the Lucknow–Bareilly section of the Oudh and Rohilkhand Railway, with a branch northwards from Shahjahanpur city. At Rosa is a sugar refinery and rum distillery, with an annual out-turn valued at Rs.13,48,000. In 1897–98 the excise duty paid or credited was Rs.6,49,336.

Shahpur, a town and district of British India, in the Rawalpindi division of the Punjab. The town is near the left bank of the river Jhelum. Population (1891), 6337; municipal income (1897–98), Rs.1789. There is an Anglo-vernacular school, and a branch of the Arya Samaj.

The district of SHAHPUR has an area of 4840 square miles. Population (1881), 421,508; (1891), 493,588, showing an increase of 17 per cent., due to the extension of irrigation; average density, 102 persons per square mile. In 1901 the population was 524,572, showing an increase of 6 per cent. The land revenue and rates in 1897–98 were Rs.6,95,949, the incidence of assessment being 5 annas per acre; cultivated area, 401,979 acres, of which 230,417 were irrigated, including 48,637 from Government canals; number of police, 445; number of schools (1896–97), 343, attended by 7551 boys, being 14·2 per cent. of the boys of school-going age; death-rate (1897), 32 per thousand. The principal crops are wheat, millet, pulse, and cotton. The largest town and chief commercial centre is Bhera. The district is traversed from different directions by two branches of the North-Western Railway, which approach each other on opposite banks of the Jhelum; total length, 75 miles; and there are 112 miles of navigable rivers.

Sháhrúd, capital of the Sháhrúd-Bostám province of Persia, situated about 258 miles east of Tehrán, on the high road thence to Mashhad, at an altitude of 4460 feet, in 36° 25′ N. and 54° 59′ E. It has a population of less than 10,000, post and telegraph offices, and a lively transit trade between western Khorassan and Astarábád, the latter place 44 miles away to the north. Although capital of the province, it is not the residence of the governor, who prefers the more salubrious Bostám, a small city with fine gardens and a mosque of the 14th century, lying 3 miles to the north-east.

Shamokin, a borough of Northumberland county, Pennsylvania, U.S.A. It is situated in 40° 47′ N., and 76° 33′ W., on Shamokin creek, east of the centre of the state, at an altitude of 730 feet. Its site is very hilly, but the street plan is fairly regular, and it is divided into ten wards. It has three railways, the Lehigh Valley, the Northern Central, and the Philadelphia and Reading. Lying within the anthracite coal region and surrounded by coal-mines, its chief industries are mining and shipping coal. Its manufactures are mainly of iron and steel. Population (1890), 14,403; (1900), 18,202, of whom 2703 were foreign-born and 65 negroes.

Shanghai, a treaty port in the province of Kiangsu, China. This city is by far the most important of all the treaty ports of China. Its geographical situation gives it peculiar advantages as a centre of trade. It lies midway on the coast line between Canton and Peking, is at the mouth of the great river Yangtse, and is the natural terminus of the ocean-borne trade coming from the Pacific coast of America and from Japan. It is thus the meeting-point of four distinct streams of trade. Its commerce, moreover, is under the protection of all the flags of Europe and America, for all are equally interested. During the Chino-Japanese war, by agreement between Great Britain and Japan, Shanghai and its approaches were specially exempted from the sphere of warlike operations. This is a precedent which will probably be followed in the event of future conflict between China and any foreign Power, while in the event of domestic revolution in China itself, all the foreign Powers would combine to offer the protection of their war vessels. Notwithstanding, therefore, the somewhat unstable condition of the Chinese Government, it would seem that whatever may happen Shanghai may reasonably be deemed safe. The value of the trade passing through the customs grew from H. taels 134,000,000 in 1880 (£36,800,000) to H. taels 306,701,000 (£46,005,000) in 1899—the silver valuation representing more nearly the volume. The principal items of import are cotton yarns (£4,620,700 in 1899), opium (£3,360,700), metals (£933,400), sugar (£907,800), petroleum (£1,185,600), and coal (£686,800); of export, silk (£14,298,300), cotton (£5,378,400), tea (£1,345,500), rice (£1,066,900), hides and skins (£1,043,800), wool, wheat, and beans. Great Britain and the British colonies supply nearly 31 per cent. of the imports, Japan 12½ per cent., and the United States 12 per cent.; and of the exports Great Britain and the British colonies take 18 per cent., the United States 12 per cent., and Japan 10 per cent. In 1900 there entered and cleared 7,982,850 tons of shipping under foreign flag, of which 5,043,700, or rather over 63 per cent., were British. In addition, 1,449,560 tons under the Chinese flag entered and cleared. Shanghai holds with respect to northern and central China the same position in point of trade that Hong Kong holds for south China. Each is the terminus of the ocean steamer traffic and the general depôt whence foreign imports are distributed to the outports, and where native produce is collected for export to foreign countries. The trade of Shanghai thus represents practically the trade of three-fourths of the country. Shanghai, moreover, is not only a port of trade, but is rapidly becoming a large manufacturing and industrial centre. In this category the

first place must be given to cotton mills, which, though not as yet very numerous, give promise of considerable development. The demand in China for cotton yarn, chiefly the produce of the Bombay mills, has been steadily on the increase, and in 1898 the import into Shanghai amounted to 330,000 bales valued at £3,000,000. On the other hand, China produces raw cotton in indefinite quantity, and has hitherto been the main source of supply for the Japanese mills. At the close of 1898 there were running in all 300,000 spindles—five out of eight mills being in foreign hands, the others being native. Cloth weaving was tried in two of the mills, but abandoned in favour of spinning. Next in importance is the reeling of silk cocoons by machinery. This is gradually supplanting the wasteful method of native reeling, giving a much better finished and consequently more valuable article. Shanghai also contains three large establishments for docking, repairing, and building ships. Among minor industries are match factories, rice and paper mills, ice, cigarette, piano, carriage, and furniture factories, wood carving, &c.

By virtue of extra-territorial clauses in the various treaties, all foreigners, subjects of any treaty Power, are exempted from the jurisdiction of the Chinese authorities, and made justiciable only before their own officials. As there are now fourteen treaty Powers represented at Shanghai, there are consequently fourteen distinct courts sitting side by side, each administering the law of its own nationality. In addition, there is also a Chinese court, commonly called the Mixed Court, though it is no more mixed than any of the others in an international sense, except that a foreign assessor sits with the Chinese judge in cases where any of his own nationality are interested as plaintiffs. At first sight this arrangement seems somewhat complicated, but the principle is simple enough, viz., that a defendant must always be sued in the court of his own nationality. In criminal cases there is of course no difficulty. For the British, English law alone prevails, and they can only be tried and punished in the British court. In the same way Frenchmen can only be tried in the French court, and so on for every nationality. In civil cases, where both parties are of the same nationality, there is also no difficulty, *e.g.*, for British subjects the British court is the forum, for German subjects it is the German court. In cases involving cross actions with mutual accounts, say between an Englishman and a German, the case may be brought into either the British or the German court according as the initiative is taken by the German or the Englishman. If the German constitutes himself plaintiff he must sue his opponent before the British court, and *vice versâ*. The greatest anomaly, however, in respect of the government of Shanghai is the local municipal control. This is exercised by the foreign community as a whole without regard to nationality, and is a share of the power which properly belonged to the Chinese local authorities, but which by convention or usage they have allowed to fall into foreign hands. It is exercised only within the area termed the foreign settlements, which were originally nothing more than the "area set apart for the residence of foreign merchants." Of these "settlements" there were and are still only three—the British acquired in 1845, the French acquired in 1849, and the American acquired in 1862. At an early date, as a foreign town began to spring up, the necessity of having some authority to lay out and pave streets, to build drains, &c., for the common benefit, became evident, and as the Chinese authorities shirked the work and the expense, the foreigners resolved to tax themselves voluntarily, and appointed a Committee of Works to see the money properly laid out. In 1854 the consuls of Great Britain, France, and the United States drew up a joint code of regulations applicable to both the then settlements, British and French, which being ratified by the respective Governments became binding on their respective subjects. The two areas thus became an international settlement, and the subjects of all three nationalities—the only Powers then interested—acquired the same privileges and became liable to the same burdens. The code thus settled was acquiesced in by the Chinese authorities and by other nationalities as they came in, and it conferred on the foreign community local self-government, practically free from official control of any description. In 1863 the area covered by the regulations was extended by the addition of the American settlement, which meanwhile had been obtained by that Government from the Chinese. But about the same time, 1862, the French decided to withdraw from the joint arrangement, and promulgated a set of municipal regulations of their own applicable to the French area. These regulations differed from those applicable to the joint settlement, in that a general supervision over municipal affairs was vested in the French consul-general, his approval being made necessary to all votes, resolutions, &c., of the ratepayers before they could be enforced at law. Since the above date there have, consequently, been two municipalities at Shanghai, the French and the amalgamated British and American settlements, to which the original regulations continued to apply. The area of the latter has been very greatly extended within the last few years, and now amounts to some nine or ten square miles. The regulations have been altered and amended from time to time, and they have been accepted expressly or impliedly by all the treaty Powers which have since come into the field. The settlements have thus lost their original character of British or American, and become entirely cosmopolitan. The consuls of all the treaty Powers rank equally, and claim to have an equal voice in municipal affairs with the British or American consuls.

The powers of self-government thus conferred on the foreign community consist in exclusive police control within the area, in draining, lighting, maintenance of streets and roads, making and enforcement of sanitary regulations, control of markets, dairies, and so forth. To meet these expenses the foreign ratepayers are authorized to levy taxes on land and houses, to levy wharfage dues on goods landed or shipped, and to charge licence fees. Taxes are payable by every one living within the settlements, Chinese included, though the latter have no voice in the local administration. The executive is entrusted to a municipal council of nine, elected annually from among the general body of foreign ratepayers, irrespective of nationality. The legislative function is exercised by all ratepayers possessing a certain pecuniary qualification in public meeting assembled. Proxies for absentee landlords are allowed. One such public meeting must be held annually to pass the budget and fix the taxation for the year. No official sanction is required, and no veto is allowed for such money votes. Special meetings may be held at any time for special purposes. New legislation of a general kind requires to be approved by all the treaty Powers in order to be binding on their several nationalities, but within certain limits the ratepayers can pass by-laws which do not require such sanction. In 1899 the revenue of the municipality amounted to taels 916,000 (£137,400). The French municipality is worked on similar lines, except that every vote and every disbursement of money is subject to the approval of the French consul-general. The executive council consists of eight members, four of whom must be French and four may be foreign. The French consul-general is chairman *ex officio*, so that the control in any case is French and practically official.

Both settlements were originally intended for the residence of foreign merchants only, but as the advantages of living under foreign protection became evident by reason of the security it gave from arbitrary taxation and arrest, Chinese began to flock in. This movement has continued, and is now particularly noticeable in the cases of retired officials, many of whom have made Shanghai their home. The total native population in the settlements by the census of 1895 was 286,753, and the estimated population of the native city was 125,000, making a total for all Shanghai of 411,753. In 1900 the foreign population was 6774, of whom 2691 were British. The magnitude of the foreign interests invested in Shanghai may be gathered from the following rough summary:—Assessed value of land in settlements registered as foreign-owned £5,500,000; docks, wharves, and other industrial public companies—market value of stock, £2,250,000; private property estimated £1,500,000,—total £9,250,000. This is exclusive of banks, shipping and insurance companies, and other institutions which draw profits from other places besides Shanghai. (G. J.)

Shanhai-Kwan, a garrison town in the extreme north-east of the province of Chihli, China. It is situated at the point where the range of hills carrying the Great Wall of China dips to the sea, leaving a *kwan* or pass of limited extent between China proper and the provinces of Manchuria. It is thus an important military station, and the thoroughfare of trade between Manchuria and the great plain of China. The Imperial Northern Railway from Tientsin and Taku, 174 miles from the former, runs through the pass, and continues skirting the northern shore of the Gulf of Pechili as far as the treaty port of Newchwang, where it is in touch with the Russian system of railways leading from Port Arthur to the Siberian main line. The pass forms the southern limit of the Russian sphere of influence as defined in the convention between Great Britain and Russia of April 28, 1899.

Shanklin, an urban district (1894), and watering-place, Hampshire, England, in the Isle of Wight, 8 miles south-east of Newport by rail. The pier was completed

in 1891, and in 1892 a lift connecting the town and esplanade was constructed at a cost of £6000. A Home of Rest for seventy-three inmates (women) was erected in 1893. Shanklin Chine is a picturesque chasm in a lofty cliff bordering the bay on which the town stands. Population (1891), 3921; (1901), 4533.

Shan Tribes. See Lolos.

Shari, an important river of North Central Africa, carrying the drainage of a large area of the interior into Lake Chad (*q.v.*). It has a considerable number of head-streams, which take their rise on the watersheds between the Lake Chad basin and those of the Nile and Congo. The most important is probably the Bamingi, one branch of which, the Kukuru, rises in about 7° N. and 21° 15′ E. At about 90 miles from its source the Bamingi is some 80 yards wide and 12 feet deep, with a gentle current, and is navigable from this point to Lake Chad. Flowing generally north-west, it receives the Gribingi on the left bank in 8° 42′ N., the Bahr Sara (probably derived from a distant source in the south-west, and thought by some to be the principal branch of the river) in 9° 20′, and the Bangoran on the right in 9° 14′ N. The Gribingi is a narrow and tortuous river with rocky banks, and often broken by rapids, though navigable at high water to 7° N. It flows in great part through a forest-clad country. The Bangoran rises in about 7° 45′ N. and 22° E., in a range of hills which separates the countries of Dar Runga and Dar Banda, and, like the Bamingi, flows through open or bush-covered plains with isolated granite ridges. Below the junction the Shari becomes a large river, reaching, in places, a width of over 4 miles in the rains; while its valley, bordered by elevated tree-clad banks, contains many temporary lakes and back-waters. Its waters abound with hippopotami and crocodiles, and the country on either side with game of all kinds. In 9° 46′ N. it receives the Bakare or Awauk from the east, known in its upper course as the Aukadebbe. This, like the Bahr es Salamat, which enters the Shari in 10° 2′ N., traverses a wide extent of arid country in southern Wadai, and brings no large amount of water to the Shari. In 10° 12′ a divergent branch, the Ergig, leaves the main stream, only to rejoin it in 11° 30′. In 12° 15′ the Shari receives on the west bank its largest tributary, the Logone, the upper branches of which rise far to the south between 6° and 7°. In 9° 15′ N. it has a width of over 500 yards. Its system is said to be connected with that of the Benue (see Niger) by means of the Tuburi Swamp, but this is somewhat doubtful. Below the Logone the Shari, here a noble stream, soon splits up into various arms, forming an alluvial delta, flooded at high water, before entering Lake Chad. The whole upper basin of the Shari, as well as the right bank of the lower river, falls within French territory, and a steamer was placed on its waters in 1897 by the French pioneer Gentil.

Sharon, a borough of Mercer county, Pennsylvania, U.S.A. It is situated on the Lake Shore and Michigan Southern and the Pennsylvania railways, in the north-western part of the state, at an altitude of 855 feet. It has extensive iron and steel works, including blast furnaces, rolling mills, foundries, and nail factories. Population (1890), 7459; (1900), 8916, of whom 1805 were foreign-born and 113 negroes.

Sharpsburg, a borough of Allegheny county, Pennsylvania, U.S.A. It is on the river Allegheny, and on the Pennsylvania and the Pittsburg and Western railways, in the south-western part of the state, at an altitude of 741 feet. Its industries are coal mining and iron manufacturing, and it has blast furnaces, rolling mills, and foundries. Population (1890), 4898; (1900), 6842, of whom 1280 were foreign-born and 258 negroes.

Shasi, a city in the province of Hupeh in China, on the left bank of the river Yangtse, about 85 miles below Ichang. It was opened to foreign trade under the Japanese treaty of 1895. The town lies below the summer level of the Yangtse, from which it is protected by a strong embankment running for many miles above and below. Its value consists in the fact that it is the terminus of an extensive network of canals which run through the whole of the low country lying on the north bank of the Yangtse as far down as Hankow. Native boats, as a rule, prefer the canal route to the turbulent waters of the Yangtse, their cargoes being transhipped at Shasi across the embankment into river boats. The population is estimated at 80,000. Foreign residents are very few, and the trade passing through the maritime customs is comparatively insignificant, amounting in 1900 to only £85,600. The place is, however, a large distributing centre for native trade, and is besides the seat of an extensive manufacture of native cotton cloth.

Shatsk, a district town of Russia, in the government and 88 miles north of the town of Tamboff. It is a growing prairie town, with a considerable export trade in grain and flour. Population (1897), 13,928.

Shaw, Henry Wheeler (1818–1885), American humorist, known by his *nom de guerre* of "Josh Billings," was born at Lanesborough, Mass., 21st April 1818, his father being a well-known member of the Massachusetts Legislature and of Congress. After knocking about in the West for a time, Shaw, in 1858, settled down in Poughkeepsie, New York, as a land-agent, and began writing newspaper articles; but it was not till he hit upon the idea of adopting a system of facetious mis-spelling that he made a success in 1860 with his "Essa on the Muel, bi Josh Billings," in a New York paper. He proceeded to work this vein of humour in a number of droll articles and volumes, which had a widespread circulation, the principal being: *Josh Billings, his Sayings* (1866), *Josh Billings's Farmers' Almanax* (1870), *Josh Billings's Complete Works* (1877), *Josh Billings's Spice-Box* (1881). He also became very popular as a platform lecturer, his mannerisms and apparently unstudied witticisms making him a conspicuous contemporary "character." He died at Monterey, California, 14th October 1885. His *Life* was published by F. S. Smith in 1883.

Shaw, Richard Norman (1831– ——), British architect, was born in Edinburgh, 7th May 1831. At the age of sixteen he went to London and became a pupil of William Burn. It was in Burn's office that he formed the friendship with William Eden Nesfield which so profoundly influenced the careers of both. There Mr Shaw was thoroughly grounded in the science of planning and in the classical vernacular of the period. This office-work was supplemented by attendance at the architectural schools of the Royal Academy, and the careful study of old and of the best contemporary buildings. In 1854, having finished his term of apprenticeship with Burn, he gained the gold medal and travelling studentship of the Royal Academy, and from then until 1856 he travelled on the Continent, studying and drawing old work. On his return in 1856 he was requested by the Council of the Royal Academy to publish his drawings. This work, entitled *Architectural Sketches from the Continent*, was issued in 1858. In the meantime Nesfield was continuing his studies with Anthony Salvin; Mr Shaw also entered his office, and remained there until 1857, when he widened his experience by working for

three years under George Edmund Street. In 1863, after sixteen years of severe training, he began to practise. For a short time he and Nesfield joined forces, but their lines soon diverged. Mr Shaw's first work of importance was Leyes Wood, in Surrey, a building of much originality, which was followed shortly afterwards by Cragside, for Lord Armstrong, begun in 1869. These buildings, and others taken in hand at about the same period, attracted immediate attention; and from that time until he retired from active practice his works followed one another in quick succession. In 1872 Mr Shaw was elected an Associate of the Royal Academy, and a full member in 1877; he joined the "retired" list towards the end of 1901.

Other characteristic examples of Shaw's work are Preen Manor, Shropshire; New Zealand Chambers, Leadenhall Street; Pierrepont, Wispers, and Merrist Wood, in Surrey; Lowther Lodge, Kensington; Adcote, in Shropshire; his houses at Kensington, Chelsea, and at Hampstead; Flete House, Devonshire; Greenham Lodge, Berkshire; Dawpool, in Cheshire; Bryanstone, in Dorsetshire; Chesters, Northumberland; New Scotland Yard, on the Thames Embankment; besides several fine works in Liverpool and the neighbourhood. He also built and restored several churches, the best known of which are St John's Church, Leeds; St Margaret's, Ilkley; and All Saints', Leek. His early buildings were most picturesque, and contrasted completely with the current work of the time. The use of "half timber" and hanging tiles, the projecting gables and massive chimneys, and the cunningly contrived bays and recessed fireplaces, together with the complete freedom from the conventions and trammels of "style," not only appealed to the artist, but gained at once a place in public estimation. Judged in the light of his later work, some of those early buildings appear almost too full of feature and design; they show, however, very clearly that Mr Shaw, in discarding "academic style," was not drifting rudderless on a sea of fancy. His buildings, although entirely free from archæological pedantry, were the outcome of much enthusiastic and intelligent study of old examples, and were based directly on old methods and traditions; but although naturally they took more or less traditional forms, the architect concerned himself more with the spirit of old work than with its letter, and within these wide limits he allowed his imagination full play. As his powers developed, his buildings gained in dignity, and had an air of serenity and a quiet homely charm which were less conspicuous in his earlier works; the "half timber" was more sparingly used, and finally disappeared entirely. His work throughout is especially distinguished by treatment of scheme. There is nothing tentative or hesitating. His planning is invariably fine and full of ingenuity. Adcote (a beautiful drawing of which hangs in the Diploma Gallery at Burlington House) is perhaps the best example of the series of his country houses built between 1870 and 1880. The exterior is simple and dignified, and the detail refined and elegant. The elements are few but perfectly proportioned and combined, and the scale throughout is consistent. The Great Hall is the keynote of the plan, and is properly but not unduly emphasized. The grouping of the rooms round the Hall is very ably managed—each room is in its right position, and has its proper aspect. The plan is a practical one, fulfilling its purpose as a modern house, but is nevertheless full of originality and character. New Zealand Chambers, in Leadenhall Street, another work of about the same period (1870–80), is a valuable example of Mr Shaw's versatility. Here he employed a completely different method of expression from any of his preceding works, in all of which there is a trace of "Gothic" feeling. This is a façade only of two storeys, divided by piers of brickwork into three equal spaces, filled by shaped bays rich with modelled plaster; above, drawing the whole composition together, is a finely enriched plaster cove. An attic storey, roofed with three gables, completes the building, which is the antithesis of the accepted type of city offices; it is yet perfectly adapted to modern uses. New Scotland Yard is undoubtedly Mr Shaw's finest and most complete work. The plain granite base is not only subtly suggestive of the purposes of the building, but by dividing the height with a strongly marked line, gives a greater apparent width to the structure; it suggests also a division of departments. By its mass, too, it prevents the eye from dwelling on the necessary irregularity of the lower windows, which are not only different in character from those of the upper storeys, but more numerous and quite irregularly spaced. The projecting angle turrets are most happily conceived, and besides giving emphasis to the corners, form the main point of interest in the composition of the river front. The chimneys are not allowed to cut the sky-line in all directions, but have been drawn together into massive blocks, and contribute much to the general air of dignity and strength for which this building is remarkable. Simple roofs of ample span complete a composition conspicuous for its breadth and unity.

Mr Shaw's influence on his generation can only be adequately gauged by a comparison of current work with that which was in vogue when he began his career. The works of Pugin, Scott, and others, and the architectural literature of the time, had turned the thoughts both of architects and the public towards a "revived Gothic." Before he entered the field, this teaching had hardened into a creed. Mr Shaw was not content to hold so limited a view, and with characteristic courage threw over these artificial barriers and struck out a line of his own. The rapidity with which he conceived and created new types, and as it were set a new fashion in building, compelled admiration for his genius, and swelled the ranks of his adherents. It is largely owing to him that there is now a distinct tendency to approach architecture as the art of Building rather than as the art of Designing, and the study of old work as one of methods and expressions which are for all time, rather than as a means of learning a language of forms proper only to their period.

Sheba. See ARABIA.

Sheboygan, a city of Wisconsin, U.S.A., capital of Sheboygan county. It is on the shore of Lake Michigan, at the mouth of the river Sheboygan, and on the Chicago and North-Western Railway, in the western part of the state, at an altitude of 589 feet. The city is regularly laid out, is divided into eight wards, has a good water-supply from the lake, and is well sewered. Its harbour is excellent, and it has a large lake commerce, principally in lumber. The manufactures consist mainly in the making of furniture, especially chairs, for which it is noted. The city was settled in 1836, incorporated as a village in 1846, and received its city charter in 1853. Population (1890), 16,359; (1900), 22,962, of whom 7399 were foreign-born.

Shechem, now NABLUS, the chief town of a sanjak of the Beirût vilayet of Asiatic Turkey, altitude 1870 feet, situated in Central Palestine, in the valley which separates Ebal from Gerizim. There are Protestant and Roman Catholic missions, with churches and schools, and a Samaritan synagogue. The population of 24,000 includes 170 Samaritans, 700 Christians, and a few Jews.

Sheep. See AGRICULTURE.

Sheerness, a garrison town and naval seaport of England, at the extreme north-west corner of the Isle of Sheppey, Kent, and on the right bank of the Medway estuary, 51 miles east of London by rail and 11 miles east-north-east of Chatham. Blue Town, the older part of the town, with the dockyard, is defended by strong modern-built fortifications, especially the forts of Garrison Point and Barton's Point. The dockyard, chiefly used for naval repairs, covers about 60 acres, and consists of three basins and five docks, the depth of water on the sill ranging from 15 to 25½ feet. Within the yard there are extensive naval stores and barracks for 1000 men. Outside the dockyard are the residence of the port admiral and admiral of the Nore and military barracks. The harbour is spacious, sheltered, and deep even at low water. The place is also visited to some extent for sea-bathing. There is steamboat connexion between Sheerness and Port Victoria, on the opposite side of the Medway; with Southend, on the opposite side of the Thames; and with Chatham and London Bridge. Queenborough Pier, 1 mile to the south, is the port of embarkation for passengers travelling to the Continent *viâ* Flushing. It was in this neighbourhood that the celebrated mutiny of the Nore broke out in 1797, the Nore being the name given to the estuary of the Thames between the Isle of Sheppey and the opposite coast of Essex. The Nore light floats above a sandbank 4 miles north-east of Sheerness. Before 1894 Sheerness formed part of the parish of Minster, but it was then formed into a separate parish. Area, 876 acres. Population (1891), 14,492; (1901), 18,273.

Sheffield, a city (1893), and a county (1888) and parliamentary borough of Yorkshire, England, at the confluence of the Sheaf with the Don, 39 miles south of Leeds, 157 miles by rail north-north-west of London. Of its constituent townships Upper Hallam still remains in large part agricultural. In 1897 the title of lord mayor was conferred on the chief magistrate, and under an Act of 1900 the city area was extended by 4003 acres. The water-works, supplying about 8½ million gallons daily to the city and district, were acquired by the corporation in 1887. New water-works are in course of construction in the Little Don valley, while Sheffield is also a constituent of the Derwent Valley Water Board (1899). The capital cost of the water-works undertaking up to 25th March 1900 exceeded £2,571,374. The electric lighting of the borough, dating from 1892, was in 1898 transferred to the corporation. From 1884 to 1886 a new sewage system, costing £132,000, and sewage disposal works, costing £44,000, were executed. Tramways, mostly electric traction, in 1900 stretched altogether over 17½ miles length of streets. Further, in 1900, 13 miles of new tramway line were sanctioned, involving in most cases the widening of the roads passed through, and an estimated expenditure of £349,495. A number of old streets have been pulled down, many narrow streets widened, new and handsome thoroughfares opened up. A handsome carriage bridge connects the districts of Walkley and Neepsend. At Newhall (Attercliffe) a single-span bridge, 46 feet 6 inches between parapets, has taken the place of the former one, only 12 feet 6 inches wide. At Carbrook a new carriage bridge displaces a wooden pedestrian structure. On 25th March 1900 the streets of Sheffield had a total length of 321·58 miles. The street improvements determined on in 1900 involved an estimated cost of £445,176. Besides the parish church of St Paul's there are 35 churches and numerous dissenting places of worship. Ransmoor Church was rebuilt in 1888 at a cost of £22,000. University College, constituted by that title in 1897, was founded in 1879 as the Firth College, enlarged in 1892, and comprises, besides the college, a technical department (1886), occupying the buildings of the former grammar school, and equipped with metallurgical laboratories, steel works, iron foundry, a machine and fitting shop, &c.; and a medical school (1888), together with a school of pharmacy (1885). Other modern buildings include a new town-hall (1897), costing, exclusive of the site, about £130,000; the Mappin art gallery (1887); the Ruskin museum, since 1890 in the custody of the corporation, and transferred to Meersbrook Park; Jubilee memorial (1887); Lodge Moor hospital (1888); the Lyceum (1893), Alhambra, and other theatres. Since 1899 the markets, purchased from the duke of Norfolk for £526,000, have been the property of the corporation. Several new parks and recreation grounds have been opened in recent years. Cutlery still continues the leading industry of Sheffield. Minor industries include important horse-hair cloth, railway-carriage fittings, and testing works. The Cutlers' Company (1624) of Sheffield, by Acts 1883–88, exercises jurisdiction, in all matters relating to the registration of trade marks, over all goods composed in whole or in part of any metal, wrought or unwrought, as also over all persons carrying on business in Hallamshire and within 6 miles thereof. The collieries include the Nunnery, with four drawing pits, and the Aldwarke main, with machinery to raise 1500 tons daily. In 1891, 3385 persons were engaged in the making of machinery; 22,115 men and 3642 women in the manufacture of cutlery, files, saws, &c.; and 2476 persons in mining. There are three daily newspapers. Area of municipal (coextensive with parliamentary) borough, 19,651 acres. Population (1891), 324,243; (1901), 380,717.

Shelbyville, a city of Indiana, U.S.A., capital of Shelby county. It is on the river Big Blue, and the Pittsburg, Cincinnati, Chicago, and St Louis and the Cleveland, Cincinnati, Chicago and St Louis railways, in the central part of the state, at an altitude of 768 feet. It is in an agricultural and coal-mining region and contains varied manufactures. Population (1890), 5451; (1900) 7169, 326 being foreign-born and 257 negroes.

Shenandoah, a borough of Schuylkill county, Pennsylvania, U.S.A. It is situated in 40° 49′ N. and 76° 12′ W., in the valley of Shenandoah creek, on the Pennsylvania, the Lehigh Valley, and the Philadelphia and Reading railways, in the eastern part of the state, at an altitude of 1249 feet. Its site is hilly and uneven, the street plan is irregular, and it is divided into five wards. It is within the anthracite coal-field, several large collieries being within its limits, and others surrounding it. Its industries relate almost exclusively to mining, handling and shipping coal. Population (1890), 15,944; (1900), 20,321, of whom 8499 were foreign-born.

Shepton Mallet, a market-town in the Eastern parliamentary division of Somersetshire, England, 5 miles east-south-east of Wells by rail. The hospital and the Masonic hall have been enlarged. Urban district offices, including rooms for technical instruction, have been built. Area of civil parish (an urban district), 3825 acres. Population (1891), 5267; (1901), 5238.

Sher Ali Khan (1825–1879), Amir of Afghanistan, was born in 1825, and was one of the younger sons of the Amir Dost Mahommed, whom he succeeded in 1863. For some time after his succession Afghanistan was in a state of anarchy, and his rebellious half-brothers overran the country while he remained at Kandahar mourning the loss of a favourite son. At length, however, the capture of Kabul in 1867 roused him to action; but in spite of his own bravery he suffered general defeat until 1868, when he regained Kabul. Supported by the viceroys of India, Lord Lawrence and Lord Mayo, Sher Ali remained on good terms with the British Government for some years; but after the rebellion of his son Yakub Khan, 1870–74, he leaned towards Russia, and welcomed a Russian mission at Kabul in 1878, and at the same time refused to receive a British mission. This led to long negotiations, and ultimately to war, when the British forced the Khaibar Pass in November 1878, and defeated the Amir's forces on every occasion. Sher Ali fled from his capital, and taking refuge in Turkestan, died at Mazar-i-Sharif 21st February 1879.

Sherbrooke, a city and port of entry of Quebec, Canada, and capital of Sherbrooke county, 80 miles east of Montreal, at the confluence of the rivers Magog and St Francis, and on the Grand Trunk, Canadian Pacific, Quebec Central and Boston and Maine railways. It is the seat of a Roman Catholic bishop and the district courts, and contains manufactories of woollen and cotton goods and machinery, also saw- and grist-mills. Population (1891), 10,110; (1901), 11,765.

Sherbrooke, Robert Lowe, Viscount (1811–1892), British statesman, was born on 4th December 1811, at Bingham, Notts, where his father was the rector. He was educated at Winchester and University College, Oxford, where he took a first class in classics and a second in mathematics, besides taking a leading part in the Union debates. In 1835 he won a fellowship at Magdalen, but vacated it on marrying, in 1836, Miss Georgina Orred (*d.* 1884). He was for a few years a successful "coach" at Oxford, but in 1838 was bitterly disappointed at not being elected to the professorship of Greek at

Glasgow. In 1841 Lowe moved to London, to read for the Bar ("called" 1842); but his eyesight showed signs of serious weakness, and, acting on medical advice, he determined to try his fortune in the colonies rather than in London. He went to Sydney, where he set to work in the law courts. In 1843 he was nominated by Sir George Gipps, the governor, to a seat in the New South Wales Legislative Council; owing to a difference with Gipps, he resigned his seat, but was elected shortly afterwards for Sydney. Lowe soon made his mark in the political world by his clever speeches, particularly on finance and education; and besides obtaining a large legal practice, he was one of the principal writers for the *Atlas* newspaper. In 1850 he went back to England, in order to enter political life there. His previous University reputation and connexions, combined with his colonial experience, stood him in good stead. *The Times* was glad to employ his ready pen, and as one of its ablest leader-writers he made his influence widely felt. In 1852 he was returned to Parliament for Kidderminster in the Liberal interest. In the House of Commons his acute reasoning made a considerable impression, and under successive Liberal ministries (1853–1858) he obtained official experience as secretary of the Board of Control and vice-president of the Board of Trade. In 1859 he went to the Education Office as vice-president of the Council in Lord Palmerston's ministry; there he pursued a vigorous policy, insisting on the necessity of payment by results, and bringing in the revised code (1862), which embodied this principle and made an examination in "the three R's" the test for grants of public money. He felt then, and still more after the Reform Act of 1866, that "we must educate our masters,"[1] and he rather scandalized his old University friends by the stress he laid on physical science as opposed to classical studies. Considerable opposition was aroused by the new régime at the Education Office, and in 1864 Lowe was driven to resign by an adverse vote in Parliament with reference to the way in which inspectors' reports were "edited." Lord Palmerston's death in October 1865 was followed by the formation of the Russell-Gladstone ministry and the introduction of the Reform Bill of 1866. Lowe, a Liberal of the school of Canning and Peel, had already made known his objections to the advance of "democracy,"—notably in his speech in 1865 on Sir E. Baines's Borough Franchise Bill,—and he was not invited to join the new ministry. He retired into what Bright called the "Cave of Adullam," and opposed the Bill in a series of brilliant speeches, which raised his reputation as an orator to its highest point and effectually caused the downfall of the Government. He remained, nevertheless, a Liberal; and after the franchise question had been settled by what Lowe considered Disraeli's betrayal, and he had been elected the first member for London University, he accepted office again in the Gladstone Cabinet of 1868 as chancellor of the Exchequer. Lowe was a rather cut-and-dry economist, who prided himself that during his four years of office he took twelve millions off taxation; but later opinion has hardly accepted his removal of the shilling registration duty on corn (1869) as good statesmanship, and his failures are remembered rather than his successes. His proposed tax of a halfpenny a box on lucifer matches in 1871 (for which he suggested the epigram *ex luce lucellum*) roused a storm of opposition, and had to be dropped. In 1873 he was transferred to the Home Office, but in 1874 the Government resigned.

[1] This phrase is always ascribed to Lowe, and has become history in association with him. But what he really said in his address to the Edinburgh Philosophical Institution in 1867, was that it was necessary "to induce our future masters to learn their letters."

When the Liberals returned to power in 1880 he was raised to the peerage as Viscount Sherbrooke, but from 1875 till his death at Warlingham, Surrey, on 27th July 1892, his health was constantly failing, and by degrees he figured less and less in public life. Bobby Lowe, as he was popularly known, was one of the most remarkable personalities of his day, with his tall, striking figure, albino complexion and hair, and faculty for epigram and irony. During the 'seventies the following epitaph was suggested for him by one of the wits of his day:—

> Here lies poor old Robert Lowe;
> Where he's gone to I don't know;
> If to the realms of peace and love,
> Farewell to happiness above;
> If, haply, to some lower level,
> We can't congratulate the devil.

Lowe was delighted with this, and promptly translated it into Latin, as follows:—

> Continentur hac in fossa
> Humilis Roberti ossa;
> Si ad cœlum evolabit
> Pax in cœlo non restabit;
> Sin in inferis jacebit
> Diabolum ejus pœnitebit.

His literary talent, though mainly employed in journalism, was also shown in a little volume of verses, *Poems of a Life* (1884). He married a second time, in 1885, but left no children.

See also *Life and Letters*, by A. PATCHETT MARTIN. Longmans, 1893. (H. CH.)

Shereef Pasha (1818–1887), Egyptian statesman, born in 1818, was a Circassian who filled numerous administrative posts under Said and Ismail Pashas. He was of better education than most of his contemporaries, and had married a daughter of Colonel Sèves, the French non-commissioned officer who became Soliman Pasha under Mehemet Ali. As minister of foreign affairs he was useful to Ismail, who used his bluff *bonhomie* to veil many of his most insidious proposals. Of singularly lazy disposition, he yet possessed considerable tact—he was in fact an Egyptian Lord Melbourne, whose policy was to leave everything alone. His favourite argument against any reform was to appeal to the Pyramids as an immutable proof of the solidity of Egypt financially and politically. His fatal optimism rendered him largely responsible for the collapse of Egyptian credit which brought about the fall of Ismail. Upon the military insurrection of September 1881, Shereef was summoned by the Khedive Tewfik to form a new ministry. The impossibility of reconciling the financial requirements of the national party with the demands of the British and French controllers of the public debt, compelled him to resign in the following February. After the suppression of the Arabi rebellion he was again installed in office by Tewfik, but in January 1884 he resigned rather than carry out the policy of the evacuation of the Sudan. He died at Gratz, 20th April 1887, on his way to take the waters at Carlsbad.

Sheridan, Philip Henry (1831–1888), American soldier, third son of John and Mary (Minor) Sheridan, was born at Albany, New York, 6th March 1831. In 1832 his father removed to Somerset, Perry county, Ohio. His early education was acquired in the primitive common school of that early day; his later at West Point, at which he graduated in 1853 as number thirty-four in a class of fifty-two. He was commissioned, July 1853, brevet second lieutenant. From 1853 to 1861 he served on the frontier and the Pacific coast, engaged in Indian war-

fare. He was appointed captain, 13th Infantry, 14th May 1861, having passed through the intermediate grades—second lieutenant, 22nd November 1854, and first lieutenant, 1st March 1861. After serving as president of a board to audit claims, and as quartermaster and commissary, Sheridan was commissioned colonel, 2nd Michigan Cavalry, 25th May, and engaged in a raid on Booneville, Miss., and in pursuit of the enemy from Corinth to Baldwin, Miss. He was in command of a cavalry brigade, 11th June, and participated in skirmishes at Booneville, Blackland, Donaldson Cross Roads, and Baldwin, and in the engagement at Booneville, 1st July, where he won his first star, being made brigadier-general of volunteers, 1st July 1862. He was engaged with Faulkner's command, 27th August, and was in command of "Pea Ridge Brigade," 6th September. He was then placed in command of infantry troops, 1st October to 2nd November, the 11th Division of the Army of the Ohio, and took part in Buell's advance in Kentucky, being heavily engaged at the battle of Perryville, Ky., 8th October. He marched to the relief of Nashville, Tenn., October to November, in command of the 3rd Division, Right Wing, 14th Army Corps, later designated the 3rd Division of the 20th Army Corps, Army of the Cumberland. His division rendered efficient service in the battle of Stone River, 31st December 1862 to 3rd January 1863, where he won his double stars, being commissioned major-general of volunteers, 31st December 1862. He took part in the pursuit of Van Dorn to Columbia, Tenn., in March 1863, capturing a train and prisoners near Eagleville; in the advance on Tullahoma, 24th June to 4th July, capturing Winchester, 27th June; in the campaign across Cumberland mountains and the river Tennessee, 15th August to 4th September; engaged in the battle of Chickamauga, 19th and 20th September; was active in operations in and about Chattanooga from September to December 1863; and was engaged in the battle of Missionary Ridge, 23rd to 25th November, where his troops were the first to reach the crest of the ridge and to break the enemy's line. From December 1863 to March 1864 he was engaged in the occupation of East Tennessee. He was then placed in command of cavalry once more, and was at the head of the Cavalry Corps of the Army of the Potomac from 4th April to 3rd August in the Richmond campaign. He took part in the battles of the Wilderness, 5th and 6th May; Todd Tavern, 7th May; Spottsylvania Court House, 8th May; and Cold Harbor, 31st May and 1st June. He engaged in a raid to Haxall's Landing and the return, 9th to 24th May, destroying parts of the Virginia Central and Richmond and Fredericksburg railways; and in the Charlottesville raid, 7th to 28th June. Then again he was transferred to infantry troops, and placed in command of the army of the Shenandoah, 4th to 7th August, and of the Middle Military Division, 7th August 1864 to 25th March 1865. He fought the battle of Opequan, 19th September, defeating Early; and was made brigadier-general in the regular army, 20th September 1864. He again defeated Early at Fisher's Hill, 22nd September. He fought the battle of Cedar Creek, 19th October, in which he turned a disastrous defeat into a great victory, for which he received the thanks of Congress and his commission as major-general U.S. Army, 8th November 1864. He undertook a raid from Winchester to Petersburg, 27th February to 24th March 1865, in which the James River and Kanawha Canal was greatly injured, and the Richmond and Fredericksburg, Virginia Central, and Gordonsville and Lynchburg railways were cut in several places. He was next engaged in the Richmond campaign, 25th March to 9th April 1865, where his services in a large measure hastened the final ending of the war, being in command at the battles of Five Forks, 1st April; Sailor's Creek, 6th April; and Appomattox Station, 8th April. From 3rd June 1865 to 5th September 1867 General Sheridan commanded successively, with headquarters in New Orleans, the Military Division of the South-West, the Military Division of the Gulf, the Department of the Gulf, and the Fifth Military District (Louisiana and Texas). From 12th September 1867 to 16th March 1869 he was in command of the Department of the Missouri, and was engaged in the winter campaign of 1868–69 against the Indians, resulting in their defeat and surrender. He was commissioned lieutenant-general U.S. Army, 4th March 1869; from 16th March 1869 to 1st November 1883 was in command of the Division of the Missouri; and from 1st November 1883 to 5th August 1888 was in command of the armies of the United States, headquarters Washington; commissioned general U.S. Army, 1st June 1888. He died at Nonquit, Mass., 5th August 1888, aged fifty-eight years.

GENERAL PHILIP SHERIDAN.
(From a photograph by Sarony, New York.)

In person General Sheridan was 5 feet 5 inches high, of compact frame, with large round head. On horseback he appeared of ordinary height, owing to his body being relatively longer than his lower limbs. As a soldier he never knew what fear was; he was cool, active, resolute, and resourceful, with every watchful care for the welfare of his troops. Fighting was his element, and to be in the thick of the fray was his greatest enjoyment. He was one of the great cavalry leaders of the world. He was president of the Society of Army of the Potomac and of the Society of Army of the Cumberland, the latter for fourteen years, and was noted as a presiding officer for despatching business by prompt military methods. In manner he was modest and unassuming. He married, 3rd June 1875, in Chicago, Miss Irene Rucker, daughter of General D. H. Rucker, of the regular army. He spent the summer of 1870 in Europe, and was the guest of the king of Prussia during the Franco-German war. He wrote his *Personal Memoirs*, 2 vols., published after his death. (H. M. C.)

Sherman, a city of Texas, U.S.A., capital of Grayson county. It is in the north-eastern part of the state, at an altitude of 720 feet, and is chiefly a railway centre, being entered by six railways, the Houston and Texas Central, the Missouri, Kansas, and Texas, the St Louis South-Western, the Gulf, Colorado, and Santa Fé, the St Louis, and San Francisco, and the Texas and Pacific, all important lines. The surrounding country produces cotton, wheat, and corn, for which Sherman is the chief shipping-point. It contains cotton gins, cotton seed oil mills, and other manufacturing establishments. Austin College, situated here, had, in 1899, 8 instructors and 108 students. Population (1890), 7335; (1900), 10,243, of whom 308 were foreign-born and 2131 negroes.

Sherman, John (1823–1900), American financier and statesman, a younger brother of General W. T. Sherman (see below), was born at Lancaster, Ohio, in 1823. He began the study of law at Mansfield, Ohio, and was admitted to the Bar in 1844. For ten years he practised his profession with success, and with only casual interest in politics. His associations and predilections were with the Whigs, and he was a delegate to the National Convention that nominated General Taylor in 1848. Upon the repeal of the Missouri Compromise in 1854, he joined the great popular movement in Ohio against this policy, and was elected to Congress in the autumn of that year as an "Anti-Nebraska" man. In the summer of the next year he took an active part in the formal organization of the Republican party in the state, and at the opening of Congress in December began a long career of public service. As a member of the House, 1855–61, he quickly manifested the qualities which characterized his whole political life. Though a thorough and avowed partisan, he was within the party the counsellor of moderate rather than extreme measures, and thus gained on the whole a position of great influence. He was a member of the committee sent by the House in 1856 to investigate the troubles in Kansas, and drafted the report of the majority. In 1859 he was the Republican candidate for Speaker of the House, but was obliged, after a contest that lasted two months, to withdraw, largely because of the recommendation he had inadvertently given to a virulent anti-slavery book. He became, however, chairman of the Committee on Ways and Means, and was instrumental in the enactment of the Morrill Tariff Act of 1860. In March 1861 he took his seat in the Senate, to which he had been elected to succeed Salmon P. Chase, when the latter became secretary of the Treasury. As senator he sat continuously till he became secretary of the Treasury in 1877. His interest and efficiency in financial legislation in the House led to his appointment on the Senate Committee of Finance, and after 1867 he was chairman of this influential committee. He thus became associated with the enactment of all the great fiscal laws through which the strain of war and of reconstruction was sustained. He gave earnest support to the Legal Tender Act, and the substitution of the national for the state banking system. When, after the end of the war, the question of financial readjustment came up, he vigorously opposed Secretary McCulloch's policy of retiring the legal tenders, and urged a different plan for effecting the resumption of specie payments. On the questions relating to political reconstruction and the policy of President Johnson, he supported his party, though opposed to its Radical leaders. He warmly advocated the insertion in the Reconstruction Acts of a provision ensuring the early termination of military government; and he opposed the impeachment of President Johnson, though he voted for conviction on the trial. During the administrations of President Grant his leadership in shaping financial policy became generally recognized. The Resumption Act of 1875, which provided for the return of specie payments four years later, was largely his work both in inception and in formulation, and his appointment to the Treasury Department by President Hayes in 1877 enabled him to carry the policy embodied in the law to successful execution. His administration of the department, in circumstances of great difficulty arising out of the "greenback" agitation and the adverse political complexion of Congress, won him high distinction as a financier.

At the end of the Hayes Administration he was again elected to the Senate from Ohio, and held his seat till 1897. During this period he was largely concerned in the enactment of the Anti-Trust Law of 1890, and of the so-called Sherman Act of the same year, providing for the purchase of silver and the issuing of Treasury notes based upon it. This latter Act he approved only as a means of escaping the free coinage of silver, and he supported its repeal in 1893. In 1880 and 1888 he aspired actively to the Republican nomination for the Presidency, but failed to obtain the requisite support in the Convention. Upon the accession of President McKinley, in 1897, he resigned from the Senate and became secretary of State; but under the tension of the war with Spain the duties of the office became too exacting for his strength at his age, and in April 1898 he resigned and withdrew into private life. Infirmities multiplied upon him, until death came at Washington 22nd October 1900. (W. A. D.)

Sherman, William Tecumseh (1820–1891), American general, was born 8th February 1820, at Lancaster, Ohio. He was descended from Edmond Sherman, who emigrated from England to the Massachusetts Bay Colony in 1634. His father moved from Norwalk, Conn., to Lancaster, Ohio, in 1810, became a judge of the Supreme Court of Ohio, and died suddenly in 1829, leaving his widow with a family of young children. William was adopted by the Hon. Thomas Ewing, a close friend of the father, sometime a senator of the United States and a member of the national cabinet. When sixteen years of age he was appointed a cadet in the United States Military Academy at West Point. He graduated in 1840, near the head of his class, and was made a lieutenant of artillery. His first field service was in Florida against the Seminole Indians. The usual changes of station and detached duty made him acquainted with the geography of all the Southern states, and Sherman improved the opportunity to make topographical studies, which became of distinct value to him later. When the war with Mexico began in 1846, he was stationed at Fort Moultrie, in Charleston Harbour, South Carolina. He asked for field duty, and was ordered to join an expedition going to California by sea. He was made adjutant-general to Colonel Mason, military governor, and as such was executive officer in the administration of local government, till peace came in the autumn of 1848 and the province was ceded to the United States. In 1849 he was sent home with despatches. In 1850 he married Miss Ewing. In 1853 he resigned from the army, and went back to California to conduct at San Francisco a branch of an important St Louis banking-house. He continued successfully in the management of this business through a financial crisis incident to a wildly speculative time, until in the spring of 1857 the house by his advice withdrew from Californian affairs. In 1859 the state of Louisiana established a military college, and Sherman became its superintendent, including in his duties the

professorship of engineering. In the spring of 1860, when it was evident that Louisiana would join the states seceding from the Union, he resigned the superintendency of the college and returned to St Louis, parting with the governor of the state and his colleagues in the school with regret and mutual esteem. Though his brother, John Sherman, the distinguished statesman, was a leader in the party which had elected Mr Lincoln, William Sherman was very conservative on the slavery question, and his distress at what he thought an unnecessary rupture between the states was extreme. Yet his devotion to the national constitution was unbounded, and he offered his services as soon as volunteers for the three-years' enlistments were called out. On 14th May 1861 he was appointed colonel of the 13th Infantry, a new regiment in the regular army, and was soon assigned to command a brigade in General McDowell's army in front of Washington. He served with it in the battle of Bull Run, 21st July, was promoted brigadier-general of volunteers, and, with his friend and classmate General Thomas, was in August sent to Kentucky to serve under General Robert Anderson. In October Anderson's health failed, and Sherman succeeded him in command of the department, coming eventually under General Halleck, who with General Buell divided the departments of the Mississippi valley. After the capture of Fort Donelson (1862), Sherman, with a division of new troops, joined Grant's expedition up the river Tennessee. At the battle of Shiloh Sherman's gallant conduct gained him promotion to major-general. His appreciation of Grant, and his sympathy with the chagrin he suffered after this battle, cemented the friendship between the two. In the campaign against Corinth, Miss., Halleck commanded in person; but in July 1862 he was made general-in-chief, and Grant resumed the command of the army of the Tennessee, with Sherman as senior subordinate. During the operations against Vicksburg, aiming at possession of the lower Mississippi valley, Sherman made expeditions to Chickasaw Bayou, near Vicksburg, and to Arkansas Post, on the Red river, and then joined Grant's main army again, becoming commander of the Fifteenth Army Corps. After Vicksburg surrendered, on 4th July 1863, Grant was made commander of all the forces west of the Allegheny mountains, and Sherman became the head of the army of the Tennessee, which consisted of three corps. To relieve the army of the Cumberland after the battle of Chickamauga, Grant and Sherman moved to Chattanooga, and in a series of brilliant victories (November and December) defeated the Confederates, under Bragg and Longstreet, again liberated East Tennessee, and opened the way for an aggressive campaign southwards. To complete the preparation for this, Sherman made a winter expedition from Vicksburg into the heart of Mississippi as far as Meridian, destroying railways and making impracticable for a season the transfer of military operations to that region. When Grant became general-in-chief of all the armies of the United States (March 1864), Sherman was made commander of the military division of the Mississippi, including his army of the Tennessee, now under McPherson, the army of the Cumberland, now under Thomas, and the army of the Ohio, under Schofield. Making detachments for garrisons and minor operations in a theatre of war over 500 miles wide, he assembled, near Chattanooga, his three armies, aggregating a hundred thousand men, and began (1st May 1864) the campaign of Atlanta, in the state of Georgia. The country was mostly forest-clad, the roads mere waggon-tracks, his line of communications a single railway, his base 400 miles away. Owing to the character of the country, both sides resorted to entrenched camps covered by formidable entanglements of felled trees, and to movements by the flank, avoiding direct attacks on the enemy's front. Atlanta was taken on 1st September. The Confederate General Hood, who had superseded Johnston, began early in October a vigorous movement on Sherman's communications, designed to carry the war back into Tennessee. After a devious chase of a month, Hood moved across Alabama to northern Mississippi. Sherman divided his army, leaving Generals Thomas and Schofield to meet Hood, and with sixty thousand men abandoned his base and marched 300 miles across Georgia to the sea. Savannah, on the Atlantic coast, was taken, railways were destroyed, and the Confederate Government was severed from its western states. In January 1865 Sherman marched northwards again, once more abandoning his base, and aiming for Richmond, the Confederate capital, near which the armies of Grant and Lee were waging a war of giants. Every mile of his march northwards through the Carolinas diminished the supply region of the enemy, and desperate efforts were made to stop his advance. General Johnston was recalled to active service, and showed his well-known skill, but his forces were inadequate. Sherman defeated him and reached Raleigh, the capital of North Carolina, on 13th April, having marched nearly 500 miles from Savannah. Lee's position in Virginia was now desperate. Thomas and Schofield, in Tennessee, had routed Hood's army, and Schofield had been transferred to the North Carolina coast (a movement of about 2000 miles by land and sea) and was now united again to Sherman, who had come into co-operation with Grant. Lee broke away from Petersburg, 3rd April, but was overtaken, and surrendered to Grant on the 9th. Johnston's surrender to Sherman soon followed, and the war was ended. When Grant became President in 1869, Sherman succeeded him as general-in-chief, and the remainder of his active service was spent in the administration of the army in peace. He died at New York, 14th February 1891.

GENERAL W. T. SHERMAN.

(From a photograph by Sarony, New York.)

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Shetland, a county of Scotland composed of a group of islands and rocks lying north-east of Orkney, the shortest distance between the two groups being 50 miles, if Fair Isle, which lies between them and belongs to Shetland, be excluded. About 20 of the islands are inhabited, and 70 others are used for grazing.

Area and Population.—The area of the county (foreshore excluded) is 362,615 acres, or about 566 square miles. The population was in 1881, 29,705; in 1891, 28,711; in 1901, 28,185, of whom 12,430 were males and 15,755 were females. Taking the land area only (352,889 acres, or 551·4 square miles), the number of persons to the square mile in 1901 was 51, and the number of acres to the person 12·5. The population decreased between 1881 and 1891 by 3·4 per cent., and between 1891 and 1901 by 1·8 per cent. Between 1881 and 1891 the excess of births over deaths was 1901, and the decrease of the resident population 994. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimates.
1880	500	111	671	5·9
1890	477	130	605	2·97
1899	432	128	597	3·0

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years :—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	22·48	22·19	21·01	20·23	21.42
Death-rate . .	16·75	16·40	16·57	15.59	15.53
Marriage-rate .	3·72	4·98	5·15	4.34	4·24

There were 67 Gaelic-speaking persons in the county in 1891, and 27 foreigners. Valuation in 1889–90, £49,273; 1899–1900, £46,680.

Administration.—Shetland unites with Orkney to return a member to Parliament. Lerwick (4061), the county town, is the only police burgh. There are 12 civil parishes, with a combination poorhouse at Lerwick; the number of paupers and dependents in September 1899 was 999. Shetland forms a sheriffdom with Orkney and Caithness, and there is a resident sheriff-substitute at Lerwick.

Education.—Twelve school boards manage 61 schools, which had in 1898–99 an average attendance of 3450, and 3 voluntary schools (2 Church and 1 Episcopal) had 163. Lerwick has a secondary school, and 2 other schools in 1898 earned grants for giving higher education. The "residue" grant is spent on swimming and navigation classes.

Agriculture.—In 1898 the percentage of cultivated land was 16·5. Of 3550 holdings in 1895 the average size was 16 acres. The percentage under 5 acres was 20·00, between 5 and 50 acres 77·44, and over 50 acres only 2·56. There were 710 crofts under 5 acres, 2391 between 5 and 20 acres; 50 holdings between 50 and 100, 32 between 100 and 300, and 9 above 300, 3 being over 1000 acres. Crofting agriculture is still primitive, tillage being done with the spade to a large extent, and seaweed being the principal manure applied to the exhausted ground. Little progress has been made, notwithstanding considerable reductions of rent. From the commencement of the operations of the Crofters' Commission in 1886 down to the end of 1898, 2496 applications to fix a fair rent had been dealt with by the Commissioners, and rents amounting to £11,203 reduced to £8015, while arrears of £13,438 had been cancelled to the extent of £9512. Of applications to enlarge holdings 217 had been dealt with and 936 acres added to existing crofts. The following table gives the principal acreages at intervals of five years from 1885 :—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	58,538	10,415	4622	1045	42,673	783
1890	59,548	9,532	5028	1085	43,094	809
1895	57,673	9,342	4997	1090	41,764	480
1899	59,687	9,327	4929	1245	43,717	469

The following table gives particulars of the live stock during the same years; the "horses" are Shetland ponies :—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1885	5,605	22,377	8465	84,727	3497
1890	4,803	18,876	8020	98,320	3129
1895	5,503	18,883	7768	102,098	2901
1899	5,863	18,859	7994	110,795	2301

In 1891, 1984 men and 606 women were returned as being engaged in agriculture. There is no wood in the county.

Industries.—Though the knitting of fine shawls and other articles with the wool of the native sheep is the distinctive industry, fishing is the mainstay of the greater part of the population, the men being generally both crofters and fishermen. There are 52 stations in the Shetland fishery district, some statistics about which are given in the subjoined table :—

Year.	Boats.			Value of Gear.	Resident Fishermen and Boys.	Total Value of all Fish.
	No.	Tons.	Value.			
1890	865	5195	£28,286	£29,455	2884	£89,504
1898	789	7504	£38,459	£26,311	3043	£134,237
1899	807	8045	£43,707	£27,827	3059	£263,888

Of the total value of fish in 1899, £234,766 was the value of herrings only. The total number of persons engaged in the district in 1899 in various branches of the sea fisheries was 8294. The industrial population in 1891 numbered 1602 men and 5318 women, of whom 4862 were engaged in the manufacture of textiles.

Communication with the mainland and between the islands is noticed under Lerwick.

See JACOB JACOBSEN. *The Old Shetland Dialect and Place Names of Shetland.* Lerwick, 1897.—*Handbook to Lerwick Town Hall*, 1864.—W. F. CLARK. *Northern Gleams.* Lerwick, 1898.—J. NICOLSON. *Sprigs o' Aithstin' Hedder.* Lerwick.—F. J. GRANT. *Zetland County Families.* Lerwick.—H. L. SAXBY. *Birds of Shetland.* Edinburgh, 1874.—R. S. COWIE. *Shetland.* Aberdeen, 1896.—C. SINCLAIR. *Shetland and the Shetlanders.* Edinburgh, 1840.—C. RAMPINI. *Shetland and the Shetlanders.* Kirkwall, 1884.—See also Orkney. (W. WA.)

Shields, North. See TYNEMOUTH.

Shields, South, a seaport, county, municipal and parliamentary borough, and railway station, Durham, England, in the Jarrow parliamentary division of the county, on the south bank of the Tyne, at its mouth, with stations on the North-Eastern Railway. The Tyne dock has a water area of 50 acres, the tidal basin of 10 acres, and the quays and yards cover about 300 acres. In 1895 the construction of a new deep-water entrance was completed. Police buildings, erected at a cost of £22,000, were opened in 1893. Population (1891), 78,391; (1901), 97,267.

Shigatsé. See TIBET.

Shikarpur, a town and district of British India, in the Sind province of Bombay. The town is about 18 miles from the right bank of the Indus; railway station 23 miles north-west of Sukkur. Population (1891), 41,991; (1901), 49,491. Shikarpur has always been an important place, as commanding the trade route through the Bolan Pass. The administrative headquarters of the district have been transferred to Sukkur, where the North-Western Railway crosses the Indus. It has a large market and manufactures of carpets, cotton cloth, and pottery. There is a high school and also two printing-presses, issuing two commercial gazettes and a vernacular newspaper.

The district of SHIKARPUR has an area of 9296 square miles. Population (1891), 915,497; (1901), 1,018,237, showing an increase

of about 11 per cent. in each decade. Land revenue (1897–98), Rs.36,13,037, the incidence of assessment being Rs.3.3.11 per acre; cultivated area, 1,084,603 acres, of which 829,945 were irrigated from Government canals; number of police, 1059; children at school, 28,294, being 2·9 per cent. of the population; death-rate (1897), 31·21 per thousand. The principal crops are wheat, millet, pulse, and oil-seeds. Both portions of the district are traversed by the main line of the North-Western Railway for 170 miles, with 22 stations, and the branch to Quetta runs from Ruk junction for 40 miles past Shikarpur town. Agriculture entirely depends upon canals from the Indus, and the river occasionally causes disastrous floods.

Shildon, a parish, urban district, and market-town of Durham, England, in the Bishop Auckland parliamentary division of the county, 9 miles west from Darlington by rail. At New Shildon (or East Thickley), a neighbouring village, are extensive railway engine and waggon works belonging to the North-Eastern Railway Company. The population of the urban district (Shildon and East Thickley) was in 1891, 9537; in 1901, 11,759.

Shillong, a town of British India, in the Khasi Hills district of Assam, of which province it is the capital. It is situated in 25° 32′ N. and 91° 55′ E., on a plateau 4978 feet above the sea, 64 miles by cart-road south of Gauhati, on the Brahmaputra. Population (1881), 3640; (1899), 6720; municipal income (1896–97), Rs.41,276; death-rate (1891), 24·26 per thousand. Shillong practically dates from 1864, when the district headquarters were transferred from Cherrapunji. It was chosen as the seat of government in 1874, when the province of Assam was constituted. Every one of the public buildings and houses that quickly grew up was levelled to the ground by the great earthquake of 12th June 1897. Cantonments are provided for a battalion of Gurkhas, 789 strong in 1898, with two guns, and it is the headquarters of a company of volunteers. There is a Government high school, with 155 pupils in 1896–97, and a training school for masters. The school for European children has been discontinued, but will be re-established by the Government. There are three printing-presses, one of which issues two monthly periodicals in the Khasi language.

Shiloh, a name applied to a locality in Hardin county, Tennessee, U.S.A., about an old meeting-house called Shiloh church. The place has become famous as the scene of one of the fiercest battles of the Civil War. It is situated in the southern part of the state, about two miles west of Pittsburg Landing, on the Tennessee river, and occupies a plateau about half a mile long and 80 feet above the river. On this ground, in April 1862, the Union forces, under General Grant, and the Confederates under Generals Johnston and Beauregard, fought fiercely for two days. The Confederates, who knew that General Buell was on his way to join Grant, determined to destroy the army of the latter, if possible, before his arrival. The attack was unexpected by the Union troops, and the first day's fighting resulted in driving them in disorder to the bluff at Pittsburg Landing, leaving a considerable number of guns and prisoners in the hands of the enemy. During the night, however, Grant was reinforced by Buell's and Lew Wallace's forces, which gave him about 50,000 fighting men, half of whom were fresh troops. To oppose them the Confederates had only about 30,000. General Johnston had fallen in the first day's fight, and Beauregard was now in command. The Confederates, after a stubborn resistance, lost all the ground gained the first day and were forced back to Corinth, Mississippi, which place they soon afterwards destroyed and evacuated. More than 100,000 men were engaged in this battle, and the losses on both sides were enormous, sometimes estimated as high as 22,000 men. This is sometimes called the battle of Pittsburg Landing.

SHIP.

I. History and Statistics.

Before steam was applied to the propulsion of ships, the voyage from Great Britain to America usually took some weeks; at the beginning of the 20th century the time was about six days. Similarly, the voyage to Australia, which took about thirteen weeks, was reduced to about thirty days, although it cannot be said that exceptionally fast vessels are employed in this service. The fastest of the sailing tea-clippers required about three months to bring the early teas from China to Great Britain; they are now brought to London by the ordinary P. and O. service in six weeks. In further illustration of the progress made, it may be mentioned that there are Atlantic liners now running between England and America which maintain a speed of 23 knots over the whole course, as compared with the 12 or 15 knots of a few years ago. The accommodation in the passenger ships above referred to is quite palatial compared with that in the corresponding wooden sailing ships of a date fifty or sixty years earlier, and the fare provided does not differ greatly from the best that can be obtained on shore.

The changes from sail power to steam power for propulsion, and from wood to iron and steel for constructional purposes, proceeded together, though at first very slowly. Knowledge of the theory of steam and the steam engine was slowly acquired; and for many years mechanical engineering as an art failed altogether to keep pace with theory. Thus the marine steam engine was at first a very imperfect motor, and the services upon which steamships could be used to advantage were, in consequence, much restricted. There was, moreover, a national prejudice against steamships of any kind. Our fathers saw, with regret, the possibility and probability that the sailing ships upon which they prided themselves, and which had arrived after many years, even centuries, at something like perfection, might pass out of existence altogether. A similar prejudice existed against the substitution of iron for wood in shipbuilding. As regards warships, "the Wooden Walls of Old England," by which England had to a considerable extent achieved her greatness, were held almost in veneration, and it was with profound regret that they were at last admitted to belong to the past.

Iron and steel construction.

It is recorded that an iron boat, intended apparently for passenger service, was built and launched on the river Foss, in Yorkshire, in 1777, and shortly afterwards iron was used for the shell plating of lighters for canal service. One of these, having its shell constructed of plates five-sixteenths of an inch thick, was built near Birmingham in 1787. About the same time parts of wooden ships began to be replaced by iron, partly, no doubt, with the view of increasing the strength of the structure, but also because of the increasing difficulty of obtaining suitable shipbuilding timber in sufficient quantities for the requirements of the day. The first iron strengthenings thus introduced were beam knees; early in the 19th century, iron "diagonal riders" for providing the longitudinal strength were introduced by

Sir Robert Seppings, and from this period down to the present day iron strengthenings for resisting both transverse and longitudinal strains have been generally used in wooden ships. The introduction of iron as a recognized material for ship construction is usually given as dating from 1818, when the lighter *Vulcan* was built on the Monkland canal, near Glasgow.

The advantages of the new material were admitted for service on canals, where there was no risk of grounding on a dangerous bottom, but they were not so readily admitted for river service, and still less for coasting and sea voyages. Among the early objections to the use of iron were: (1) from its weight it could not be expected to float, and was therefore unsuitable for the construction of a floating body; (2) when a ship constructed of this material grounded and was exposed to bumping on a shore, the bottom would be easily perforated; (3) the bottom could not be preserved from fouling by weeds and barnacles; and (4) the iron affected the compass, making it untrustworthy, if not useless. Gradually, however, the material made its way, and the objections to it proved to be for the most part untenable. Objection (1), although often repeated, was proved to involve a fallacy. With regard to objection (2), it was found that iron ships might ground and be subjected to a great deal of bumping and rough usage without being destroyed, and that, on the whole, they were better off in this respect than wooden ships. On more than one occasion when iron and wooden ships were stranded together by the same gale and in approximately the same circumstances, the iron ships were got off and, apart from local injury, were found to be little the worse for the grounding, while the wooden ships were either totally wrecked, or, if got off, were strained to such an extent as to be ruined. The power of resistance of iron ships to the strains produced by grounding received, in 1846–47, a remarkable confirmation in connexion with the grounding of the *Great Britain*, the first large screw steamer built of iron. This ship had been initiated by, and was built under the supervision of, Mr I. K. Brunel, who had bestowed much attention upon the details of her construction. In 1846 she ran ashore in Dundrum Bay, in Ireland, and settled on two detached rocks; and although she remained aground for eleven months, including a whole winter, she was subsequently got off and repaired, and afterwards did good service. As regards the fouling of the bottom, this evil, although not preventible, can be lessened materially by frequent cleaning and repainting, provided, of course, that docks are available. The fourth objection, the effect of iron on the compass, was a matter of very serious moment, and the attention of one of the leading scientific men of the day (Sir G. B. Airy) became directed to it. After experimenting with the *Rainbow* at Deptford and the *Ironsides* at Liverpool, Sir G. B. Airy in 1839 read a paper on the subject before the Royal Society, and the rules which he gave for the correction of the error caused by the iron at once became the guide for future practice. Besides the above, a further objection was raised which applied only to warships, namely, the nature of the damage which would be done to an iron ship by the enemy's shot: this also was found to be less serious, when proper appliances were supplied, than the damage done in the same circumstances to a wooden ship. Thus during the Chinese war in 1842 the *Nemesis*, an iron vessel, was able to repair her damage from shot in twenty-four hours at the scene of the fight, while some wooden ships which were damaged to about the same extent had to go to Bombay, the nearest port at which repairs could be carried out.

Steel, as a material for shipbuilding, was introduced under modern conditions of manufacture during the years 1870–75. It is a homogeneous metal, stronger than iron, and of a more uniform and more trustworthy character. Its quality is to a considerable extent independent of the skill of those employed in its manufacture, whereas iron is produced by a laborious and unhealthy process, and is largely dependent for its quality on the skill of the workmen. Among the advantages which experience has proved iron and steel to possess over wood for the purposes of ship construction are: (1) the structure of the ship has less weight; (2) it has greater durability; (3) the requisite general and local strengths are much more easily obtained.

The importance of the first of these advantages can scarcely be overstated. The primary object of a particular ship is to carry cargo or passengers, or both, from place to place, at a given speed (in the case of a warship, the armament, ammunition, armour, &c., constitute the weight to be carried); and since at the maximum draught at which the vessel can properly and safely proceed on her passage the total weight of vessel, cargo, &c., complete, must be a definite quantity, namely, the weight of the water displaced by the ship, it follows that the less the weight required for the structure of the ship, the greater is that available for the cargo, &c.

As to durability, in wooden ships the chief source of deterioration is dry-rot, in iron or steel ships the wasting of the surfaces, especially of such portions of the outer surfaces of the bottom plating as are frequently left bare of paint and exposed to the sea, and of the inner surfaces of the bottom in machinery spaces, &c. If dry-rot can be prevented, the life of the wood ship will be lengthened; so also will the life of the iron or steel ship if the surfaces can be kept covered with paint, to prevent the action of air and water. With both wood and iron or steel ships, if the parts which have become deteriorated can be removed and replaced, this is usually worth doing when the deterioration is only local. At the end of the 18th century the preservation of wood was not so well understood as it is at the present day, and teak, one of the most durable of woods, was, in Great Britain at least, little known. The ships for the Royal Navy as then constructed were only expected to be available for service some fifteen or twenty years. The ships built for the East India Company made, on an average, four voyages, which occupied eight years. This at one time was considered the vessel's life, so far as the Company's service was concerned; but subsequently, if on examination at the expiration of that time they appeared worth repairing, this was done, and they were allowed to make two more voyages. It was very unusual for one of these ships to make more than six voyages; after this they were sold for other services, or broken up. In certain cases, however, ships lasted a considerable length of time; a number of vessels built in the 17th century continued in the service of the Royal Navy until the middle of the 18th century, though with a reduced number of guns. Of small wood merchant vessels there are instances of the attainment of very remarkable age. The collier brig *Brotherly Love*, of South Shields, was over one hundred years old when she was broken up; and the schooner *Polly*, built in 1805, was still sailing in 1902; as also was the brig *Hvalfisken*, built at Calmar in Sweden in 1801. The dimensions of the last vessel are: length, 88 ft. 8 in.; breadth, 21 ft. 2 in.; depth of hold, 14 ft. 7 in.; and her gross tonnage, 211. We have so far had very little experience concerning the life of iron and steel ships properly taken care of, as in most instances these ships have been condemned only because they were obsolete; but when broken up, after twenty or even forty years' service, those parts which by accident or intention had remained properly covered and protected were found very

little the worse for wear. Thus the inner surfaces of the bottoms of such vessels, coated with cement, have been found to be in nearly as good condition as when the ships were first built.

That general and local strength is more easily obtained in an iron or steel ship than in a wooden one follows partly from the fact that the weight required for the structure is less in the former than in the latter, and also from the fact that iron and steel are more suitable materials for the purpose. They can be obtained in almost any desired shape, the parts can be readily united to one another with comparatively little loss of strength, and great local strength can be provided in very little space.

For some purposes, and in some markets, wood is still in favour; for instance, for resisting ice-pressure. In scientific expeditions to the Polar regions, also, it is of the highest importance to avoid any disturbance of the compass, and this can be ensured by constructing the vessel of wood, with metal fastenings. The *Fram*, built in 1892 for Nansen's Arctic expedition, was of wood, her outside planking, in three thicknesses, amounting in the aggregate to from 24 in. up to 28 in.; she was 117 ft. long, rigged as a three-masted schooner, and provided with auxiliary machinery working a screw propeller. The *America*, fitted out for the Ziegler expedition to the North Pole, was an old Dundee whaler (the *Esquimaux*), and was reported to be still a "stout" ship with timbers as sound as on the day they were put in thirty-six years before. She is 157 ft. long, 29½ ft. beam, 19¼ ft. deep, net tonnage 466; her engines have a nominal horse-power of 100, and she has a lifting screw. During the year 1901 a wood vessel, the *Discovery*, 172 ft. in length, was built at Dundee for Antarctic exploration; and in Germany another wood vessel for similar service has been constructed. On the other hand, in the *Ermack*, built on the Tyne for ice-breaking in the Baltic and for pioneer work farther afield, steel has been used as the most approved material for the service contemplated, and this after previous experience with similar vessels.

Some progress had been made in the introduction of steam propulsion before the end of the 18th century, but the advance became more rapid in the 19th. In the early steam vessels paddle-wheels only were used for propulsion.

Steam propulsion.

In 1801–02 the *Charlotte Dundas*, one of the earliest steam vessels, was constructed by Symington in Scotland. She proved her capability for towing purposes on the Forth and Clyde canal, but, although successful in the work for which she was intended, did not see much service, as the canal-owners feared the wash of the steamboat would damage the banks of the canal. About the same time Fulton made his experiments in France, and after visiting Scotland and witnessing the success of the *Charlotte Dundas*, constructed the *Clermont* on the East Hudson river in America in 1807. The engines for this vessel were obtained from Boulton and Watt, of England. She ran as a passenger boat between New York and Albany, and at the end of her second season proved too small for the crowd that thronged to take passage in her. In 1809 the *Phœnix* made the passage from Hoboken, in New Jersey, to Philadelphia, and was thus the first steamer to make a sea voyage. In 1812 Bell began running his steamer *Comet*, with passengers, between Glasgow, Greenock, and Helensburgh: she was 42 ft. long, 11 ft. broad, 5½ ft. deep, and her engine had one cylinder 11 in. in diameter, with a 16-in. stroke. Owing to the success achieved by these and other vessels in America and Great Britain, steamers soon began to make their appearance on many of the principal rivers of the world. Early in 1814 there were five steamboats on the Thames, and the steamboat *Margery*, built on the Clyde, was brought through the Forth and Clyde canal and round by the east coast to the Thames. In the same year a writer in the *Gentleman's Magazine* was able to say: "Most of the principal rivers in North America are navigated by steamboats; one of them passes two thousand miles on the great river Mississippi in twenty-one days, at the rate of five miles an hour against the descending current." In 1816 the first steam passenger-boat ran across the English Channel from Brighton to Havre, and a line of steamers was started to run between New York and New London. All of these vessels were built of wood; but in 1820 the first iron steamship, the *Aaron Manby*, was constructed and employed in a direct service between London and Paris. In 1822 a return was made to the House of Commons showing the times occupied by steamers as compared with sailing vessels on some thirty coasting routes: the average speed given for steamers in the best of these was from eight to nine knots, while the average time taken varied from one-half to one-sixth (or even less) of the time taken by the sailing vessels.

Steam vessels were employed at a very early date upon the mail services, for besides being very much quicker than the sailing vessels, they were practically independent of the direction of the wind, and to a considerable extent of the weather; consequently the regularity of their passages contrasted very favourably with the irregular times kept by the sailing vessels. The mail service across the Irish Channel, between Holyhead and Dublin, was especially uncertain in the days of the sailing packets, frequently occupying three or four days, and occasionally as much as seven and nine days. All this was altered when in 1821 the steamers *Royal Sovereign* and *Meteor* were placed on the service. The advantages were so apparent that steam mail packets between Great Britain and the Continent, and on many other services, were soon established. The mail boats had been for many years owned by the Crown, but in 1833 the carrying of the mails to and from the Isle of Man, and between England and Holland and Hamburg, was entrusted to private companies. Marked improvement in the services, and especially in the boats employed, resulted from the competition to secure the distinction and other advantages of carrying His Majesty's mails. An intermediate stage followed, extending over a comparatively short period, during which the Crown still held many of the mail boats, while in a considerable number of cases the mail services were let to private companies. After this the British Government abandoned altogether the policy of being the owners of the boats, and ever since, the mail services have been competed for by private companies.

The *Savannah* was the first steamship to cross the Atlantic. She ran from Savannah to Liverpool in 1819 in twenty-five days, under steam, however, only for a portion of the time. She was built at New York as a sailing ship, but before launching was fitted with steam power, the paddle-wheels being arranged to be removed and placed on deck when not required. She was 130 ft. long, 26 ft. broad, 16½ ft. deep, and of about 380 tons. The success of the *Enterprise*, of 470 tons, which made the voyage from London to Calcutta by the Cape of Good Hope in 1825 in 103 sailing days, is noteworthy. The distance is 11,450 nautical miles, and the vessel was under steam for 64 days and under sail for 39 days. The steamer afterwards (1829–30) made the trip between Bombay and Suez in 54 days, in furtherance of a scheme to reach the former place from London by the Red Sea route. The year 1838 witnessed the successful trans-Atlantic voyages of the steamers *Sirius* and *Great Western*. The latter vessel, built under the advice of I. K. Brunel, the engineer of the Great Western Railway Company, was the first steamer actually constructed for the trans-Atlantic service. She was built of wood, her dimensions being—length 212 ft., breadth 35½ ft., depth 23¼ ft., and tonnage 1340 B.O.M.; and her total displacement on a draught of 16 ft. 8 in. was 2300 tons. Although not originally built for the service, the *Sirius* was subsequently placed on it at the recommendation of Mr M'Gregor Laird of Birkenhead. This vessel also was built of wood, and was 178 ft. long, 25½ ft. broad, 18¼ ft. deep, and her tonnage was 703. Mr Laird's arguments in favour of placing the vessel on the trans-Atlantic service throw light on the steaming capabilities of vessels of that day. He pointed to the steamers *Dundee* and *Perth* making 11 miles per hour, "in all weathers, winter and summer, fair and foul"; and to the other vessels making from 10 to 10½ miles per hour. He based his estimate for the coal required on the voyage on a speed of 10 miles per hour and a coal consumption of 30 tons per day, which gave 525 tons for the whole voyage. Finally, he allowed 800 tons, corresponding to the difference of the displacement at 15 ft. load draught and at 11 ft. light draught, so that he had a margin of 275 tons for contingencies. (See also STEAMSHIP LINES in this volume.)

All the vessels just named were propelled by paddle-wheels, but in 1843, in the *Great Britain*, screw propulsion was adopted for the Atlantic service. The screw propeller had been introduced a few years before by Ericsson, of Sweden, and by F. P. Smith, of Hendon, in Great Britain. The *Archimedes*, fitted by the latter investigator, had, after some very remarkable trials, been acquired by Brunel for further experiments, and as a result the paddle-wheel engine design, originally prepared for the *Great Britain*, was discarded, and a design for screw engines

substituted. The advantages of the screw over the paddle-wheel for war-vessels were recognized about this time by the British Admiralty. These advantages were chiefly that the screw did not interfere to the same extent as the paddle-wheel with the sailing qualities of the ship, and that it was protected against injury in action by its position below the surface of the water, while the latter was very liable to injury. In a few years the screw almost entirely superseded the paddle-wheel for war-vessels, and in 1854, during the war with Russia, Great Britain possessed a screw steam fleet, including all classes of ships, built of wood.

The performances of the *Great Western* and other vessels had demonstrated that ships could traverse the oceans of the world by steam power alone, but great advance had to be made in the marine engine before the ordinary trade could be carried on by its means with economy. In the early marine engines only one cylinder was provided, and various means were employed for transmitting the power to the paddle shaft; later came the oscillating cylinder engine and the diagonal engine, the latter being the type of paddle engine now most frequently adopted in Great Britain. With the introduction of the screw-propeller the arrangements became much modified. At first the engines were run at comparatively low speeds, as in paddle-boats, gearing being supplied to give the screw-shaft the number of revolutions required, but direct-acting two-cylinder engines gradually replaced the geared engines. The compound engine was first adapted successfully to marine work by John Elder in 1854, and in time the direct-acting vertical engines, with one high and one low pressure cylinder, became the common type for all ships. The boiler pressure, moreover, in 1854, had been raised to 42 ℔ per square inch. The further change, accompanying still higher pressures of steam, from compound to triple-expansion engines was, like many other changes, foreseen and in some measure adopted by various workers at about the same time, but the first successful application of the principle was due to Dr A. C. Kirk. In 1874 he fitted a three-crank triple-expansion engine in the *Propontis*. The boiler used proved a failure, but in 1882 he fitted a similar set of engines in the *Aberdeen*, with a boiler pressure of 125 ℔, and the result was entirely successful. All modern marine engines of high power have either triple or (in a few cases) quadruple expansion.

Statistics of ship-building.

Notwithstanding the early advances made in the introduction of iron for construction purposes, and steam for that of propulsion, the bulk of the trade of the world was still carried on as recently as 1870 by wooden sailing ships. At that date, however, the building of wood vessels had already begun rapidly to decline, so far as Great Britain was concerned, and this decline has continued at an almost uniform rate down to the present day. On the other hand, the construction of iron vessels had in 1870 begun to increase at a greater rate than that of the decline in the construction of wood vessels; and including steel with iron ships, this increase, apart from fluctuations due to waves of trade and depression, has continued down to the present time. For some years previous to 1870 the construction of sailing vessels had gradually decreased, the decrease nearly corresponding to the rate of increase in the construction of steam vessels. But while from 1870 nearly down to the present day, apart from fluctuations, the construction of sailing vessels has remained generally constant, the construction of steam vessels has, on the other hand, rapidly increased. These changes for Great Britain will be clearly seen on examination of the figures given in Table I., but they are represented graphically and much more completely by the curves in Figs. 1 and 2.

It will be seen from Table I. that during 1860 there were 181 iron ships, of 100,830 tons aggregate, and 835 wood ships, of 161,180 tons aggregate, added to the register of the United Kingdom. Soon after 1860 the production of iron ships exceeded the production of wood ships, and whilst in 1870 there were 445 iron ships, of 408,510 tons aggregate, added to the register, there were only 529 wood ships, of 80,262 tons, added to the register; during 1880 there were 431 iron and steel ships, of 525,568 tons, added, and only 293 wood ships, of 19,938 tons. The general increase in iron and steel ships and the diminution in wood ships continued, until in 1900 there were 613 iron and steel ships, of 1,128,283 tons, and only 223 wood ships, of 12,527 tons, added to the register. It will be seen from Table I., but more clearly from Fig. 2, that although during the last few years of the period the amount of sailing tonnage registered fell off considerably, yet for some twenty to thirty years previously the amount registered did not show any general falling-off. On the other hand, a rapid advance in the construction of steamships is shown;

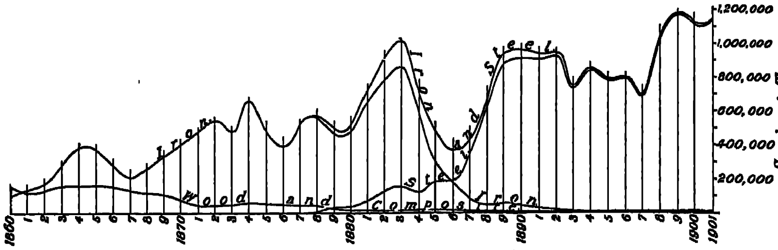


FIG. 1.—Gross tonnage of all wood, composite, iron and steel merchant vessels over 100 tons gross built in and added to the register of the United Kingdom during each year from 1860 to 1901.

in 1870 there were 364,860 tons added to the register, in 1880 there were 485,661 tons added, and this general rate of increase was maintained until in 1900 the total added reached 1,123,074 tons. The variations in the rates of production, due to fluctuations in trade and other causes, will be seen at a glance from Figs. 1 and 2, in which the ordinates of the curves represent tons of shipping produced and registered in the United Kingdom during the year, and the abscissæ represent time. It will be seen that the decline in the production of wood and composite vessels has been fairly uniform since 1870, whereas the variations in the production of iron and steel ships have been exceedingly great. These variations synchronize with the improvements and depressions in trade which took place over the period named. The curves in Fig. 1 show how

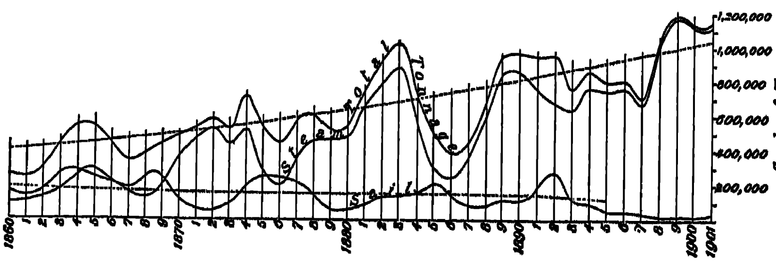


FIG. 2.—Gross tonnage of all sailing and steam merchant vessels over 100 tons gross built in and added to the register of the United Kingdom during each year from 1860 to 1901. The dotted lines may be taken as representing the average production from year to year.

rapidly steel displaced iron as a material for shipbuilding. So rapid indeed was the change that the great depression between 1883 and 1886 had little or no effect in reducing the production of steel ships during these years. As might have been expected, the variations in the curve of steam vessels (Fig. 2) correspond generally to the variations in the curve of iron and steel vessels in Fig. 1.

From Table II., which gives the distribution of ownership of existing merchant vessels and other vessels, excepting warships, of 100 tons and upwards throughout the world, it appears that the total tonnage of the existing shipping, excluding vessels under 100 tons, but including the wood vessels on the Great Lakes of America, is about 30½ millions. Of this total, rather more than one-fifth is in sailing vessels, and the remainder in steam vessels. Taking the number of ships instead of their aggregate tonnage, the sailing vessels are 43 per cent. of the whole. Out of the 30½ million tons, Great Britain and her colonies own about 14¾ millions, or 48 per cent. of the whole, 12¾ millions being steamers and 2 millions sailing vessels. Next to Great Britain, the largest ship-owning country of the world is the United States of America, with 3 million tons of shipping, nearly 10 per cent. of the total. Then come in order Germany, with nearly 3 millions, 9½ per cent. of the total; Norway, with 5·3 per cent.; France, with 4·6 per cent.; Italy, with 3·6 per cent.; and Russia and Spain, with 2·6

TABLE I.—*Showing the Number, Tonnage (Gross and Average), and Description of all Vessels (excluding Warships) built in and added to the Register of the United Kingdom during each year enumerated.*

Year.	Mode of Propulsion.	Wood and Composite.		Iron.		Steel.		Totals.		Average Gross Tonnage.
		No.	Gross Tonnage.*	No.	Gross Tonnage.*	No.	Gross Tonnage.	No.	Gross Tonnage.	
1860	Sail	786	154,130	32	14,290	...	...	818	168,420	206
	Steam	49	7,050	149	86,540	...	...	198	93,590	473
1865	Sail	806	160,430	116	88,970	...	...	922	249,400	270
	Steam	38	5,780	344	287,360	...	...	382	293,140	767
1870	Sail	478	72,970	63	50,940	...	...	541	123,910	229
	Steam	51	7,290	382	357,570	...	..	433	364,860	843
1875	Sail	373	46,060	193	206,110	...	...	566	252,170	446
	Steam	66	8,740	291	281,390	...	...	357	290,130	813
1880	Sail	273	18,159	39	40,015	4	1,671	316	59,845	189
	Steam	20	1,779	362	447,389	26	36,493	408	485,661	1190
1881	Sail	259	16,448	50	68,650	3	3,167	312	88,265	283
	Steam	30	1,659	411	590,503	34	68,366	475	660,528	1391
1882	Sail	246	13,066	83	112,852	8	12,478	337	138,396	411
	Steam	30	1,784	446	672,740	65	115,449	541	789,973	1442
1883	Sail	229	13,551	72	114,698	11	14,193	312	142,442	457
	Steam	30	1,651	548	742,292	92	141,552	670	885,495	1322
1884	Sail	277	17,142	93	130,017	9	13,360	379	160,519	424
	Steam	38	2,364	413	456,982	67	108,978	518	568,324	1097
1885	Sail	266	17,841	144	160,034	27	30,569	437	208,444	477
	Steam	37	2,751	177	148,508	122	154,249	336	305,508	909
1886	Sail	226	14,266	55	97,713	31	30,588	312	142,567	457
	Steam	30	1,467	119	82,201	124	160,973	273	244,641	896
1887	Sail	170	8,782	27	44,979	29	25,994	226	79,755	353
	Steam	24	1,097	66	40,070	196	326,530	286	367,697	1286
1888	Sail	177	8,686	13	18,882	33	42,666	223	70,234	315
	Steam	23	2,370	87	31,697	321	571,437	431	605,504	1405
1889	Sail	157	8,256	11	12,385	47	90,469	215	111,110	517
	Steam	25	1,368	97	46,402	411	783,193	533	830,963	1559
1890	Sail	142	7,704	6	5,911	59	96,374	207	109,989	532
	Steam	26	1,326	110	40,144	432	817,010	568	858,480	1515
1891	Sail	156	8,541	3	1,544	93	178,593	252	188,678	749
	Steam	25	1,212	167	31,381	388	730,051	580	762,644	1315
1892	Sail	151	8,372	6	5,121	128	260,874	285	274,367	963
	Steam	19	1,026	86	18,937	365	660,847	470	680,810	1449
1893	Sail	154	7,980	4	418	66	113,097	224	121,495	542
	Steam	27	1,551	64	12,458	328	622,099	419	636,108	1518
1894	Sail	155	7,570	3	207	67	83,167	225	90,944	404
	Steam	26	1,183	65	12,400	389	751,668	480	765,251	1594
1895	Sail	150	7,529	9	782	32	41,313	191	49,624	260
	Steam	35	1,579	66	9,897	379	736,412	480	747,888	1558
1896	Sail	161	7,519	5	792	36	37,709	202	46,020	228
	Steam	17	591	79	11,593	398	750,106	494	762,290	1543
1897	Sail	183	8,317	2	232	34	28,481	219	37,030	169
	Steam	33	1,581	63	9,974	366	658,646	462	670,201	1451
1898	Sail	196	8,813	6	798	40	8,456	242	18,067	75
	Steam	20	765	80	13,654	546	996,814	646	1,011,233	1565
1899	Sail	165	7,342	2	182	60	11,757	227	19,281	85
	Steam	29	1,497	64	12,184	534	1,152,999	627	1,166,680	1861
1900	Sail	159	8,718	5	420	46	8,598	210	17,736	84
	Steam	64	3,809	86	16,375	476	1,102,890	626	1,123,074	1794
1901	Sail	146	7,826	2	174	54	22,118	202	30,118	149
	Steam	83	5,479	14	2,474	469	1,115,227	566	1,123,180	1984

The above table has been taken from information supplied to Lloyd's Registry by the Registrar-General of Shipping.

* As no actual returns are available for the gross tonnages for the years from 1860 to 1879 inclusive (only net tonnages having been recorded), the gross for these years are only approximate, and are based on the relation of gross to net for the years 1883 to 1900.

per cent. each. The leading particulars as to the distribution of ownership of the merchant shipping throughout the world for 1873, 1890, and 1901 respectively are represented graphically in the three diagrams given in Fig. 3. These have been constructed from particulars given in Table II. and similar tables for 1873 and 1890. Warships, all vessels under 100 tons, and the wood vessels on the Great Lakes of North America, unless known to be employed in sea trade, are not included. The total tonnage owned throughout the world in these years, with these exceptions, is represented by squares drawn to the same scale, and these squares are divided up amongst the principal countries owning shipping, a small area on the right-hand side of each representing a number of holdings too small to be shown separately. Part of each holding is shaded so as to show what portion of this is sailing tonnage and what portion is steam tonnage. The total tonnage owned is given in the heading, and this is represented by the square shown for each year. The percentages owned by various countries are tabulated; and on each square the proportion of the shipping of the day which was severally steam and sailing is also recorded. For 1890 and 1901 in Fig. 3 there is also shown the distribution of the total as regards materials of construction in each country. The tonnage of the shipping of the world has advanced at an increasing rate for many years. The character of this rate will be gathered at once from the data given in Fig. 3. In 1873 Great Britain and her colonies owned 43¼ per cent. of the shipping of the world, and this number rose in 1880 to 52 per cent.; but in 1900, although the advance in the shipping of Great Britain and her colonies had continued approximately at the same uniform rate, such was the increasing rate of the advance of the world's shipping that the percentage owned by the British Empire had fallen to 48·65.

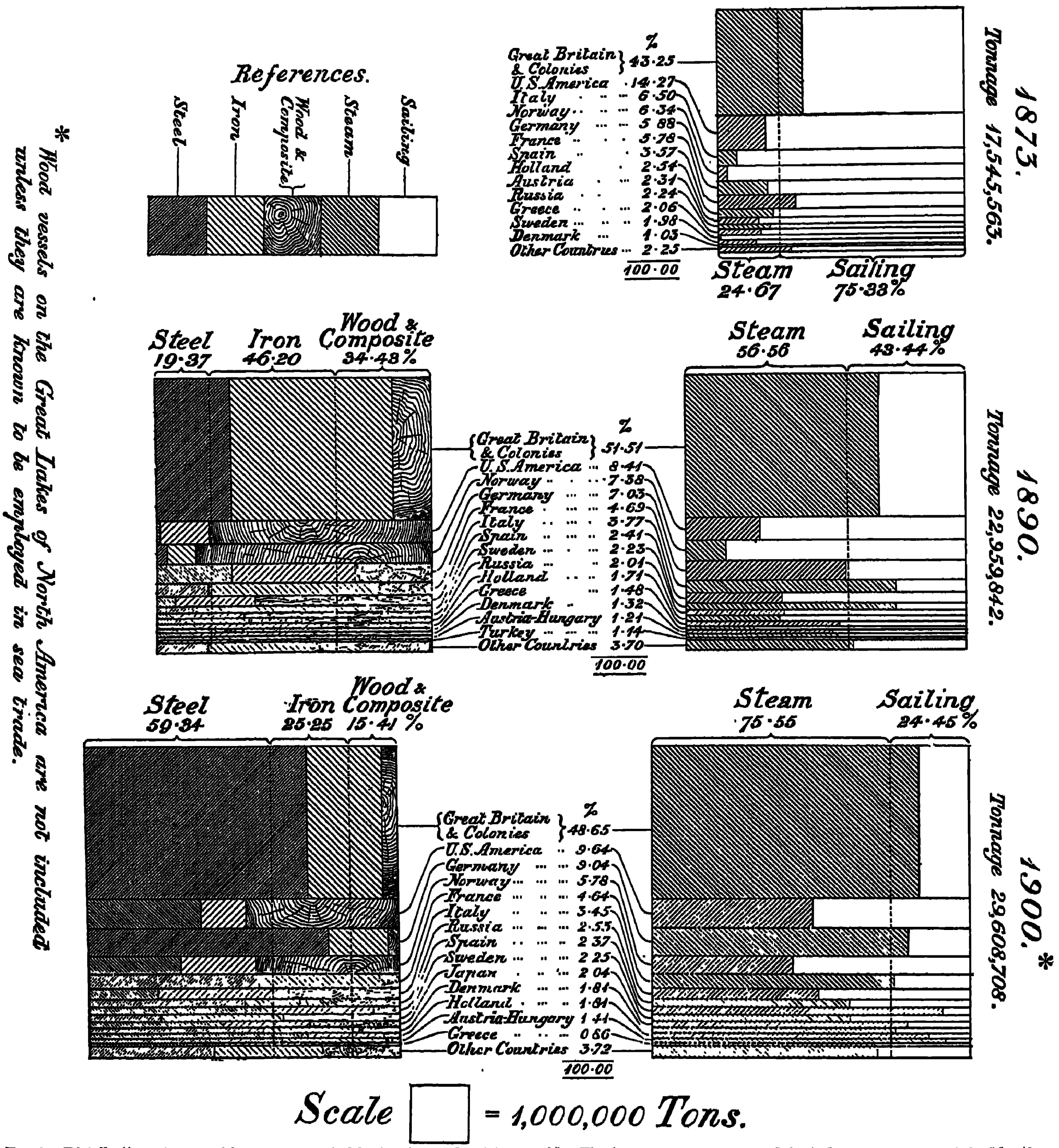


FIG. 3.—Distribution of ownership of merchant shipping throughout the world. The tonnages are gross, and include, so far as ascertainable, those of all vessels over 100 tons in existence at the dates specified, with the exception of wood vessels on the Great Lakes of North America.

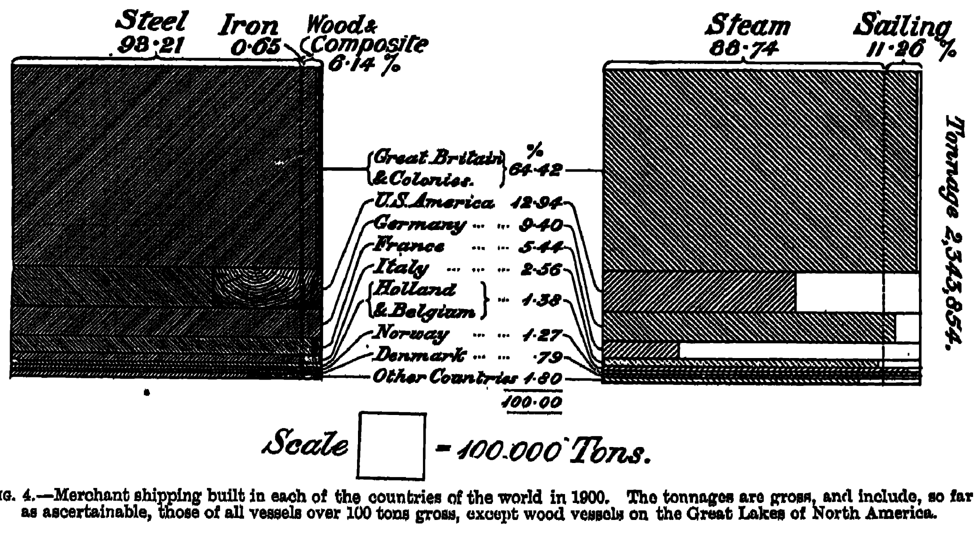


FIG. 4.—Merchant shipping built in each of the countries of the world in 1900. The tonnages are gross, and include, so far as ascertainable, those of all vessels over 100 tons gross, except wood vessels on the Great Lakes of North America.

TABLE II.—*Shipping owned in each Country of the World (extracted from Lloyd's Register of British and Foreign Shipping for 1901–02).*
Number, Tonnage, and Description of all Vessels (exclusive of War Vessels) of 100 tons and upwards.

Flag.	Steam Vessels.															Sailing Vessels.										Summary of Steam and Sailing Vessels.	
	Wood.			Composite.			Iron.			Steel.			Total.			Wood.		Composite.		Iron.		Steel.		Total.		Total No. of Steam and Sailing Vessels.	Total Tonnage of Steam and Sailing Vessels (Net Tonnage of Sailing Vessels and Gross of Steamers).
	No.	Net Tonnage.	Gross Tonnage.	No.	Net Tonnage.	Gross Tonnage.	No.	Net Tonnage.	Gross Tonnage.	No.	Net Tonnage.	Gross Tonnage.	No.	Net Tonnage.	Gross Tonnage.	No.	Net Tonnage.	No.	Net Tonnage.	No.	Net Tonnage.	No.	Net Tonnage.	No.	Net Tonnage.		
British: United Kingdom	109	9,316	17,236	6	746	2,302	2634	1,300,747	2,198,062	4412	6,091,942	9,835,794	7,161	7,402,750	12,053,394	687	120,148	7	2,637	621	760,909	458	719,073	1,773	1,602,767	8,934	13,656,161
British: Colonies*	259	42,003	70,670	24	4,867	8,712	321	137,940	225,465	342	225,888	380,939	946	410,698	685,786	890	298,749	18	10,493	56	36,213	25	20,804	989	360,259	1,935	1,052,045
British: Total	368	51,318	87,906	30	5,613	11,014	2955	1,438,687	2,423,527	4754	6,317,830	10,216,733	8,107	7,813,448	12,739,180	1,577	418,897	25	13,130	677	797,122	483	739,877	2,762	1,969,026	10,869	14,708,206
American (United States): Sea	295	120,341	174,351	7	2,901	3,496	212	239,827	348,067	246	311,437	477,881	760	674,506	1,003,795	2,110	1,138,552	2	979	33	39,588	31	49,011	2,176	1,228,130	2,936	2,231,925
American (United States): Lake*	..	..	..	10	14,548	19,598	31	31,637	40,232	235	485,602	640,531	276	531,787	700,361	16	11,888	..	..	1	195	57	132,975	74	145,058	350	845,419
American (United States): Total	295	120,341	174,351	17	17,449	23,094	243	271,464	388,299	481	797,039	1,118,412	1,036	1,206,293	1,704,156	2,126	1,150,440	2	979	34	39,783	88	181,986	2,250	1,373,188	3,286	3,077,344
Argentine	2	217	359	1	94	132	40	11,871	18,324	59	21,522	39,705	102	33,704	58,520	62	14,920	..	..	20	7,201	19	4,649	101	26,770	203	85,290
Austro-Hungarian	3	183	368	..	..	..	80	72,171	115,929	154	215,792	286,069	237	288,146	402,366	39	17,698	..	..	6	6,738	..	..	45	24,436	282	426,802
Belgian	1	244	336	..	..	..	60	40,927	57,881	67	72,398	106,574	118	113,569	164,791	1	244	..	..	..	..	..	..	1	244	119	165,035
Brazilian	10	2,309	3,544	..	..	..	55	24,923	39,621	168	61,128	95,182	233	88,360	138,347	75	20,126	..	..	3	1,517	12	3,277	90	24,920	323	163,267
Chilian	..	..	..	..	..	..	26	16,940	27,257	25	21,758	35,119	51	38,698	62,376	56	31,782	2	1,494	4	3,376	1	930	63	37,588	114	99,964
Chinese	2	340	481	1	1,468	2,330	8	7,177	11,012	14	9,554	15,353	25	18,539	29,176	1	573	..	..	..	..	..	..	1	573	26	29,749
Colombian	..	..	..	..	..	..	1	555	877	..	..	..	1	555	877	4	934	..	..	..	..	..	..	4	934	5	1,811
Danish	6	1,127	1,954	..	..	..	145	60,401	116,811	214	177,380	291,703	365	238,908	410,468	339	59,919	..	..	32	21,750	43	16,057	414	97,726	779	508,194
†Dutch	5	525	956	..	..	..	96	75,196	116,663	206	253,238	397,911	307	328,959	515,530	47	18,336	2	2,264	10	8,207	57	33,772	116	62,579	423	578,109
French	12	874	1,732	1	375	566	347	244,827	404,937	319	293,524	660,801	679	539,600	1,068,036	380	65,067	..	..	52	42,917	136	230,863	568	338,847	1,247	1,406,883
German	1	105	203	3	377	676	873	191,581	312,175	916	1,309,219	2,104,356	1,293	1,501,282	2,417,410	122	64,130	4	1,925	151	107,048	216	254,969	493	488,372	1,786	2,905,782
†Greek	6	459	815	..	..	..	73	43,884	71,500	79	101,620	159,226	158	145,963	231,541	209	60,021	1	498	..	..	..	..	210	60,519	368	292,060
Haytian	2	481	832	..	..	..	..	..	..	3	431	918	5	912	1,750	..	..	..	..	..	..	1	244	1	244	6	1,994
Italian	6	562	1,106	..	..	..	230	234,808	369,917	103	184,681	286,958	339	420,051	657,981	733	316,947	14	12,366	90	90,070	37	40,174	874	459,557	1,213	1,117,538
Japanese	255	35,087	57,629	9	2,877	4,285	120	112,309	176,038	119	176,199	286,173	503	326,472	524,125	882	120,539	..	..	..	..	..	..	882	120,539	1,385	644,664
Mexican	2	217	277	1	150	300	7	2,241	3,095	20	7,020	12,518	30	9,628	16,190	12	2,588	..	..	2	839	..	..	14	3,427	44	19,617
Montenegrin	..	..	..	..	..	..	1	1,064	1,857	..	..	..	1	1,064	1,857	15	3,790	..	..	..	..	..	..	15	3,790	16	5,647
Norwegian	84	20,803	34,618	26	4,638	7,123	352	157,851	273,474	397	311,241	495,120	859	494,533	810,335	1,249	618,476	8	5,735	172	157,374	33	35,300	1,462	816,885	2,321	1,627,220
Peruvian	..	..	..	..	..	..	1	1,400	2,100	2	1,804	2,769	3	3,204	4,869	31	8,943	..	..	1	761	..	..	32	9,704	35	14,573
Portuguese	1	98	119	1	60	102	23	10,105	16,341	23	25,697	39,474	48	35,960	56,036	131	34,264	4	3,692	16	13,369	2	369	153	51,694	201	107,730
Rumanian	..	..	..	..	..	..	5	636	1,281	11	9,009	15,962	16	9,645	17,243	4	874	..	..	..	..	..	..	4	874	20	18,117
†Russian	13	1,875	2,980	5	747	1,140	184	76,317	112,784	327	252,041	416,125	529	330,980	533,029	715	205,038	7	4,029	29	35,739	10	11,418	761	256,224	1,290	789,253
Sarawak	..	..	..	..	..	..	2	244	418	1	266	400	3	510	818	..	..	..	..	..	..	..	..	..	..	3	818
Siamese	..	..	..	..	..	..	1	108	208	1	476	779	2	584	982	1	294	..	..	..	..	..	..	1	294	3	1,276
Spanish	4	212	431	2	618	1,105	219	142,234	221,676	241	332,490	511,346	466	475,554	734,557	158	48,243	1	543	2	1,755	2	1,257	163	51,798	629	786,355
Swedish	29	3,194	5,058	95	12,347	19,708	361	159,809	254,347	218	104,070	171,907	703	279,420	451,020	737	198,094	8	2,466	27	19,405	8	5,234	780	225,199	1,483	676,219
†Turkish	26	2,100	3,765	..	..	..	83	51,573	81,292	27	4,328	8,176	136	58,001	93,233	194	53,015	1	1,061	..	..	..	..	195	54,076	331	147,309
Uruguayan	1	206	374	..	..	..	2	383	705	14	5,849	9,389	17	6,438	10,468	22	8,812	..	..	3	1,886	1	121	26	10,819	43	21,287
Venezuelan	..	..	..	..	..	..	9	2,136	3,570	2	234	445	11	2,370	4,015	8	1,185	..	..	..	..	..	..	8	1,185	19	5,200
Zanzibar	..	..	..	..	..	..	3	1,871	2,808	..	..	..	3	1,871	2,808	..	..	..	..	..	..	..	..	..	..	3	2,808
Other countries:— Cuba	12	4,878	7,018	..	..	..	15	7,288	11,422	12	10,428	16,518	39	22,594	34,958	10	1,907	..	..	..	..	..	..	10	1,907	49	36,865
Philippine Islands	21	2,426	4,100	1	130	251	38	13,241	20,138	13	4,819	8,161	73	20,616	32,650	42	8,264	..	..	..	..	..	..	42	8,264	115	40,914
Various: Arabia, Salvador, Oman, Ecuador, Liberia, Samos, Nicaragua, Bulgaria, Costa Rica, Egypt, Persia, Porto Rico, &c.	4	560	817	..	..	..	11	6,257	10,596	15	3,005	5,772	30	9,822	17,185	18	5,669	3	2,796	1	960	..	..	22	9,425	52	26,610
Total	1171	250,741	392,129	193	46,943	71,826	6159	3,482,479	5,729,489	9005	11,094,090	17,815,445	16,528	14,874,253	24,008,883	10,000	3,560,329	32	52,978	1332	1,417,817	1149	1,560,503	12,563	6,591,627	29,091	30,600,510

* Wooden vessels belonging to ports situated on the Great Lakes of North America are not included in the Register Book unless they are known to be employed in sea trade, but from the report of the American Commissioner of Navigation, dated June 1890, there were at that date registered on the Great Lakes 2845 wooden vessels, having a gross tonnage of 877,818, the net tonnage not being recorded.

† In the absence of satisfactory information, the records of numerous small sailing vessels, belonging chiefly to Greece, Turkey, Southern Russia, and the Dutch East Indies, have been omitted from the Register Book.

TABLE III.—*Number, Gross Tonnage, and Description of all Vessels of 100 Tons gross and upwards built in each of the several Countries of the World, during the Year 1900, according to Lloyd's Register Book for 1901–02.*

Country in which Built.	Whether Sail or Steam.	Wood and Composite. 100 to 999 Tons.	1000 to 1999 Tons.	2000 to 2999 Tons.	3000 to 3402 Tons.	Total. No.	Total. Tonnage	Iron and Steel. 100 to 999 Tons.	1000 to 1999 Tons.	2000 to 2999 Tons.	3000 to 3999 Tons.	4000 to 4999 Tons.	5000 to 5999 Tons.	6000 to 6999 Tons.	7000 to 7999 Tons.	8000 to 8999 Tons	9000 to 9999 Tons	10,000 to 10,999 Tons.	11,000 to 11,999 Tons.	12,000 to 12,999 Tons.	13,000 to 13,999 Tons.	14,000 to 14,999 Tons.	15,000 to 15,999 Tons.	16,000 to 16,502 Tons.	Total. No.	Total. Tonnage	Grand Total. No	Grand Total. Tonnage.
Great Britain and Colonies *	Sail	33				33	6,535	5	3																8	6,291	41	12,826
	Steam	15				15	2,645	295	68	47	110	56	30	18	12	2	5	2	1	4	4				654	1,494,366	669	1,497,011
	Total	48				48	9,180	300	71	47	110	56	30	18	12	2	5	2	1	4	4				662	1,500,657	710	1,509,837
U. S. America *	Sail	65	19	7	1	92	88,991		9		1	1	2												13	29,396	105	118,387
	Steam	24	5			29	17,231	22	5	9	2	7	14	3											62	167,721	91	184,952
	Total	89	24	7	1	121	106,222	22	14	9	3	8	16	3											75	197,117	196	303,339
Germany	Sail	1				1	160	36																	36	16,822	37	16,982
	Steam							27	15	3	6	1	12	2				2	1	1				1	71	203,417	71	203,417
	Total	1				1	160	63	15	3	6	1	12	2				2	1	1				1	107	220,239	108	220,399
France	Sail	13				13	3,463		2	37	1														40	92,871	53	96,334
	Steam							10				1							2						13	31,094	13	31,094
	Total	13				13	3,463	10	2	37	1	1							2						53	123,965	66	127,428
Italy	Sail	22	2			24	7,676																				24	7,676
	Steam							2		1	3	6	2												14	52,299	14	52,299
	Total	22	2			24	7,676	2		1	3	6	2												14	52,299	38	59,975
Holland and Belgium	Sail							7																	7	1,152	7	1,152
	Steam							14	2	6	1	2													25	31,288	25	31,288
	Total							21	2	6	1	2													32	32,440	32	32,440
Norway	Sail	1				1	287																				1	287
	Steam	8				8	4,962	13	15																28	24,400	36	29,362
	Total	9				9	5,249	13	15																28	24,400	37	26,649
Denmark	Sail	11				11	2,017	1																	1	211	12	2,228
	Steam							4	2	3			1												10	16,321	10	16,321
	Total	11				11	2,017	5	2	3			1												11	16,532	22	18,549
Austria-Hungary	Sail																											
	Steam							7		5															12	14,945	12	14,945
	Total							7		5															12	14,945	12	14,945
Japan	Sail																											
	Steam	5				5	1,793	3	4	2															9	11,542	14	13,335
	Total	5				5	1,793	3	4	2															9	11,542	14	13,335
Russia	Sail	34				34	6,301																				34	6,301
	Steam							1																	1	149	1	149
	Total	34				34	6,301	1																	1	149	35	6,450
Sweden	Sail	6				6	1,023	1																	1	231	7	1,254
	Steam	2				2	376	12	1																13	4,762	15	5,138
	Total	8				8	1,399	13	1																14	4,993	22	6,392
Spain	Sail																											
	Steam							1																	1	572	1	572
	Total							1																	1	572	1	572
Greece	Sail	2				2	363																				2	363
	Steam																											
	Total	2				2	363																				2	363
Portugal	Sail	1				1	181																				1	181
	Steam																											
	Total	1				1	181																				1	181
Totals	Sail	189	21	7	1	218	116,997	50	14	37	2	1	2												106	146,974	324	263,971
	Steam	54	5			59	27,007	411	112	76	122	73	59	23	12	2	5	4	4	5	4			1	913	2,052,876	972	2,079,883
	Total	243	26	7	1	277	144,004	461	126	113	124	74	61	23	12	2	5	4	4	5	4			1	1019	2,199,850	1296	2,343,854

* Excluding wood vessels built on the North American Lakes

This decline has been chiefly due to the increasing rate at which the shipping of the United States of America and of Germany has advanced.

Table III. gives the output of merchant and other vessels throughout the world in 1900, excluding warships, all ships of less than 100 tons, and the wood vessels of the Great Lakes of North America. It will be seen that the total output for the year was 2,343,854 tons, of which 1,509,837 tons, or 65 per cent. of the whole, was built in the United Kingdom and the British colonies; 13 per cent. by the United States of America; 9·3 per cent. by Germany; and 4·5 per cent. by France. The leading particulars given in Table III. are represented graphically in Fig. 4, which is similar in its construction to the diagrams of Fig. 3. The total tonnage built in 1900 is made up of 972 steamers, of which 59 were wood or composite, and 913 of iron or steel; and 324 sailing vessels, of which 218 were wood or composite, and 106 of iron or steel. Of the 913 steamships built of iron or steel, 70 only were of iron, and these were all below 400 tons each. Thus iron has practically ceased to be used, except for some special purposes. Forty steel sailing ships of over 1000 tons were built in France, their aggregate tonnage being about 93,000, the production of these vessels being no doubt due in large measure to the French shipping bounties, which favour their construction. The relative sizes of the iron and steel ships built in different countries is worthy of note: thus the mean tonnage of those vessels built in Germany was 2354; of those built in Italy, 3626 tons; whilst of those built in Great Britain it was only 2258 tons.

The average increase in size of ships registered in the United Kingdom from 1860 down to the present time is well shown by the figures of Table I. For iron and steel ships combined the average size of those registered in 1860 was 560 tons; in 1870 it was 920 tons; in 1880, 1220 tons; in 1890, 1580 tons; and in 1900 it was 1840 tons. These figures may be taken as representing the general increase throughout the world; but as in these averages large numbers of comparatively small vessels are included, the vast increase in the number of large-sized ships which have been built, especially during recent years, is not adequately represented. Of the vessels built in 1890 only 1 per cent. exceeded 8000 tons in displacement, whereas the vessels of over 8000 tons built in 1900 made up 12 per cent. of the whole tonnage. In 1890 there were no vessels built whose displacement exceeded 9000 tons; in 1900 such vessels constituted $11\frac{1}{2}$ per cent. of the whole, and about $\frac{3}{4}$ per cent. of the whole were over 16,000 tons.

Merchant Vessels.

Generally speaking, so far as the distribution of sails is concerned, except as regards the abolition of studding-sails, the sailing ships of to-day differ little from those which existed in the middle of the 19th century, and in case of many types at a much earlier period. The change from wood to iron and steel resulted, of course, in some changes in rig, to suit the longer and larger vessels; and steel masts, with wire rope standing rigging and various labour-saving appliances, have been introduced. The larger ships also carry steam winches for various purposes, steam windlasses, and steam steering gear, but the general appearance of the vessels has changed very little.

Sailing ships.

Barges.—Rivers and canals abound with barges of various types, such as the Thames barge, the Tyne wherry or keel, and the Dutch galliot or pink. The Thames barge, which may be taken as a representative vessel of this class, has a length of from 70 to 80 ft., and a carrying capacity of from 100 to 120 tons on about 6 ft. draught. Like the Dutch galliot, she is provided with lee-boards, and is fore-and-aft rigged with sprit-sail and jigger.

In recent years the use of barges or lighters has been extended beyond river and canal service, and a rapidly increasing number are now used, in addition, for sea transport. For example, on the east coast of England lighters of about 500 tons carrying capacity are used in the coal trade. These are loaded on the Tyne, sent down the river, towed from its mouth to the Nore, and sent up the Thames to London. By this means the tug spends very little of her time going up and down rivers, and waiting at docks and wharves, and saving is effected on account of the small capital cost for the lighters, as well as their low cost of maintenance. The system has been carried much farther on the Great Lakes of North America, where cargo barges are in use of over 350 ft. in length, and approaching 5000 tons displacement when loaded. There, however, it appears to have reached its limit, as the building of such vessels shows signs of falling off in favour of steamers of about the same carrying capacity; but on the east coast of the United States the practice is still growing, and barges, built sometimes of wood and sometimes of steel, are employed, carrying from 2000 to 4000 tons of coal, oil, grain, &c.

Smacks or Cutters.—This type of rigging is still largely adopted in the merchant service for small vessels, usually called smacks, of a length, say, from 60 to 90 ft., and a displacement from 150 to 200 tons. They are single-masted, sharp-built vessels, provided with fore-and-aft sails only, and fitted with a running bowsprit; they have no standing jib stay. Such vessels were at one time generally used for coasting passenger traffic. The term "cutter" is also applied to an open sailing boat carried on board ship.

Schooners, Brigs, and Brigantines.—A schooner (Fig. 5, Plate I.) is usually a two-masted vessel, with yards only on the foremast and fore-and-aft sails on the main. The foresail is not bent to the yard, but is set flying. In some cases there are no yards at all; and the schooner is then called a fore-and-aft schooner, a schooner with yards being sometimes called a square-rigged schooner. Before the days of steam, two- and three-masted schooners, known as "Fruiterers," were extensively employed in the fruit trade from the Western Islands, Italy, Malta, and other orange-growing countries to London. In the 'fifties as many as three hundred were thus employed; they kept their place till the 'eighties, and some even yet survive the introduction of steam as a motive power. They were beautifully modelled craft, and very fast under canvas. A brig is a two-masted vessel having yards, or square-rigged on both masts. A brigantine is a two-masted vessel having the foremast square-rigged, as in a brig, the main mast being rigged as in a schooner. Much of the coasting trade of the world is carried on by schooners, brigs, and brigantines. These vessels were formerly employed in the Baltic, and to some extent in the West Indies and the Mediterranean. Schooners such as the above are usually from 80 to 100 ft. long, 20 to 25 ft. broad, 10 to 15 ft. deep, and have a gross tonnage of 130 to 200 tons. Brigs are generally larger, varying in tonnage from 200 to 350 tons; they are from 90 to 115 ft. long, from 24 to 30 ft. broad, and from 12 to 18 ft. in depth of hold. Brigantines usually occupy, as to size, a position intermediate between schooners and brigs. Brigs are used in various navies for the purpose of training boys. Some six exist at present in the British navy, and are stationed at Devonport and Portsmouth.

Vessels somewhat larger than two-masted schooners and brigs, but of a similar form, are often rigged as three-masted schooners and as the so-called barquentines. The former is like a schooner with a third or mizzen mast added, this being rigged fore and aft, as is the main mast. The latter resembles a brigantine with a third mast added, which is also fore-and-aft rigged. The two rigs thus very nearly resemble each other: both are square-rigged on the foremast, and fore-and-aft rigged on the main and mizzen; but while in the former the foresail is set flying, in the latter it is bent to the yard.

Larger vessels than these are sometimes fitted with four, five, six, and even seven masts, as fore-and-aft schooners. A large number of vessels fitted in this manner are much in favour for the coasting trade of America. Fig. 6 (Plate I.) shows the *Helen W. Martin*, a five-masted wooden schooner, built in 1900 in the United States; she is 280 ft. 6 in. long, 44 ft. 9 in. broad, and 21 ft. depth of hold, and her gross tonnage is 2265. Another vessel built at the same time, also of wood, and named the *Eleanor A. Percy*, is 319 ft. 3 in. long, 48 ft. 9 in. broad, and 23 ft. depth of hold, with a gross tonnage of 2970; she is rigged as a six-masted schooner. An interesting vessel of this class is a seven-masted schooner, under construction in 1902 by the Hore River Ship and Engine Co., Quincy, Mass. This vessel is of steel, 368 ft. long, 50 ft. beam, $34\frac{1}{2}$ ft. depth of hold, and on a draught of 26 ft. 6 in. will be of 10,000 tons displacement, thus being the largest sailing vessel yet constructed. These three must all be regarded as ocean-going vessels.

Barques and Ships.—Vessels intended to sail to all quarters of the globe are usually rigged as barques or ships; but, as indicated above, these rigs are very far from embracing all those in use; many others are very common. A barque is a three-masted vessel, square-rigged on the two foremost masts (the fore and main masts) and fore-and-aft rigged on the mizzen mast. A ship (a ship-rigged vessel) has three masts, each of which is square-rigged. These were the rigs employed in types of vessels now fast passing away, if indeed they must not be considered as already obsolete, in which great speed was the quality chiefly aimed at, and carrying power was of secondary importance. For instance, the *Phœnician*, built in 1852, had a length of 150 ft. and a net tonnage of 478; the *Shannon*, built in 1862, was 217 ft. long and her tonnage 1292. The former made the quickest run on record, up to 1852, from Sydney to London, accomplishing the distance in 83 days; and the latter made a round voyage from Melbourne to London and back from thence to Sandbridge Pier in 5 months and 27 days, handling two full cargoes in the time. The American ship *Witch of the Wave*, built in 1852, and the British ship *Cairngorm*, built in 1853, were engaged in the keen competition carried on between Great Britain and the United States for the rapid conveyance of

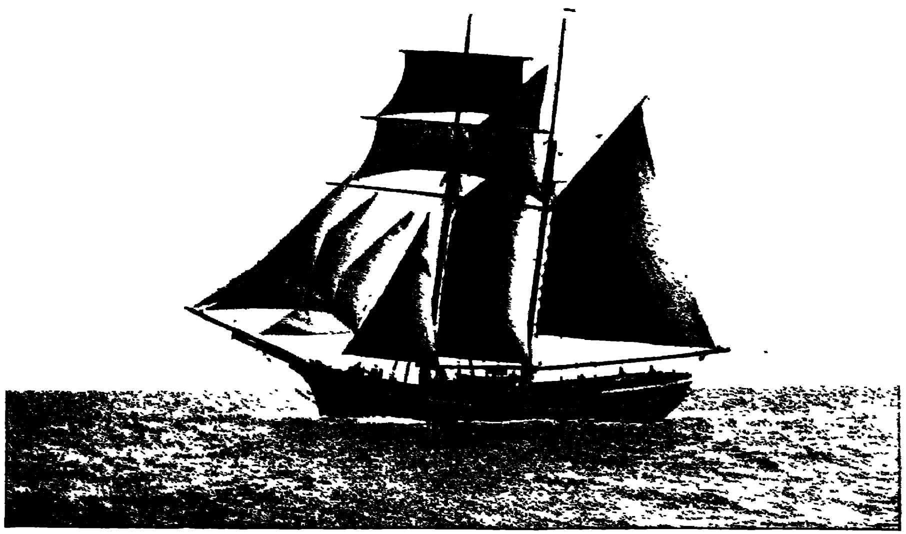


FIG. 5.—Coasting Schooner.

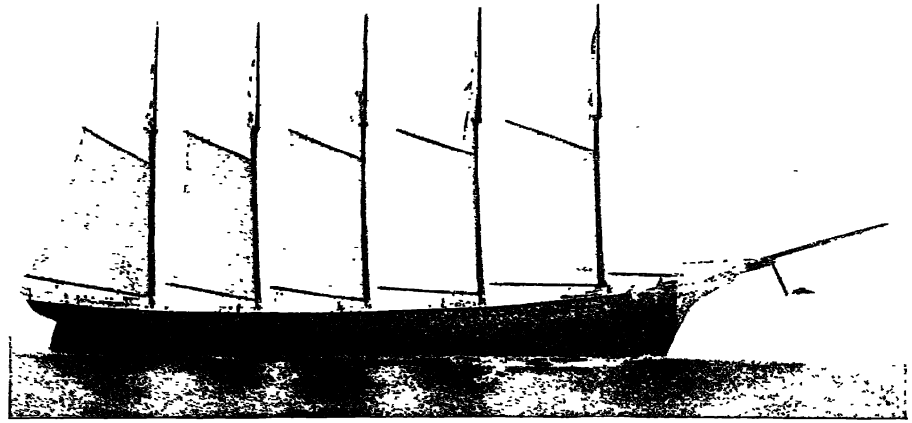


FIG. 6.—Schooner, *Helen W. Martin.*

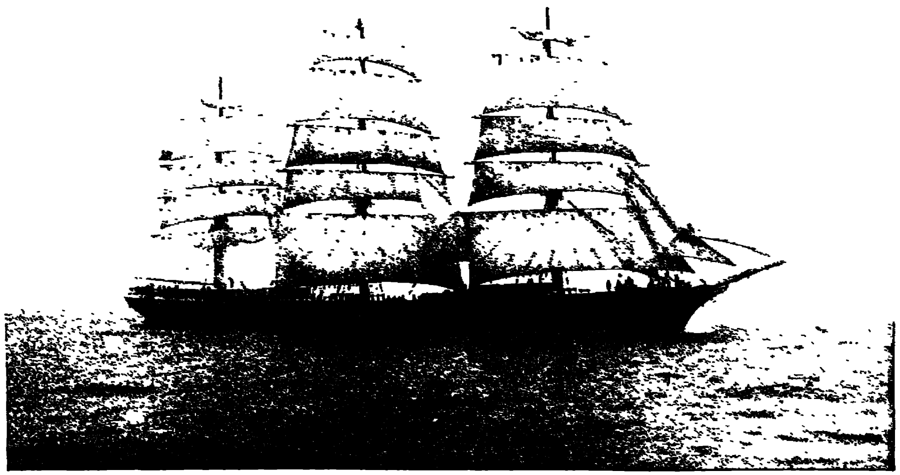


FIG. 7.—Ship, *Victoria Regina.*

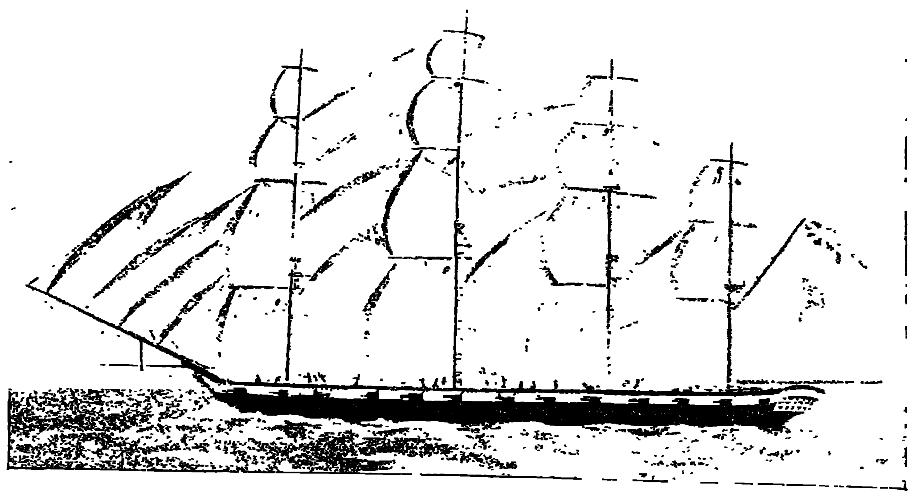


FIG. 8.—French Ship, *L'Invention.*

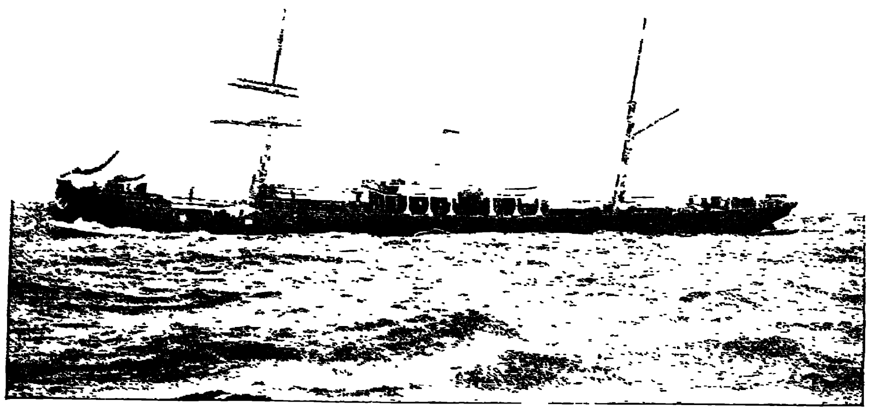


FIG. 9.—Well-Decked Vessel.

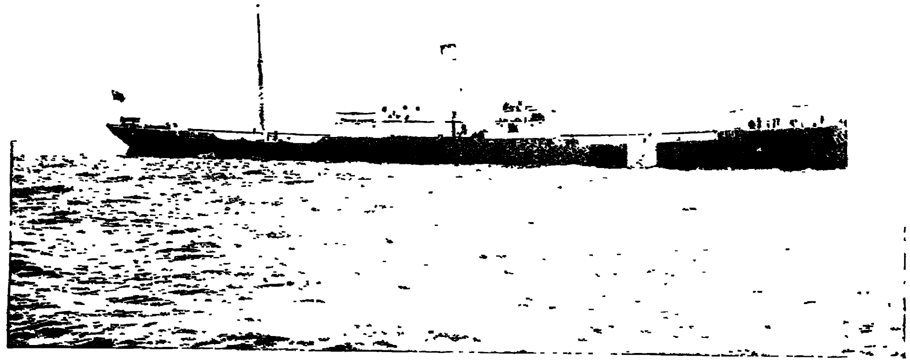


FIG. 10.—Vessel with top-gallant, forecastle, bridge house, and poop.

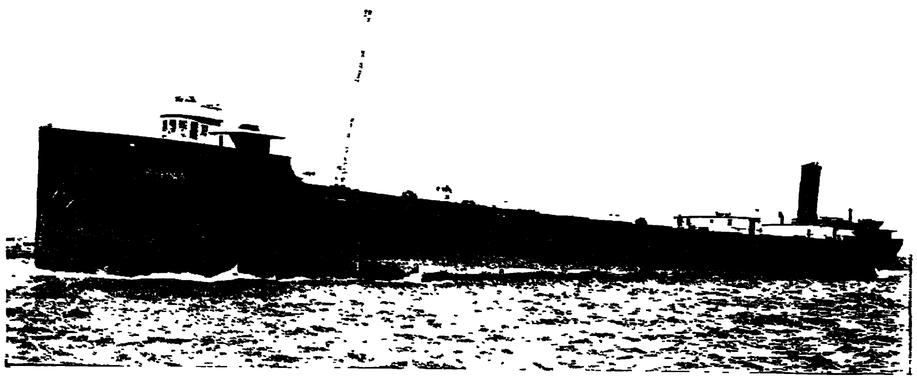


FIG. 11.—American Lake (Whale-back) Steamer.

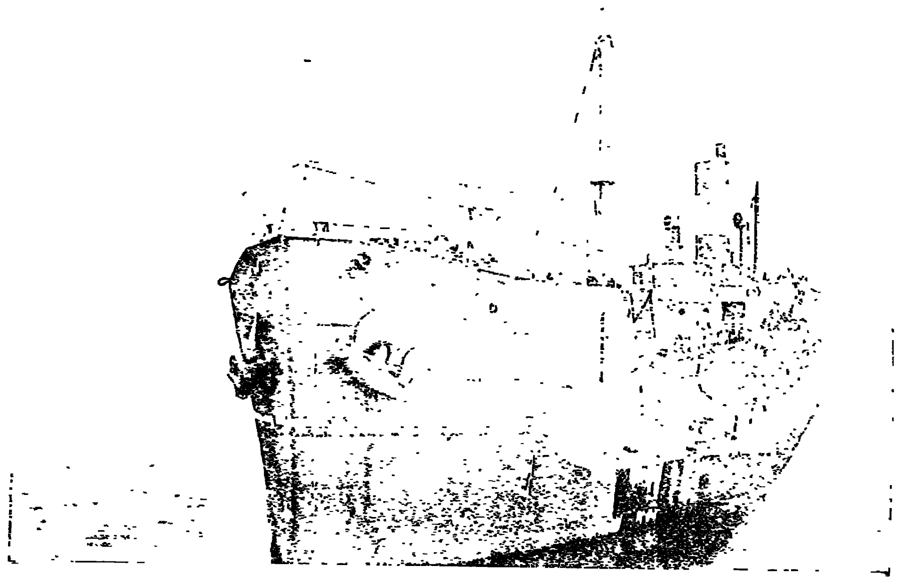


FIG. 13.—Turret Steamer, *Tulloch Moor*,

early teas from China to London. The American builders had for some years been more successful than the British builders, and the *Cairngorm* was the first ship which equalled the American ships in speed, and it was, moreover, claimed for her that she delivered her cargo in better condition than the American ships. She was 215 ft. long, and her tonnage was 1250 old measurement, or 938 new measurement. The *Witch of the Wave* on her best voyage made the passage from Whampoa to Dungeness in 90 days, the best day's run being 338 knots in 24 hours, a very remarkable performance. Later, in 1856, the *Lord of the Isles* beat the two fastest American clippers then existing in a race from China to Great Britain, one of them only by a few minutes; her length was 183 ft., and her tonnage, new measurement, 630. It is noteworthy that the competition in bringing the early teas home from China, started between British and American ships, was carried on subsequently between British ships alone. In the memorable race of 1866 from Foo-Chow to London, five ships, the *Ariel*, *Taeping*, *Serica*, *Fiery Cross*, and *Taitsing* took part. The first three left Foo-Chow the same day—the *Ariel* first, followed 20 minutes later by the *Taeping* and *Serica* together. The vessels separated, and lost one another till they reached the English Channel, when the *Ariel* and *Taeping* got abreast, and raced to the Downs, the former arriving some ten minutes before the latter, the *Serica* reaching the Downs a few hours later. These three occupied 99 days on the voyage; the *Fiery Cross* and *Taitsing* took two days longer, making the passage from Foo-Chow to the Downs in 101 days. The best day's run on the passage for all these ships differed but little, the *Fiery Cross* showing a slight superiority in this respect, having run 328 knots in the 24 hours. The time occupied in the above voyages was beaten in 1869 by the *Thermopylæ* and *Sir Lancelot*, both British ships and of composite build; the times occupied by their passages were respectively 90 days from Foo-Chow to Dungeness for the former, and 88 days from Foo-Chow to Deal for the latter, each taking one day more to get into the docks. The dimensions of the *Thermopylæ* were 212 ft. by 36 ft. by 21 ft. depth of hold, and of the *Sir Lancelot* 197½ ft. by 33⅝ ft. by 21 ft. The best day's run of the *Sir Lancelot* was 354 knots in 24 hours. Shortly before the above voyage the *Thermopylæ* made the passage from London to Melbourne in an unprecedentedly short time, namely, 62 days from Gravesend to Port Phillip harbour. With the opening of the Suez Canal and the general introduction of steam, the demand for exceptionally fast sailing vessels of these types has very considerably diminished, and, indeed, almost ceased to exist. The type of cargo sailing ship usually met with to-day is better illustrated by Fig. 7 (Plate I.), which represents the *Victoria Regina*, built of iron in 1881 at Southampton; she is 270 ft. long and has a gross tonnage of 2006. Although she has a good spread of canvas and is a fast vessel, she carries a very large cargo for her dimensions.

Ships with four and five masts were employed by several countries during last century. Sometimes, in the case of four-masted ships, these were square-rigged on the fourth or mizzen mast, and sometimes fore-and-aft rigged, in which case they are called four-masted barques in Great Britain and shipentines in America. Five-masted ships are sometimes square-rigged on the fourth mast and fore-and-aft rigged on the fifth mast, and sometimes fore-and-aft rigged on both of these masts. The *Naval Chronicle*, vol. vii., 1802, contains particulars of the French privateer *L'Invention*, shown in Fig. 8 (Plate I.), which was captured by the British ship *Immortalité*; she was rigged as a four-masted ship, carried 26 guns, and had a complement of 220 men. It is remarkable how little her rig differs from that of modern vessels. A five-masted vessel is described in the same number of the *Naval Chronicle* which was square-rigged on the foremast and fore-and-aft rigged on the other four masts; she was apparently a forerunner of the American five-masted schooner of the present day. The shipentine clipper *Great Republic*, built in 1853, is noteworthy as being the first ship fitted with double topsails, now so generally adopted. She was 305 ft. long and her tonnage was 3400; she could spread 40,500 square ft. of canvas, excluding stay-sails; she had four decks and was built of wood, though her framing was diagonally braced with iron. The shipentine *Madeleine*, built in France in 1896, is almost identical in rig to the *Great Republic*; her length is 321 ft. and her gross tonnage 3026. A five-masted barque *France*, built in Glasgow in 1890, is 361 ft. long and has a gross tonnage of 3942. As further examples of the large sailing ships built in recent years may be mentioned the *Astral* and *Potosi*. The *Astral* was built by Arthur Surall and Co. at Bath, Maine, in 1900, for the oil trade. She is a full-rigged four-masted ship, 332 ft. long, 45½ ft. beam, 26 ft. moulded depth, gross tonnage 3292, and intended to carry 1,500,000 gallons of oil in cases of 10 gallons each from the United States to Shanghai, returning with cargoes of sugar, hemp, &c. The masts and yards of this vessel, as well as the hull, are of steel. The five-masted German barque *Potosi*, built in 1895, which is 366 ft. long, has a gross tonnage of 4027 and a dead-weight capacity of 6200 tons; she has a splendid record of quick passages, one reducing the record from Portland Bill to Iquique to 62 days.

As instances of the times occupied on the voyages of modern sailing ships the following may be given:—66 days from Iquique in Chile to the English Channel by the British ship *Maxwell*, gross tonnage 1856; 29 days from Newcastle, New South Wales, to Valparaiso by the British four-masted ship *Wendur*, 2046 gross tonnage; 30 days from the Lizard to Rio de Janeiro by the British ship *Salamanca*, of gross tonnage 1262; and 78 days from Dover to Sydney for the same ship; 153 sailing days for a voyage round the world, made up of 50 days from Cardiff to Algoa Bay, 28 days from Algoa Bay to Lyttelton, and 74 days from Lyttelton to the Lizard, by the British ship *Talavera*, gross tonnage 1796; 59 days from Cape Town to Iquique by the British ship *Edenballymore*, of gross tonnage 1726; 88 days from San Francisco to Queenstown by the British four-masted barque *Falls of Garry*, of gross tonnage 2088; and 69 days from Scilly to Calcutta in 1876 by the *Coriolanus*, gross tonnage 1074. Amongst the voyages recorded recently by German ships the following may be enumerated:—71 days from Iquique to Hamburg by the ship *Preussen*, gross tonnage 1761; 58 days from the English Channel to Valparaiso by the four-masted barque *Placilla*, gross tonnage 2845; 71 days from the English Channel to Melbourne by the barque *Selene*, gross tonnage 1319; and 69 days from the English Channel to Adelaide by the four-masted barque *Hebe*, of gross tonnage 2722.

Although alterations in the rigs of ships have not caused much difference in their appearance over a very long period, a number of changes have been made, mostly for the purpose of saving labour. The mechanical reefing of topsails and top-gallant sails was introduced about 1858, but only remained in favour for a few years; double topsails, on the other hand, first used in the four-masted American clipper ship *Great Republic*, have held their own, and double top-gallant sails have since been adopted. Until about 1875 almost all ships carried studding-sails, but since this date they have been gradually discontinued, and at present are usually only to be found in training vessels, and now and again in square-rigged yachts. As already stated, wire rope has been adopted for standing rigging, and deadeyes and lanyards have given place almost universally to rigging screws. Masts and the heavier yards have been made of iron for many years, and more recently of steel, and the lower masts and top masts have in a number of cases been made in one length; when constructed in this manner the mast is termed a pole mast. This arrangement is very common in America, where the latest steel sailing ships are so fitted. Most large sailing ships carry a steam boiler or boilers, and engines are provided for all sorts of purposes, for which hand labour used to be commonly employed. The result of this and other labour-saving arrangements has been to effect a very considerable reduction in the number of hands carried. As indicating the nature of the change which has taken place, it may be mentioned that whereas a 1000-ton ship of the East India Company in the middle of last century had a crew of 80 all told, a modern four-masted barque of 2500 tons has a total complement of 33 only.

As to the employment of sailing ships, there can at the present day be seen at most large shipping ports a number of sailing ships of various types and sizes. Some of the largest ships are employed in the jute trade of India, the grain trade of California, British Columbia, &c., and the nitrate trade of Chile. From Great Britain they usually take out coal, which, however low freights may be, may in nearly all cases be relied on.

Steam-ships.

Of merchant steamships, vessels of all sizes are to be met with, from a small launch to the stately Atlantic liner of 16,500 tons gross and 23½ knots speed, and the huge cargo ship of over 20,000 tons gross and 15 knots speed. They are employed on every service for which sailing ships are used, and upon others for which sailing ships are not employed, and they monopolize nearly the whole of the passenger traffic of

the world. In general, the different sizes have no bold characteristic features such as distinguish sailing ships; they possess different deck structures and certain differences in form, but, to the ordinary eye, a photograph of a vessel of, say, 1000 tons, apart from details of known size that may serve to fix the scale, may often be taken to represent a vessel of even ten or twenty times the size.

Merchant steamships may be classed into various types. There are *Flush-deck Vessels*, in which there are no deck structures, beyond possibly engine and boiler casings; there are vessels which have a *Monkey Forecastle* forward, from which the anchors are worked, a small poop or *Hood* aft to protect the steering gear, and a deck-house under the bridge amidships, called a *Bridge House*. Some have a complete forecastle above the main deck, called a *Top-gallant Forecastle*, with a corresponding *Poop* and a *Bridge House;* some have a *Top-gallant Forecastle* and a *Bridge House* associated with simply a *Raised Quarter-deck*. In others the bridge house and poop join one another, when the vessels are described as having a *Top-gallant Forecastle* with a *Long Poop* and *Bridge House* combined, and are known as *Well-decked Vessels*, a name also applied to vessels in which the *Bridge House* joins a *Raised Quarter-deck*. The foregoing types include most small vessels, but comparatively few very large-sized vessels. Most of the latter have a continuous upper deck above the main deck: if this be of light construction, and openings be left between it and the main deck, the vessel is called a *Shade-decked Vessel;* if there be no openings between the decks, she is called an *Awning-decked Vessel;* if there be no openings and the scantlings be somewhat heavier, she is called a *Spar-decked Vessel;* and if the scantlings be heavier still, she is called a *Three-decked Vessel*. Besides the above, vessels are built with almost every other conceivable variation of these features, and there are in addition *Turret-deck Vessels*, *Trunk-deck Vessels*, and *Whale-back Vessels*, the last named being peculiar to the Great Lakes of North America.

Sailing ships with machinery of low power, for use in calms and in getting into port, are called *auxiliary* steamships. In the early days of steam all sea-going vessels provided with means of steam propulsion may be said to have come under this description. The screw propeller offered less obstruction than paddle-wheels when the sails were set and the engines stationary, but the resistance caused by the screw when not in use led to a number of devices for either lifting it completely out of the water, or for fixing its blades in positions so as to offer the least obstruction in going through the water. Auxiliary steam yachts have in the present day many friends. In them the pleasures of sailing may be secured with a fair amount of certainty of making port when desired. Small vessels intended for seal and whale fishing are sometimes fitted as auxiliary steamships: six such vessels, all barque-rigged, and one of them fitted with a lifting screw, hailed in 1902 from Dundee, and a few also hailed from Norway, from Newfoundland, and from Bedford, U.S.A. Several navies possess auxiliary steam gunboats and other auxiliary steam vessels for service in distant parts of the world, and a few possess auxiliary steam training ships. The Chilian training ship *General Baquedano*, for example, built in 1899, of steel sheathed with teak and coppered, is 240 ft. long, 45¾ ft. broad, and has a displacement of 2500 tons on a mean draught of 18 ft.; she has a large spread of canvas and can steam 13 knots when required.

Steam Trawlers.—Screw steam trawlers are among the vessels frequently met with round the British coasts. As an example the *Anglesey* may be quoted. Built in 1898, she is 107 ft. long, with a beam of 20½ ft. and a depth in hold of 11 ft.; her gross tonnage is 158 and her net tonnage 52. One of the chief advantages which such vessels possess over sailing vessels lies in the certainty with which they can get to the fishing-ground, and then back again quickly to the market with their fish.

Tugs.—Smaller tugs are employed on canals and rivers and larger ones for ocean work. A sea-going steel tug, built by the Bath Iron Works, Bath, Me., for the American coal trade, is 165 ft. over all and 1045 tons displacement, with triple-expansion engines of 900 H.P. A paddle-tug, the *Flying Scotsman*, built in 1898, has a length of 118 ft., beam of 20 ft., depth in hold of 10 ft.; her gross tonnage is 177 and her net tonnage 29. A screw tug, the *Hannah Jolliffe*, built in 1900, is 103 ft. long, 23 ft. 6 in. broad, and 12 ft. deep; her gross tonnage is 178 and net tonnage 11. As already stated, one of the earliest uses to which steam vessels were put was for towing other vessels on canals and rivers, into and out of harbour, &c.; and in 1902 there was employed on the Clyde the paddle-tug *Clyde*, which was built of iron in 1851, of nearly the same dimensions as those of the vessels given above.

Colliers and Tank-steamers.—In a number of cases vessels are built to carry special cargoes; coal-carrying vessels, *colliers*, are well-known examples of this class. One of the first steam colliers was built at Wallsend as early as 1844, and called the *Q.E.D.* She was constructed of iron, had an over-all length of 150 ft., with a breadth of 27½ ft. She was propelled by a single screw driven by a 20-H.P. engine, and her dead-weight capacity was 340 tons. In certain respects she was a remarkable vessel, for she was fitted with a double bottom, the space between the bottoms being divided into tanks and arranged for water ballast, a system which is common in colliers, and indeed in most cargo ships. The advantage of the arrangement in the case of colliers is especially great, as they usually carry a full cargo one way and return empty. In their light condition sufficient water-ballast can be at once added to make them seaworthy, and this at the end of the voyage can be pumped out at a small cost. The *Wallsend*, a typical modern collier, is 210 ft. long, 30 ft. beam, 13 ft. 6 in. depth, and has a gross tonnage of 899, a net tonnage of 538, with triple-expansion engines. *Tank-steamers* form another example of vessels built for a particular cargo. Large numbers of these are employed in carrying oil in bulk from American and Russian sources, and from Borneo, to numerous ports all over the world. Their construction and the character of the material carried are such that they cannot be used to any considerable extent for any other purpose. Many of them are of large dimensions, while some are comparatively small. On the Caspian Sea, for instance, numerous small steamers are employed conveying oil from the Baku district to other ports, and to towns along the Volga. On the other hand, for longer passages when the demand is great, larger ships are employed, on account of their greater economy. As an example of a large oil vessel, the *Pinna*, engaged in carrying petroleum from Russian ports to the East, may be mentioned. She is 420 ft. long, 52 ft. broad, and 34 ft. deep, and she can carry 9000 tons of oil in her fully-laden condition. The machinery is placed well aft, and the cargo-space is divided up into twelve large tanks, extending to the height of the main deck, by seven transverse bulkheads and a longitudinal middle-line bulkhead. The spaces between the transverse bulkheads are called Nos. 1, 2, 3, 4, 5, and 6 holds respectively, and each hold has a port and a starboard tank. Each tank is provided with an expansion trunk, in order that the free surface of the oil may always be small, however much the bulk of the latter may expand or contract with changes of temperature.

Cargo Ships.—Many vessels are built to carry a particular cargo on one voyage and a general cargo on the return voyage. This usually results in their having certain features which adapt them for the special cargo, and do not interfere materially with their carrying a general cargo at remunerative rates. Usually, indeed, the object kept in view in constructing these vessels is to have as large a range of cargoes to choose from as possible, and the arrangements by which a particular cargo or particular cargoes can be carried are only provided with the view of achieving this object. Ordinary cargo ships, or "Ocean Tramps," as they are often designated, do a very large portion of the world's cargo-carrying. They may be of any size, and of any type required by the exigencies of trade, the fashion of the day, or the fancy of the owner. There is very little ornamentation about them, their decks even being often unsheathed with wood, but the greatest attention is paid to the arrangements for the rapid handling of the cargoes; they are mostly built of steel, and their usual speed is from 10 to 11 knots. In the early 'nineties well-decked vessels formed a large proportion of the total number; but ten years later comparatively few of this type were being built, and these were principally intended for the coal trade, or were comparatively small vessels for coasting purposes. Partial awning-deck steamers, again, which were much in favour at the same period, gave place, a decade later, to other types; and vessels having a raised fore-deck went entirely out of fashion, the tendency being to revert to flush-deck vessels, having short poop, bridge house, and forecastle.

TABLE IV.—*Types of Cargo Steamers.*

When built	A. Built in 1881.	B. Built in 1894.	C. Built in 1897.	D. Built in 1898.	E. Built in 1900.
Type of Vessel	Well-decked.	With Top-gallant Forecastle, Bridge House, and Poop.	Awning-decked.	Spar-decked.	American Lake Steamer.
Length	263′ 6″	300′ 0″	470′ 0″	330′ 0″	478′ 0″
Breadth	35′ 8″	40′ 0″	50′ 0″	45′ 6″	52′ 0″
Depth (moulded)	20′ 6″	23′ 6″	34′ 10″	20′ 6″	30′ 6″
Draught (without keel)	19′ 3″	19′ 2″	27′ 5″	21′ 10″	17′ 10″
Weight of steel or iron in hull	820 tons	...	3676 tons	1875 tons (steel or iron in hull and wood, outfit, &c.)	2850 tons
,, ,, wood, outfit, &c.	166 ,,	...	509 ,,		280 ,,
,, ,, propelling machinery	184 ,,	...	615 ,,	370 ,,	300 ,,
Total light displacement	1170 ,,	1620 tons	4800 ,,	2245 ,,	3430 ,,
Load displacement	3740 ,,	5530 ,,	16,710 ,,	7695 ,,	10,600 ,,
,, block coefficient	·72	·80	·81	·82	·85
Ratio of light to load displacement	·313	·293	·287	·292	·324
Dead weight carried	2570 tons	3910 tons	11,910 tons	5450 tons	7170 tons
Ratio of dead weight carried to load displacement	·687	·707	·713	·708	·676
Cargo capacity in cubic feet	115,000	170,000	680,000	288,000	468,000
Tonnage under deck	1436	2150	7038	3028	5822
,, gross	1816	2385	7296	3222	5946
,, net	1167	1500	4770	2078	4446
Water-ballast capacity	357 tons	500 tons	3346 tons	804 tons	2960 tons

Table IV. gives the dimensions, carrying capacity, and other leading particulars of five existing cargo steamers of different types, arranged in the order in which they were built. A is a well-decked vessel (Fig. 9, Plate II.), having a top-gallant forecastle with a long raised quarter-deck and bridge house combined, and is fitted with one deck, but has two tiers of beams. B (Fig. 10, Plate II.) is a vessel with a top-gallant forecastle, bridge house, and poop, and a single deck. C is an awning-decked vessel, with two decks, but three tiers of beams. D is a spar-decked vessel of 3222 tons gross, and E (Figs. 11 and 12, Plate II.) an American Lake steamer in which the draught was restricted to 18 feet. Besides the principal dimensions and light and load displacements, the block "coefficients" corresponding to the load conditions are given in Table IV., in order to show the fulness of form commonly adopted in these vessels. The *block coefficient* is the ratio of the volume of the immersed portion of the ship to the volume of the parallelopipedon, whose length, breadth, and depth are the same as the length, breadth, and mean draught (without keel) of the vessel

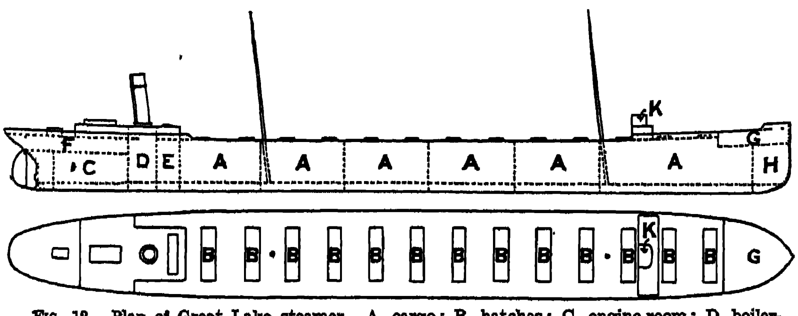


FIG. 12.—Plan of Great Lake steamer. A, cargo; B, hatches; C, engine-room; D, boiler-room; E, coal-bunker; F, accommodation; G, crew's space; H, water ballast; K, pilot-house.

itself; and it will be seen that in four cases out of the five given, the immersed volume, *i.e.*, the displacement, is 80, or upwards of 80 per cent. of this circumscribing parallelopipedon. The low speed, which is found economical for the "Ocean Tramp," admits of this fulness, and provides that capability for large stowage accommodation for cargo which has brought them into existence. In vessels whose speed is of great importance the block coefficient varies from ·5 to ·65, the lower limit being reached on the smaller vessels on cross-channel services, and the higher limit on very long vessels, such as the fast Atlantic liners. The total weight of material in the hull, *i.e.*, the iron or steel and woodwork, outfit, &c., and the propelling machinery, is called the vessel's *light displacement*. The *load displacement* is made up of the light displacement, together with the weight of the cargo, &c., or the dead weight carried; this, it will be seen from Table IV., varies from two to two and a half times the amount of the light displacement. This dead weight is fixed within certain limits by the builders and owners with regard to the safety and economical working of the ship, but British law provides that a vessel shall not be loaded deeper than a certain mark, known for many years as the Plimsoll mark, which has to be placed on the sides of all merchant vessels. The position of this mark, however, is, within certain limits, left to the discretion of the aforesaid builders and owners. The cargo capacity in cubic feet, the tonnage under deck, and the gross and net tonnage, are given in Table IV. for each vessel. The mode of measuring tonnage is based on the Act of 1854. (See TONNAGE.) The cubic contents of all closed-in spaces, available either for cargo or passengers, is calculated, and a ton of measurement is assumed to be provided by 100 cubic feet of space. Gross tonnage is the tonnage of all such spaces. "Under-deck" tonnage is the tonnage of spaces below the tonnage deck, which is defined as the upper deck in all ships having less than three decks, and the second deck from below in all others. The net tonnage is obtained from the gross by deducting an allowance for machinery spaces; for crew spaces, including accommodation for the master; for sail-room (in sailing ships) of not more than 2½ per cent. of the gross tonnage; for helm, capstan, and anchor gear, boatswain's store, and chart spaces. Thus net tonnage is the space which is available for the stowage of cargo. It has nothing to do with the displacement of the vessel or with the dead weight carried, to each of which the term tonnage is often applied. It will be seen from the table that in the vessels A, B, C, and D the net tonnage is less than one-half the dead weight carried.

Fig. 13 (Plate II.) is an example of a *Turret-deck* steamer, of which a considerable number have been built by Messrs Doxford of Sunderland. Her dimensions are: length 439 ft. 8 in., beam 51 ft. 7 in., gross tonnage 5995, and net tonnage 3794. Such vessels have the reputation of being good dead-weight carriers, and the shelf on each side of the central trunking can very conveniently be used for carrying timber, and for other purposes.

A general idea of the construction of a modern cargo steamer may be had by reference to Fig. 19 in the article on SHIPBUILDING. Fig. 14 shows the interior arrangements of the White Star *Cedric*, a vessel designed to carry a large amount of cargo in addition to many passengers.

Passenger Steamers.—There are numerous varieties of passenger steamers, both as to size and shape. For river service, where the traffic is considerable, paddle-wheel vessels of limited speed are usually preferred, as possessing great manœuvring power, and therefore the capability of being brought alongside the landing-places with rapidity and safety. The *King Edward*, a steamer which began to ply on the Clyde in 1901, is 250 ft. long, 30 ft. wide, 10 ft. 6 in. deep to the main deck, and 17 ft. 9 in. to the promenade deck. She was the first passenger steamer to be driven by Parsons's steam turbine, though she presents the usual appearance of a screw passenger vessel. Her speed is 20 knots. A second turbine steamer, the *Queen Alexandra*, began to run on the Clyde in 1902; she is generally similar to the *King Edward*, but larger and faster. The paddle-wheel steamer *La Marguerite*, which in the summer months

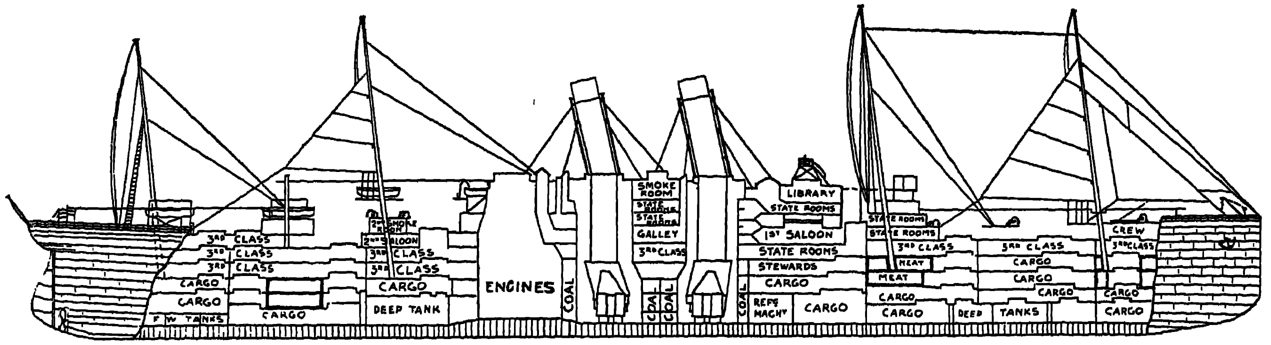


FIG. 14.—Plan of *Cedric*.

makes trips from London to the coast of Kent and thence across the Channel, is 330 ft. long, has accommodation for a large number of passengers, and obtained 22 knots with 7500 I.H.P. on trial.

Cross-Channel Steamers.—The mail service between Holyhead and Kingstown has for many years employed a number of splendid vessels, which may be taken as typical of this class. The four paddle-steamers, *Ulster*, *Munster*, *Leinster*, and *Connaught*, built in 1860 for this service, were 337 ft. long, 35 ft. broad, and 19 ft. deep; their speed was 18 knots with 6000 I.H.P. A vessel of the same type, but larger, named the *Ireland*, was added to the fleet in 1885. In 1896 and 1897 the four new twin-screw steamers were built, and received the same names as the four vessels built in 1860, which they have replaced. Their length is 360 ft., breadth 41 ft. 6 in., depth 29½ ft., and displacement 2230 tons at 14 ft. 6 in. load draught. Their sea-going speed is 23 knots. They have sleeping-berths for 238 first-class and 124 second-class passengers, and large dining and other public rooms for general accommodation. Considerable space is set apart on the main and lower decks for the mails, &c. The engines consist of two sets of triple-expansion four-cylinder engines, there being two low-pressure cylinders of equal size in each set, an arrangement which lends itself readily to the balancing of the machinery.

Atlantic Liners.—Particulars of the famous liners which have had a share in the development of the trans-Atlantic service are given in Table V., which is taken chiefly from *The Atlantic Ferry*, by A. J. Maginnis, and many more details may be found in the opening portion of the article STEAMSHIP LINES in this volume, and in the historical sketches it contains of the various lines, such as the Allan, the American, the City of Dublin, the Collins, the Cunard, the Guion, the Hamburg-American, and the White Star. Some of the most noteworthy vessels are illustrated in Figs. 15–19 (Plates III. and IV.). The *Persia* (Fig. 15) was the first iron steamer to be placed on the Atlantic service by the Cunard Company (1856). Fig. 16 is the *City of Rome*, built in 1881 at Barrow for the Inman Line, one of the most graceful vessels on the Atlantic; when first completed she was square-rigged on the three forward masts, and looked even better than she does in the illustration. The *Campania* (Fig. 17) and her sister-ship the *Lucania*, each 600 ft. long, and built in 1893 for the Cunard Company by the Fairfield Shipbuilding Company, held the record for fast passages across the Atlantic for several years. With twin-screws and triple-expansion engines they attained a speed of 23½ knots on trial with 31,050 I.H.P. On her best runs the *Lucania* crossed the Atlantic, 2823 nautical miles, in 5 days, 8 hours, 38 minutes, the mean speed being 22 knots for the run, maintained with a consumption of coal amounting to 20½ tons an hour. The second *Oceanic*, built for the White Star Line at Belfast in 1899, is shown in Fig. 18; and the *Deutschland* (Fig. 19), built at Stettin for the Hamburg-American Line, broke the

TABLE V., *showing Dimensions, &c., of Famous Atlantic Liners.*

Name of Ship.	Owners.	When Built.	Where Built.	Material.	Length between Perpendiculars.	Breadth.	Depth.	Displacement.	Gross Tonnage.	Speed.	How Propelled.	Steam Pressure per Square Inch.	Indicated Horse-Power.
					Feet.	Feet.	Feet.	Tons.		Knts.		Lbs.	
Savannah	Colonel Stevens	1819	New York	Wood	130	26	16·5	1,850	320	6	Paddles	10	90
Royal William	City of Dublin Co	1838	Liverpool	„	145	27	17·5	1,080	720	7·5	„	5	400
Sirius	Brit. & Amer. St. Nav. Co.	1838	Leith	„	178	25·5	18·25	1,995	703	8·5	„	15	600
Great Western	Great Western S.S. Co.	1838	Bristol	„	212	35·3	23·25	2,300	1,340	8·5	„	15	750
British Queen	Brit. & Amer. St. Nav. Co.	1839	London	„	275	37·5	27·0	2,070	1,863	8	„	15	700
Britannia	Cunard	1840	Greenock	„	207	34·5	22·5	2,050	1,150	8·5	„	12	740
Great Britain	Great Western	1843	Bristol	„	274	48·2	31·5	5,780	3,270	11	Single Screw	25	1,500
America	Cunard	1848	Greenock	„	251	38	25·3	4,250	1,825	10·25	Paddles	13	1,400
Asia	Cunard	1850	„	„	208	45	24	3,020	2,227	12	„	15	2,000
Arctic	Collins	1850	New York	„	282	45	31·5	6,200	2,860	12·5	„	17	2,000
Persia	Cunard	1856	Glasgow	Iron	300	45	29·9	7,130	3,300	12·5	„	20	3,600
Adriatic	Collins	1857	New York	Wood	355	50	35·0	7,504	3,670	13·5	„	25	4,000
Great Eastern	Great Eastern S.S. Co.	1858	Millwall	Iron	680	82·8	48·2	32,160	18,915	13	S. Screw and Paddles	30	11,000
Scotia	Cunard	1862	Glasgow	„	379	47·8	30·5	7,600	3,871	13·5	Paddles	25	4,000
City of Paris	Inman	1866	„	„	346	40·4	26·2	6,411	2,651	13·5	Single Screw	30	2,000
Russia	Cunard	1867	„	„	358	43	28·8	6,770	2,959	13·5	„ „	25	2,500
City of Brussels	Inman	1869	„	„	390	40·3	27·1	6,000	3,081	14·5	„ „	30	3,000
Oceanic	White Star	1871	Belfast	„	420	41	31	7,240	3,707	14·75	„ „	65	3,000
City of Richmond	Inman	1874	Glasgow	„	441	43·5	34	9,320	4,623	15	„ „	70	4,000
Britannic	White Star	1874	Belfast	„	455	45·2	33·7	9,600	5,000	16	„ „	75	5,100
City of Berlin	Inman	1875	Greenock	„	488·5	44·2	35	10,100	5,491	16	„ „	75	5,200
Arizona	Guion	1879	Glasgow	„	450·2	45·4	35·7	9,900	5,147	16·25	„ „	90	6,300
Servia	Cunard	1881	„	Steel	515	52·1	37·9	12,300	7,392	16·5	„ „	90	12,000
City of Rome	Inman	1881	Barrow	Iron	560·2	52·3	37	13,500	8,144	17·5	„ „	90	11,500
Alaska	Guion	1881	Glasgow	„	500	50	38	9,500	7,142	17·75	„ „	100	11,000
Notting-Hill	Notting-Hill S.S. Co.	1881	„	Steel	420	45·1	26·5	6,210	3,920	12	Twin Screw	100	2,800
Aurania	Cunard	1882	„	„	470	57·2	37·3	13,360	7,269	17	Single Screw	90	8,500
Oregon	Guion and Cunard	1883	„	Iron	501	54·2	40	12,500	7,375	19	„ „	110	13,000
America	National	1884	„	Steel	432	51·3	38·6	9,550	5,528	18·75	„ „	95	8,300
Etruria	Cunard	1885	„	„	501	57·3	38·2	13,800	8,120	19·5	„ „	110	14,500
Aller	North German	1886	„	„	438	48	34·6	10,460	5,400	16·5	„ „	150	8,200
City of Paris (second of name)	Inman	1889	„	„	527·6	63·2	39·2	17,270	10,670	20	Twin Screw	150	18,500
Teutonic	White Star	1889	Belfast	„	566	57·8	39·2	16,740	9,984	20	„ „	180	17,500
Fürst Bismarck	Hamburg-American	1890	Stettin	„	502·6	57·6	38	15,200	8,874	19·5	„ „	160	17,000
Campania	Cunard	1893	Glasgow	„	598	65	43	21,000	12,950	22	„ „	165	30,000
St Louis	American	1895	Philadelphia	„	535·7	63	42	16,000	11,630	20	„ „	200	20,500
Kaiser Wilhelm der Grosse	North German	1897	Stettin	„	625	66	43	23,760	14,350	22·8	„ „	178	32,000
Kaiser Friedrich	North German	1898	Danzig	„	584	64	41	20,100	12,000	21·5	„ „	226	27,000
Oceanic (second of name)	White Star	1899	Belfast	„	685	68	49	26,100	16,000	21·5	„ „	192	29,000
Deutschland (second of name)	Hamburg-American	1899	Stettin	„	666	65·5	45·5	24,400	14,500	23·25	„ „	225	36,000

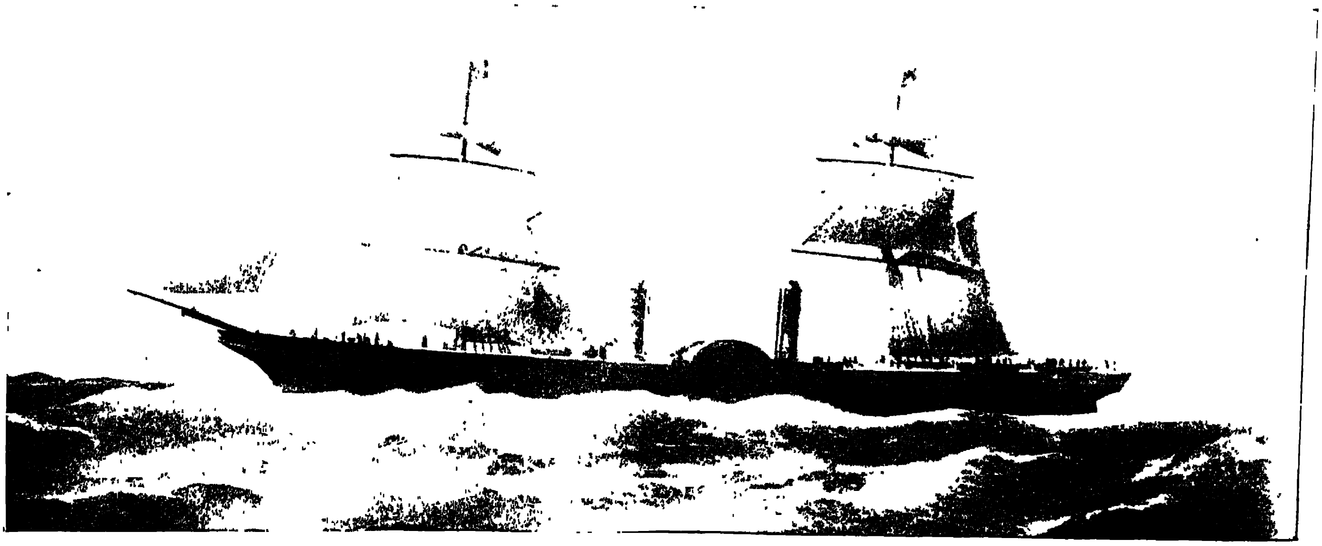


FIG. 15.—*Persia.*

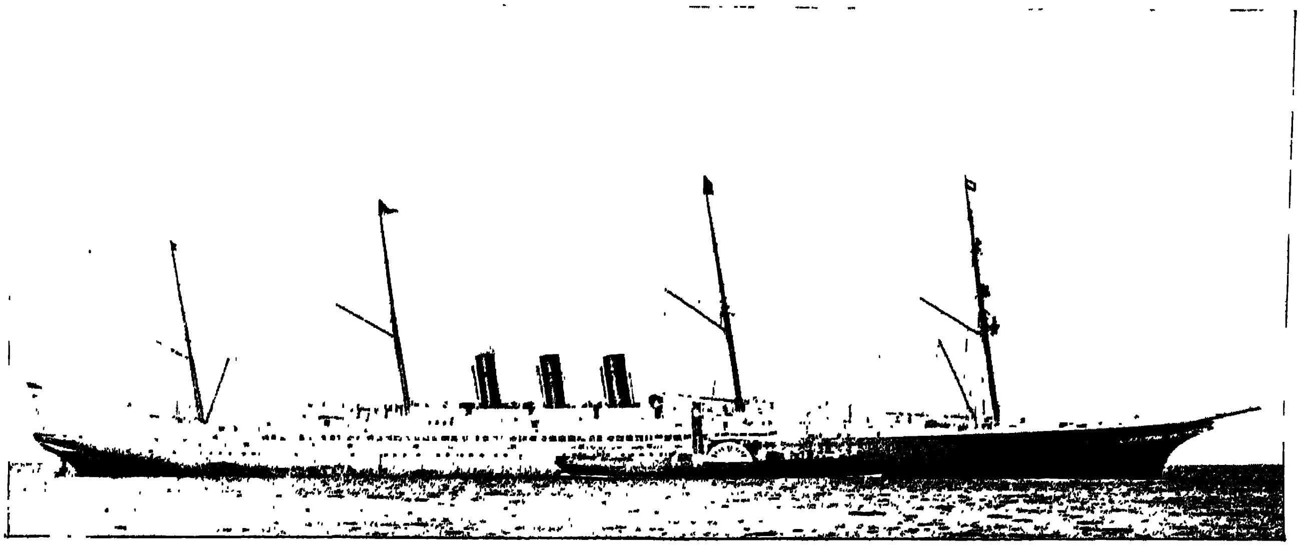


FIG. 16.—*City of Rome.*

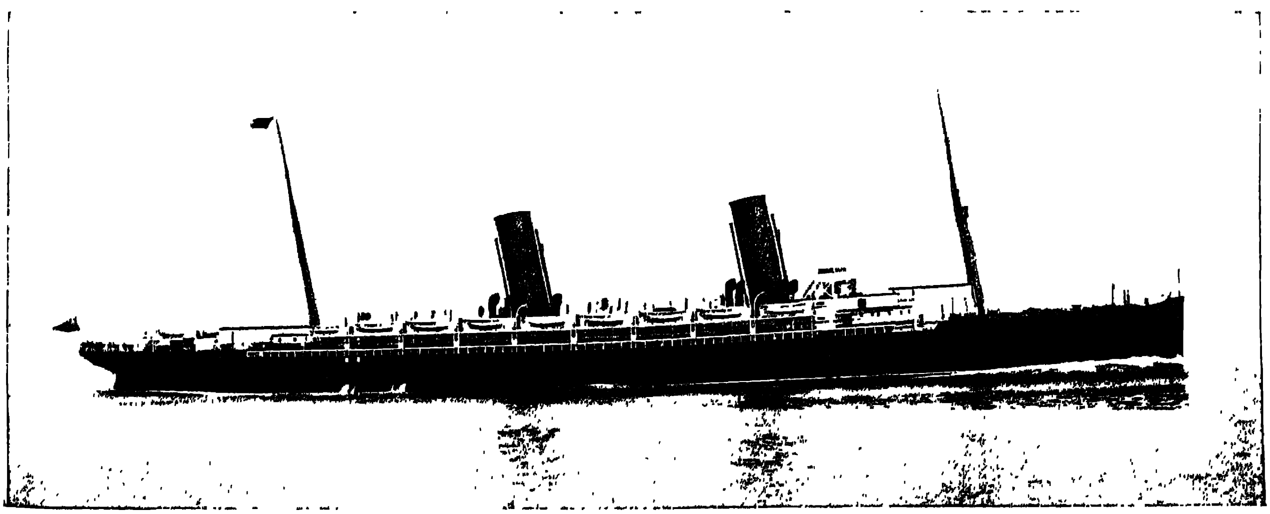


FIG. 17.—*Campania.*

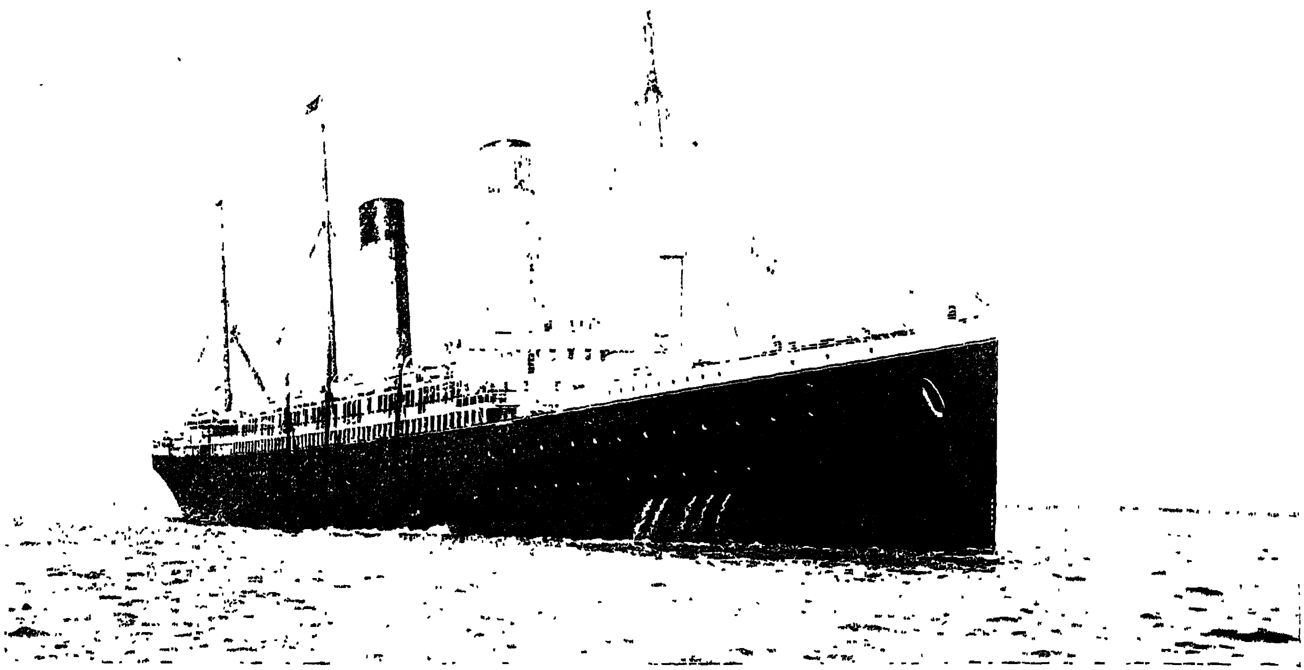


FIG. 18.—*Oceanic.*

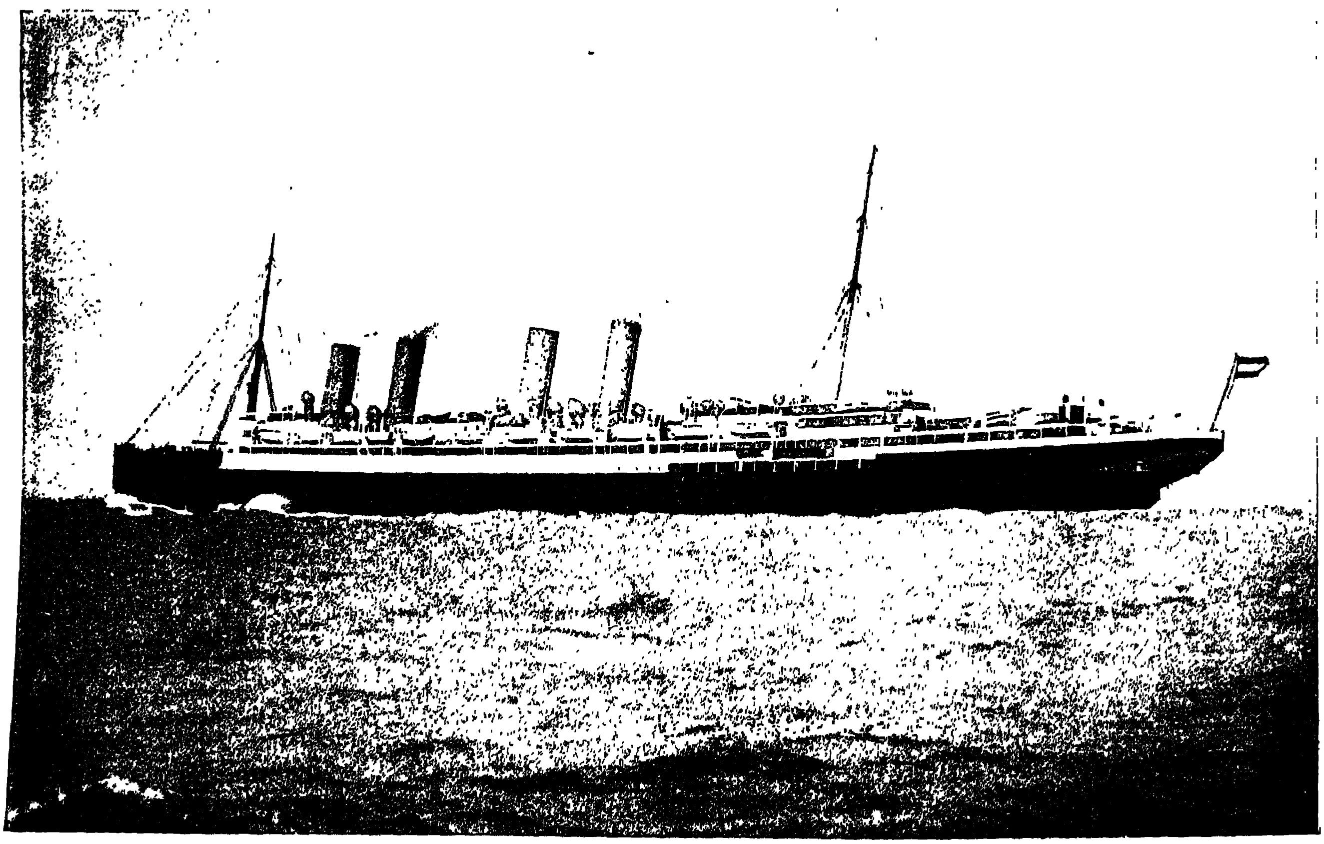


FIG. 19.—*Deutschland.*

record in 1900, traversing the Atlantic from New York to the Eddystone in 5 days, 17 hours, 28 minutes, at a mean speed of 23·36 knots. In a subsequent voyage she maintained an average of 23·52 knots. A still larger vessel, the *Kaiser Wilhelm der Zweite*, launched in 1902 for the North German Lloyd, is 706½ ft. long, with a beam of 72 ft. Her gross tonnage is about 20,000, and when loaded with 5600 tons of coal her displacement will be 26,000 tons. She is intended to maintain a speed of 23½–24 knots across the Atlantic.

In recent years a remarkable development in shipbuilding has proceeded in the United States, following on the demands in connexion with the building of the modern American navy, and work of every kind of the highest class is in progress on a large scale. The Newport News Co. has built the *Siberia* and *Korea*, for the service of the Pacific Mail Co. from Hong Kong to San Francisco, which are far in advance of all previous vessels on the Pacific lines. These vessels are 572 ft. over all, 63 ft. beam, and of 18,600 tons displacement on a draught of 27 ft. Their machinery is of 18,000 I.H.P., and is capable of maintaining 18 knots ocean speed. The Philadelphia firm of Cramp and Son has turned out the American Line vessels *St Louis* and *St Paul*, which have run with great success on the New York and Southampton service; and more recently the splendid vessels *Sierra*, *Ventura*, and *Sonoma*, for the Oceanic Steamship Co., for the mail service between Sydney, New Zealand, Honolulu, and San Francisco. Their dimensions are: length 425 ft. over all, beam 50 ft., moulded depth 28 ft. 3 in., tonnage about 6000, horse-power 8000, speed 17 knots. Although these vessels are smaller than the *Siberia* and *Korea*, they are far superior to any previous vessels on the Pacific routes, excepting the *Empress of India* and other vessels on the Hong Kong and Vancouver service. They have magnificent accommodation for a large number of passengers, and are specially built so that in thirty-six hours they can be fitted up as armed cruisers for the U.S. navy. More remarkable than either of these are the vessels being built by the Eastern Shipbuilding Co. of New London for the Oriental service of the Great Northern Railway. The aim in these vessels is to carry an immense cargo at a low cost, and at the same time a considerable number of passengers with greatly improved accommodation; they are 630 ft. long, 73 ft. beam, 55 ft. depth, and when fully laden their displacement will be nearly 33,000 tons, of which about 20,000 tons may be cargo. Their speed is stated to be about 14 knots, and their cost about £500,000 per ship. With the exception of the *Celtic* and the *Cedric* of the White Star Line, these will be the largest vessels in the world.

Special Vessels.—Many vessels are built for special and exceptional purposes, and cannot be classed with either ordinary cargo or passenger vessels. Amongst these may be included dredgers, train-carrying ferry-boats, and ice-breakers. To *dredgers* a special article has been devoted (see vol. xxvii.). *Train ferries* have been in use since 1870. In 1869 Mr Scott Russell described (*Trans. Inst. Nav. Arch.*) a train ferry-boat of special construction in use on the Lake of Constance, having a length of 220 ft., a breadth over the paddle-boxes of 60 ft., and a displacement of 1600 tons; the horse-power of her machinery was 200, divided between the two paddle-wheels, each of which was driven by a pair of independent oscillating engines. The object of this steamer was to convey trains between Romanshorn, on the one side of the lake, and Friedrichshafen, on the other; she was built of iron, and was designed to have great strength combined with light draught. In 1872 train ferry-boats were introduced into Denmark to carry trains between the mainland and the islands and, later, between Denmark and Sweden. In 1883 the *Solano*, a large train ferry 406 ft. long was built by Messrs Harlan and Hollingsworth, of Wilmington, Delaware, to run between Bernicia and Porto Casta in connexion with the Central Pacific Railway. Two other interesting examples of train ferries, shown in Figs. 20 and 21 (Plate V.), were built on the Tyne by Sir W. G. Armstrong, Whitworth, and Co. Ltd., in 1895 and 1896, the former for service on the river Volga, and the latter for service on Lake Baikal in Siberia. The Volga has a rise and fall of no less than 45 feet between spring and midsummer, and the ice upon it in winter is usually 2 ft., and sometimes 3 ft., thick; thus the problem presented considerable difficulties, which were increased by the fact that the locks of the Marinsky canal system, through which all vessels bound for the Volga must pass, are of such dimensions that it was impossible for vessels of sufficient size to be got through in one piece. It was decided to use two vessels to do the work, the first to act only as an ice-breaker, and the other to act only as a train-carrier. The ice-breaker was built in two pieces, the parting being at the longitudinal middle-line plane of the vessel. This was satisfactorily carried out by means of a double longitudinal middle-line bulkhead extending the whole length of the vessel. On arrival at the canal she was divided into halves, and was joined up again after passing through the last of the locks. Her dimensions were: length 147 ft., breadth 37 ft. 6 in., and depth 16 ft. 6 in., and she was fitted with compound engines and twin screws. The ferry steamer itself (Fig. 20, Plate V.) was 252 ft. long, of 55 ft. 6 in. beam, and of 14 ft. 6 in. depth. Four lines of rails were laid upon her deck, sufficient space being provided for 24 trucks or carriages, which are shown in position in the figure. The difficulty presented by the great difference in the river level was got over by an arrangement of hydraulic hoists, placed at the bow, by which two trucks could be lifted at once to a height of 25 ft., and by having lines of rails at the landing-stages at two levels. The vessel was fitted with twin screws and compound engines, which gave her a speed of 9 knots. It was found necessary to divide her into four parts for the passage through the canal locks; the divisions were made at the longitudinal middle-line plane and athwartships at her middle. Each quarter, when apart, formed a water-tight hull, and reunion was effected while the parts were afloat.

The *Baikal Ferry* (Fig. 21, Plate V.) is employed in carrying trains across the lake in connexion with the Siberian Railway. For more than half the year the lake is frozen over to a considerable thickness, and in this case the vessel must of necessity be herself a powerful ice-breaker as well as a ferry steamer. The figure is from a photograph of a model, in which part of the side is removed in order to show the railway carriages in position. Her dimensions are: length 290 ft., beam 57 ft., draught under ordinary conditions 18 ft. 6 in., and displacement 4200 tons. The hull is closely subdivided for additional safety in case of perforation. She has three sets of triple-expansion engines, working three independent screw propellers, two placed aft, as in ordinary twin-screw ships, and one placed at the forward extremity for the purpose of disturbing the water under the ice, thus assisting the heavy cast-steel stem and armoured bow to break up the solid field-ice which the vessel has to encounter. The complete structure was first erected on the Tyne, then taken to pieces and shipped to St Petersburg; from thence its numerous parts were carried to the farthest point on the Siberian Railway, whence they were taken to their destination on sledges, and there the ship was re-erected and launched. The boilers constituted the heaviest individual pieces thus transported, as the weight of each could not be reduced below 20 tons.

Ice-breaking steamboats for securing a passage through frozen waters also date from an early period; one is spoken of as early as 1851, and several have recently been constructed for the Baltic and other parts for special purposes, instances of which have just been noticed in connexion with train ferries. The *Ermack* (Fig. 22, Plate V.), built in 1898, aims at being more effective than any previously constructed. Her dimensions are: length 305 ft., breadth 71 ft., depth to the upper deck 42 ft. 6 in., and displacement 8000 tons; her engines develop 8000 I.H.P., giving her a speed of 15 knots. Her

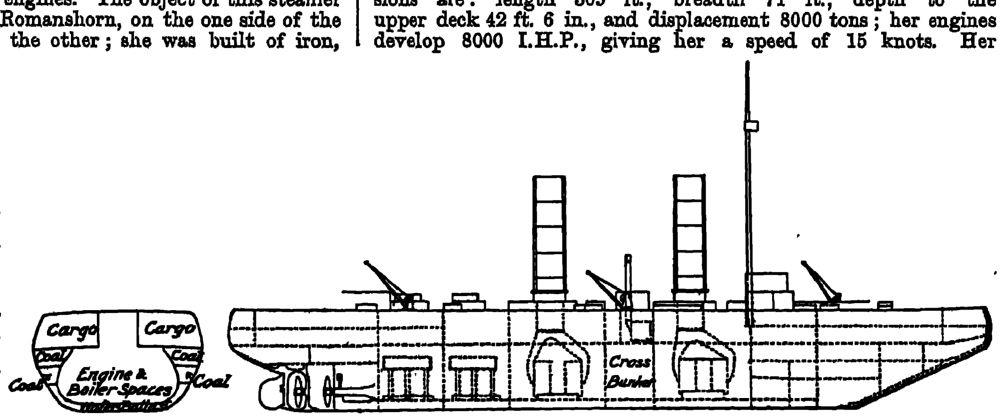


FIG. 23.—Section of *Ermack*.

general outline is shown in Fig. 23, from which it will be seen that her bow slopes upwards from below, so as to enable her to run up on to the ice and bring her weight to bear in breaking it. Her stern is so shaped as to protect the propellers as much as possible from masses of ice; and her transverse form is such that when wedged in between masses of ice she will tend rather to rise than to be depressed. She is built of steel, and is of very

great strength, the bow being specially strengthened to enable it to withstand the impact with the ice. As first constructed, she had three screws aft and one forward. The forward screw was provided with the object of sucking water by its action from under the ice, and so giving more effect to the weight of the ship; but on an experimental voyage in the Polar Sea, working through thick field-ice, the shaft of this screw became bent, and it was necessary to remove the propeller and provide temporary protection to the shaft-end. A new bow, that shown in Fig. 23, was afterwards fitted, with this forward propeller omitted. The *Ermack* made her maiden voyage in the middle of the winter of 1898–99, when she steamed through the Baltic to Kronstadt, crushing the ice with comparative ease. After this passage, during the remainder of the winter she assisted 41 steamers which were in difficulty, including the salvage of a Russian warship, which had unfortunately stranded on the island of Hogland. In the summer of 1899 she made the experimental voyage, above referred to, in the Polar Sea north of Spitsbergen, and notwithstanding her accident, continued far enough to demonstrate that she could make her way through this vast ice-field and deal with floes of the greatest thickness. An account of this vessel was given by Colonel Swan, C.B., before the Institution of Naval Architects in 1899.

War Vessels.

In the development of the modern warship during the latter half of the 19th century we shall have to deal with progress even more remarkable than that recorded for merchant ships. The adoption of iron and steel as the material for shipbuilding, and the development of the steam engine, have influenced warship construction in the same manner as they have influenced the construction of ships for the mercantile marine; but, in addition, the introduction of armour for the protection of ships, the great advances made in its manufacture, and, above all, the marvellous improvements in explosives and in the design and manufacture of guns, have almost continuously changed the conditions of naval warfare, and called for corresponding change in the design of warships. Those who are concerned in such questions may refer with advantage to an interesting comparison between the old *Victory* and a modern battleship instituted by Sir Andrew Noble in his address to the Mechanical Science Section of the British Association in 1890. Sir Andrew Noble's remarks in this connexion are the more weighty as coming from the director of the largest arsenal in the world, the works of Sir W. G. Armstrong, Whitworth, and Co., and from one whose scientific research has incalculably advanced our knowledge of artillery and explosives. Sir Andrew follows up this comparison by the following reference to the condition of things just before the Crimean war:—

"The most improved battleships of the period just anterior to the Crimean war differed from the type I have just described mainly by the addition of steam power, and for the construction of these engines the country was indebted to the great pioneers of marine engineering, such as J. Penn and Sons, Maudslay, Sons, and Field, Ravenhill, Miller, and Co., Rennie Bros., &c., not forgetting Messrs Humphreys and Tennant, whose reputation and achievements now are even more brilliant than in those earlier days. Taking the *Duke of Wellington*, completed in 1853, as the type of a first-rate just before the Crimean war, her length was 240 ft., her breadth 60 ft., her displacement 5830 tons, her indicated horse-power 1999, and her speed on the measured mile 9·89 knots. Her armament consisted of 131 guns, of which thirty-six 8-in. and 32-pdrs. were mounted on the lower deck, a similar number on the middle deck, thirty-eight 32-pdrs. on the main deck, and twenty short 32-pdrs. and one 68-pdrs. pivot gun on the upper deck. Taking the *Cæsar* and the *Hogue* as types of second- and third-rate line-of-battleships, the former, which had nearly the displacement of the *Victory*, had a length of 207 ft., a breadth of 56 ft., and a mean draught of 21. She had 1420 indicated horse-power, and her speed on the measured mile was 10·3 knots. Her armament consisted of twenty-eight 8-in. guns and sixty-two 32-pdrs., carried on her lower, main, and upper decks. The *Hogue* had a length of 184 ft., a breadth of 48 ft. 4 in., a mean draught of 22 ft. 6 in.; she had 797 indicated horse-power and a speed of $8\frac{1}{2}$ knots. Her armament consisted of two 68-pdrs. of 95 cwt., four 10-in. guns, twenty-six 8-in. guns, and twenty-eight 32-pdrs. of 50 cwt.—sixty guns in all.

"Vessels of lower rates (I refer to the screw steam frigates of the period just anterior to the Crimean war) were, both in construction and armament, so closely analogous to the line-of-battleships that I will not fatigue you by describing them, and will only allude to one other class, that of the paddle-wheel steam frigate, of which I may take the *Terrible* as a type. This vessel had a length of 226 ft., a breadth of 43 ft., a displacement of about 3000 tons, and an indicated horse-power of 1950. Her armament consisted of seven 68-pdrs. of 95 cwt., four 10-in. guns, ten 8-in. guns, and four light 32-pdrs."

The warships which existed at the beginning of the latter half of the 19th century were, with the exception of special vessels, divided roughly into three classes—ships of the line, frigates, and gun-vessels. At the present day the corresponding types are known as battleships, cruisers, and gunboats, and a fourth class has been created in the torpedo-boat and torpedo-boat destroyer. It is proposed to refer to these in the order named. (See also Navies.)

Battleships.

The destruction of the Turkish fleet at Sinope (30th November 1853) by the Russian fleet, the latter alone being armed with shell guns, and the combined experience of the British and French fleets before Sebastopol when engaging Fort Constantine, demonstrated conclusively that for ships of the line armour-protection had become essential. The French Government immediately began to build five armour-plated vessels, or batteries, as they were called, for service in the Black Sea; and eight similar vessels were begun shortly afterwards by the British Government for the same service. The British vessels did not arrive in time to take any part in the war; but three of the French batteries did, and were very favourably reported on by Admiral Bruat after an engagement with the Kinburn Forts on 17th October 1855. With the exception of these three French batteries, the whole of the fleets employed in the operations were composed of unarmoured wood ships, and a large number of them were sailing line-of-battleships. As the result of the engagement with the Kinburn Forts, the French commenced to build the first armour-plated wood frigate, *Gloire*, at Toulon in March 1858; and shortly afterwards (June 1859) the armour-plated iron frigate *Warrior* (Fig. 24) was commenced by the British Government. A number of vessels quickly followed, including, on the side of the British Government, the *Black Prince*, which was a sister ship to the *Warrior*, and four other vessels, the *Achilles*, the sister ships *Minotaur* and *Agincourt*, and the *Northumberland*. The distribution of the armour and other features of these vessels are shown in Fig. 24. The *Warrior* and *Black Prince*, which were 380 ft. long and of 9210 tons displacement, had a speed of $12\frac{3}{4}$ knots, and were originally armed with twenty-six 68-pdrs. and eight 110-pdrs. on the main deck, and two 110-pdrs. and four 40-pdrs. on the upper deck, which armament was afterwards altered to four 8-in. 9-ton guns and twenty-eight 7-in. $6\frac{1}{2}$-ton guns, all mounted on the broadside. They had a central citadel 213 ft. long, protected with $4\frac{1}{2}$-in. iron armour extending from a few feet below the water-line to the height of the upper deck. Their outline was similar to the outline of the wooden frigates of the day, and their rudder-heads and steering-gear were above water and unprotected against injury by shot and shell. In the four vessels which immediately followed, which were from 500 to 1500 tons more displacement, the overhanging bow, as will be seen from Fig. 24, was given up, bows more adapted for ramming were introduced, and some protection was afforded to the steering-gear by water-line belts of armour which extended the whole length of the vessel. In 1861 the British Government began the construction of eleven armour-clads, six of which, including the *Hector* and *Valiant*, sister ships of 6700 tons, were iron vessels, and five,

the *Caledonia*, *Royal Oak*, *Ocean*, *Prince Consort*, and *Royal Alfred*, were wooden vessels of rather over 4000 tons.

The reconstruction of the British fleet was taken in hand in earnest in 1863, when Mr (afterwards Sir) Edward J. Reed was placed at the head of the Construction Department at the Admiralty, with Messrs Barnaby, Barnes, Crossland, Morgan, and Wright—the last named (afterwards Sir James Wright) holding the position of engineer-in-chief—as his immediate assistants. Various types of vessels were devised, with arrangements of armour and dispositions of guns, to provide for the new conditions which had been introduced; and, in addition, great advance was made in the structural arrangements of ships, which up to this period had been considerably influenced by the old systems of construction in use in wooden ships. In investigating the qualities of ships, Sir Edward Reed had the good fortune to secure the co-operation and assistance of Mr William Froude, F.R.S., who had been the first to demonstrate accurately the theory upon which the behaviour of ships in a seaway depends. Mr Froude's experimental investigations on the forms of ships and kindred matters, begun in 1870 on behalf of the Admiralty and continued till his death in May 1879, had a most important bearing on the improvement of ships and on the science of naval construction generally. It is not too much to say that nearly the whole of the accurate information as to the best forms of ships and their resistance at various speeds, in the possession of naval architects to-day, is the direct result of Mr Froude's work, and that of his son, Mr R. E. Froude, F.R.S., who has continued the work since his father's death.

Sir E. J. Reed.

Among the considerations which Mr Reed had in view in the reconstruction of the navy, and which may be said to hold down to the present day, with variations dependent on the development of steam propulsion, gun attack, character of armour, and other conditions, may be enumerated the following:—(1) Steadiness of ship as a gun platform, with ample stability in all conditions of lading to enable her to keep the sea in all weathers, and sufficient stability in a partially-riddled condition to enable her to reach port in safety. (2) Protection by armour of the vitals of the ship, and of the heavy-gun positions, especially against shell fire. (3) The carrying of guns of power sufficient to penetrate the armour of any possible enemy. (4) Mounting the guns sufficiently high above the water-line to enable them to be fought in bad weather. (5) Simultaneous all-round fire, with concentration of as many guns as possible on any given point of the compass, fire in the line ahead from as great a number of guns as possible being considered of special importance. (6) Speed to overtake or get away from an enemy. (7) Manœuvring power to maintain, as far as possible, any desired position with regard to an enemy. (8) As large a radius of action as possible, coal-carrying capacity and economy of fuel being the two factors governing the radius of action and the strategical advantages dependent thereon in vessels provided with steam power alone. (9) The proper provision for the berthing of officers and crew. (10) The importance of limiting size and cost.

Objections were raised to the early armour-plated ships on the score of their unhandiness, heavy rig, exposed position of guns, &c. To meet these, Mr Reed designed a number of vessels, among which may be mentioned the *Bellerophon*, launched in 1865. She was a vessel of 7550 tons displacement, 4000 I.H.P., 14 knots speed, and was 300 ft. long, or 100 ft. less than the *Minotaur*. Her armament consisted of ten 9-in. 12-ton and five 7-in. 6½-ton guns. Her water-line was wholly protected by 6-in. armour, and she was provided with a central battery 98 ft. long, protected with armour of the same thickness. She carried a considerable spread of canvas, and she was fitted with a balanced rudder. The *Hercules*, completed in 1868, was a much more important ship than her predecessors, her dimensions being: length 325 ft., breadth 59 ft., draught 26½ ft., and her displacement 8680 tons. Her engines were of 8500 I.H.P., which gave her a speed of about 14½ knots. She had two 9-in. guns, mounted one forward and one aft on the main deck behind 6-in. armour, and eight 10-in. guns, mounted in a central battery on the main deck, four of which were mounted on revolving platforms, and could be worked from angle ports at the corners of the battery as well as from the broadside ports. Her water-line was protected by armour 9 in. thick amidships, reduced to 6 in. at her ends, and her battery was protected by 6-in. armour. She was handy under canvas, and was undoubtedly the most successful sea-going armour-clad of her day. The *Sultan*, completed in 1871, was in many respects a similar ship to the *Hercules*, but rather larger, having a displacement of 9200 tons, the same length, 2 ft. more beam, and 1 foot more draught; she attained a speed of upwards of 14 knots. Her main-deck battery carried the same guns as the main-deck battery of the *Hercules*, but the 9-in. guns at the extremities of the vessel on this deck were dispensed with, and she carried, in addition, an upper-deck battery, placed over the after-end of the main-deck battery,

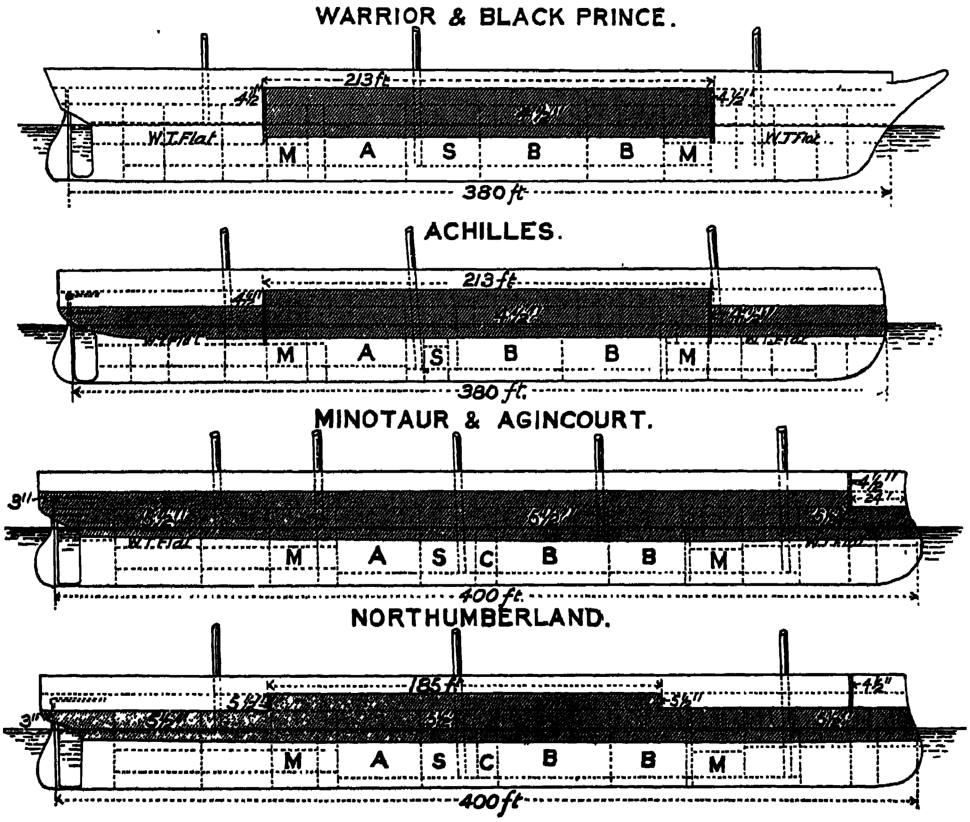


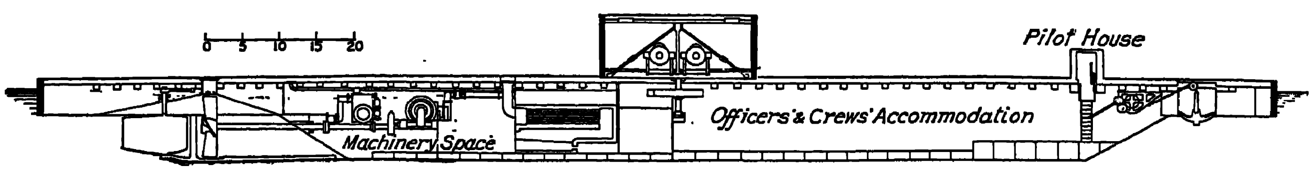
FIG. 24.—Plan of *Warrior* and *Black Prince*, *Achilles*, *Minotaur* and *Agincourt*, and *Northumberland*. A, engine-room; B, boiler-room; C, coal bunkers; M, magazines; S, shell-rooms.

in which four 9-in. guns were carried. Both batteries were protected with 6-in. armour; elsewhere the armour was of same thickness and was disposed in a similar manner to the corresponding armour in the *Hercules*. As originally completed, the *Sultan* was a fully-rigged ship, but on her refit in 1892 her old masts were removed and a pair of military masts substituted, as shown by Fig. 25 (Plate VI.).

Turret Ships.—The first turret ship in the British navy was the *Royal Sovereign*, built of wood and launched in 1857 as a 121-gun ship of 3760 tons, and afterwards cut down and reconstructed as a turret ship, under the superintendence of Captain Cowper Coles, between 1862 and 1864. The system of mounting heavy guns on revolving turrets had been worked out in America during the war by Captain Ericsson. Captain Cowper Coles, who had designed turret ships for foreign powers, became the advocate of the turret system in Great Britain; and as the result of discussion and the pressure brought to bear by public opinion, the *Monarch*, of 8850 tons displacement, was laid down in June 1866 as a sea-going turret ship. She was launched May 1868. Her dimensions were: length 330 ft., breadth 57 ft. 6 in., and draught 26 ft.; her I.H.P. was 8000, giving her a speed of about 15 knots, and she carried a large spread of canvas. She had a complete armour belt 9 ft. 9 in. wide and 7 in. thick, reduced to 6 in. at the extremities. Above this armour belt amidships, for a length of 84 ft., she was provided with a citadel, also of 7-in. armour, which protected the bases of two revolving turrets, each protected with 10-in. armour and carrying two 12-in. guns. She also carried two 9-in. guns forward on the upper deck and one 7-in. gun aft on the main deck, all protected by armour.

The design of the *Monarch* did not satisfy Captain Coles, and he induced the Admiralty to build a turret ship of much lower freeboard, in accordance with his views. This vessel was the *Captain*, built at Birkenhead and launched in March 1869. By an unfortunate error her freeboard was even less than Captain Coles had contemplated. She was fully rigged, with tripod masts and large sail-spread; this spread of canvas, with her low freeboard and deficient stability, resulted in the terrible disaster in the Bay of Biscay, when she capsized on 6th September 1870, amongst those drowned being her designer.

A number of low-freeboard turret vessels of the *Monitor* class, without masts and sails, were built for the British navy at this time, mostly for coast defence. Amongst these, the *Cerberus* for Australia and the *Abyssinia* and *Magdala* for India were completed in 1870. The *Abyssinia* had a displacement of 2900 tons and a speed of about 9½ knots; her dimensions were: length 225 ft., beam 42 ft., draught 14½ ft., and her armament consisted of four 10-in. 18-ton guns. The other two vessels had the same armament, but were somewhat larger, being of 3340 tons displacement; and the thickness of their side armour was 8 to 6 in., against 7 to 6 in. in the *Abyssinia*. Several vessels of this type were also built for home service, including the single-turret vessels *Glatton* (Fig. 26, Plate VI.) of 4910 tons and *Hotspur* of 4010 tons, each carrying two 18-in. 25-ton guns, and the *Cyclops*, *Gorgon*, *Hecate*, and *Hydra*, each of 3560 tons and provided with two turrets carrying two 10-in. 18-ton guns. They were protected with armour from 8 to 12 in. thick, and their speed was from 10 to 12 knots. A diagram of the original *Monitor* of the U.S. navy of this period is shown (Fig. 27). She is about 170 ft. long, of low speed, armed with two powerful guns, and protected throughout with thick armour.



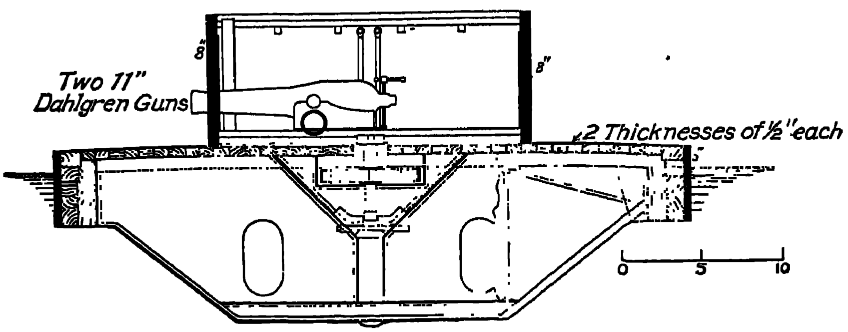


FIG. 27.—Diagram of U.S.A. *Monitor*.

The *Devastation*, commenced in 1869, represented Mr Reed's views of what a sea-going turret ship should be. Low sides were adopted, but not in combination with rigging and sails. She was the first sea-going battleship in the British navy which depended wholly on steam power for propulsion. She was 285 ft. long, 62 ft. 3 in. broad, 26 ft. mean draught, and 9060 tons displacement. Her sides, which, except right forward, rose only to a height of 4 ft. 6 in. above water, were protected with armour 12 in. thick. Her armament consisted of four 25-ton guns, mounted in pairs in two turrets, one at each end of a raised breastwork or redoubt which extended about 150 ft. along the middle of the upper deck. The guns were thus elevated to the height of some 14 ft. above the surface of the water. The turrets were protected by armour 12 in. and 14 in. thick, and the breastwork or redoubt by armour 10 in. and 12 in. thick. A forecastle extended forward from the fore-end of the breastwork at a height of 9 ft. 3 in. above the waterline; but in wake of this forecastle the side armour dropped to a height of only 4 in. above the surface of the water, at which level there was an armoured deck. She was provided with twin-screw machinery of 5600 I.H.P., which gave her a speed of 12½ knots, and she carried a large coal supply. A good idea of her general appearance may be obtained from Fig. 28 (Plate VI.). After the loss of the *Captain*, and to remove the doubt which naturally arose as to the safety of other ironclads, and particularly as to that of the *Devastation*, a special committee, including many of the highest professional and scientific authorities in the United Kingdom, was appointed to examine into the design of those vessels. Of the *Devastation* they reported that "ships of this class have stability amply sufficient to make them safe against the rolling and heaving action of the sea"; they agreed, however, in recommending a plan, which the constructors of the Admiralty had proposed, with the view of increasing her range of stability and the accommodation of the crew. This consisted in the addition of side superstructures, formed by continuing up the ship's side with light framing and plating as high as the level of the top of the breastwork, and carrying the breastwork deck over to the sides. The structures were continued aft on each side, some distance beyond the breastwork, providing two spacious wings, which added largely to the cabin accommodation.

Sir Edward Reed retired from the Admiralty a short time before the *Captain* foundered at sea. During his seven years' term of office some forty iron armour-clads of various sizes and types, besides iron cruisers and numerous other vessels, had been added to the British navy, the adoption of armour for the protection of the vital parts of ships had become established, and especially had the importance of utilizing armour in such a manner as to exclude projectiles from the region of the water-line become recognized. The change from the widely-distributed armament of the first broadside armour-clads to the highly concentrated armament of the turrets, and from the high freeboard ship with sail-power to the low freeboard turret ship without sails, had also been effected; so that when Sir Edward Reed retired in 1870, the latest type of battleship was entirely different from that which existed when he took office; and although the construction of broadside ironclads had not been discontinued, "the wooden walls" had practically ceased to exist. Sir Edward Reed was succeeded by a Council of Construction composed of his immediate assistants, with Mr Barnaby (afterwards Sir Nathaniel Barnaby) as its president; but three years later this council was dissolved, and Sir N. Barnaby was placed at the head of the Construction Department.

The sea-going qualities of the *Devastation* had success-

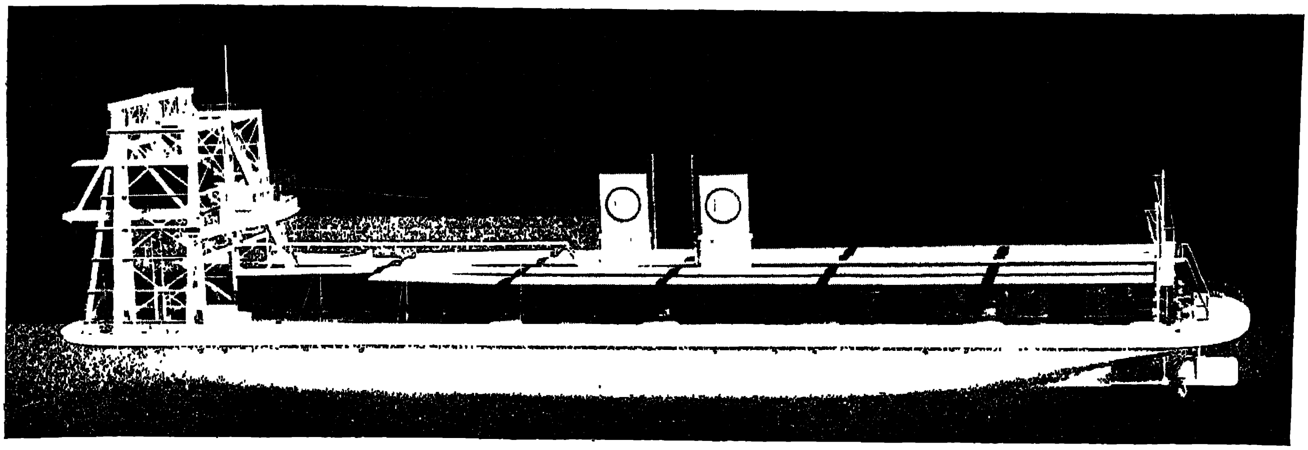


FIG. 20.—River Volga Train Ferry.

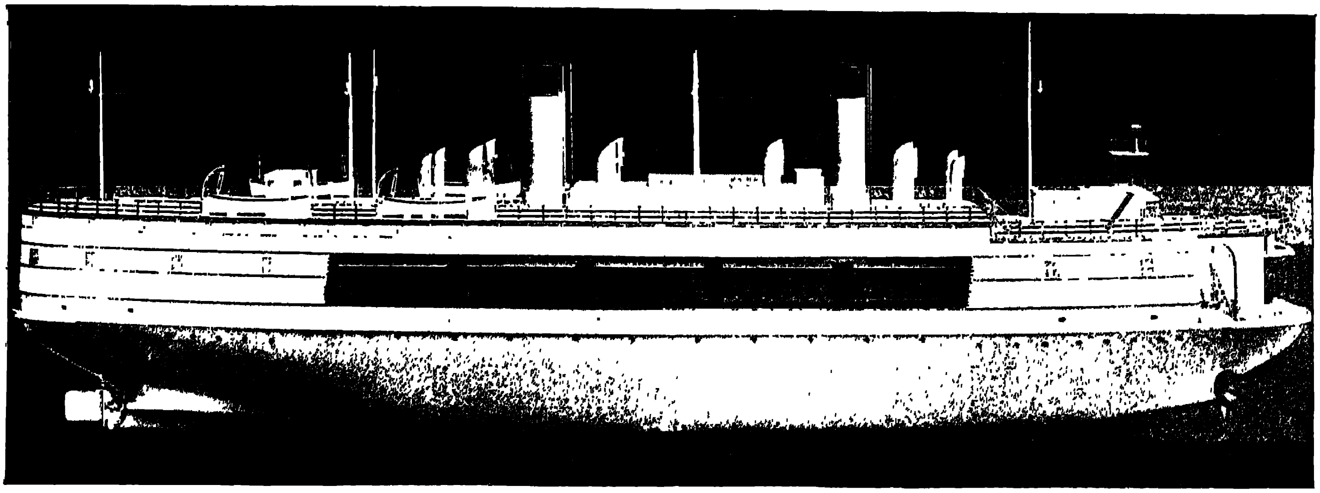


FIG. 21.—Lake Baikal Train Ferry.

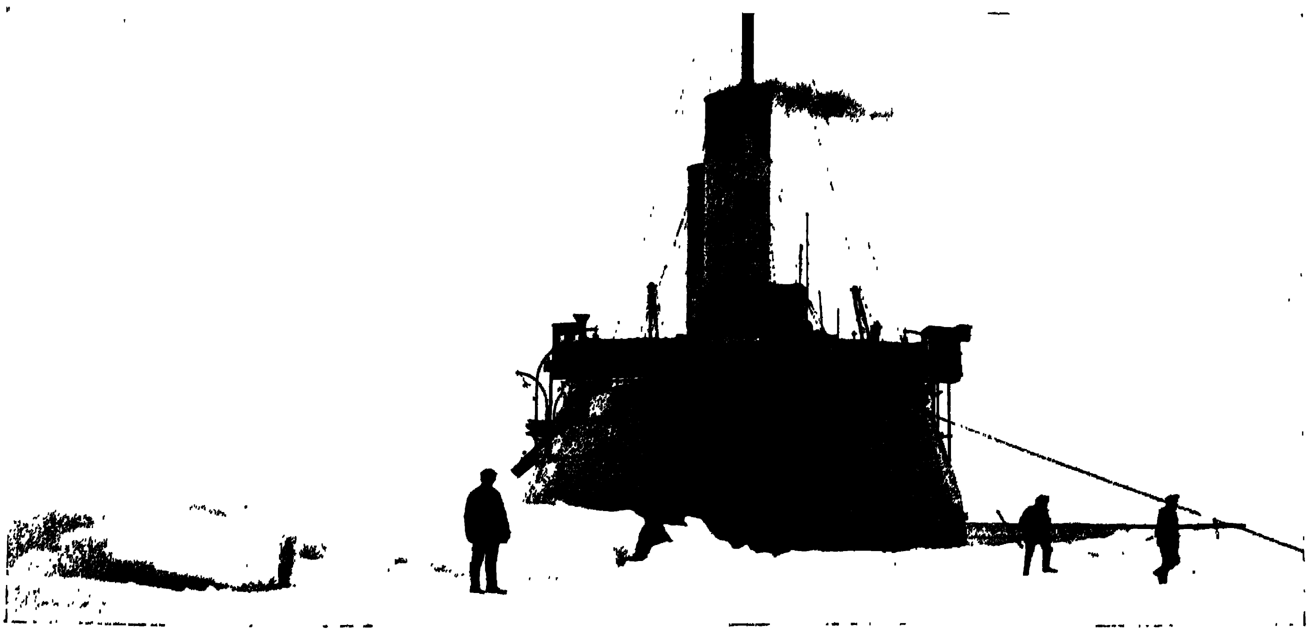


FIG. 22.—*Ermack.*

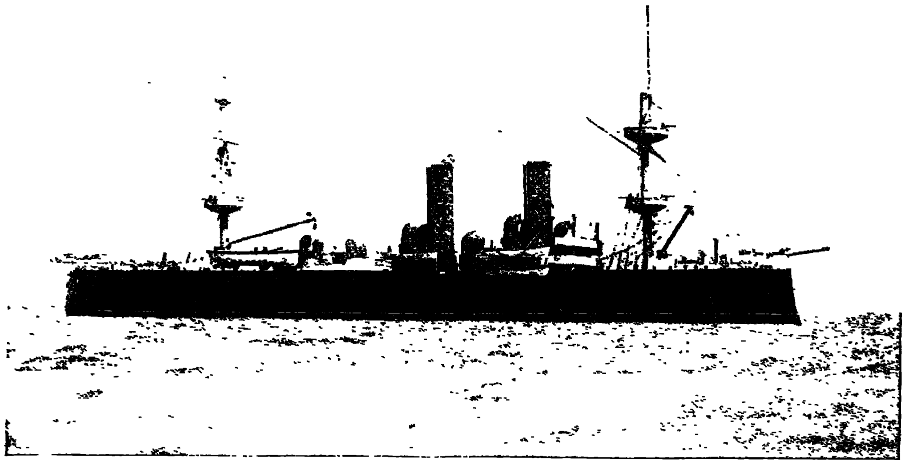


Fig. 25.—H.M.S. *Sultan*.

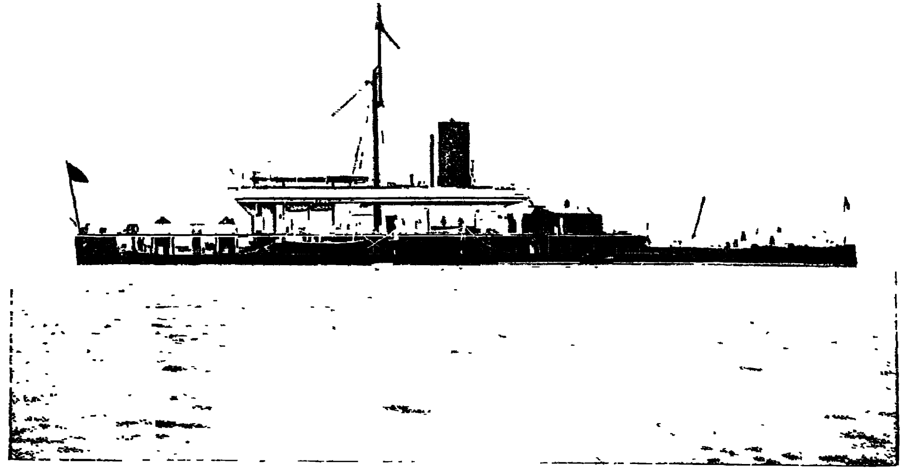


Fig. 26.—H.M.S. *Glatton*.

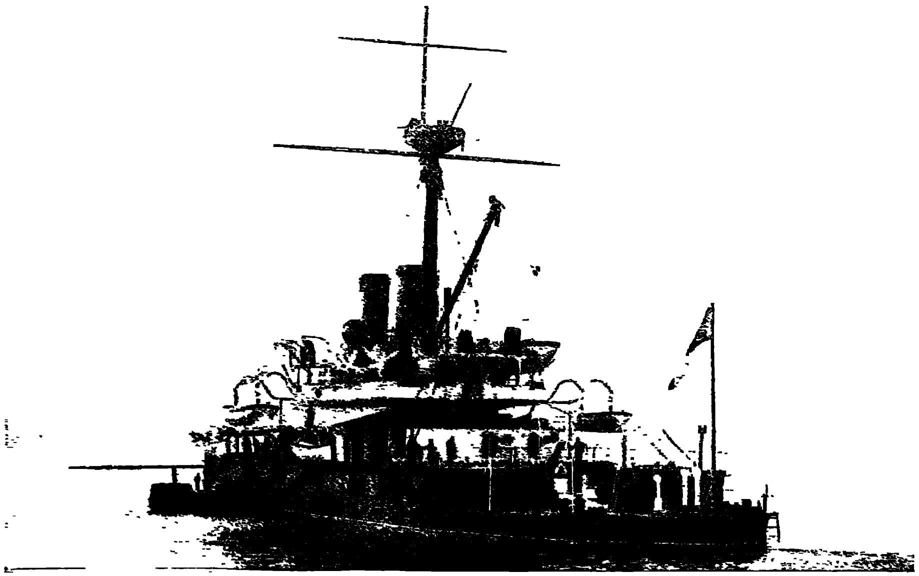


Fig. 28.—H.M.S. *Devastation*.

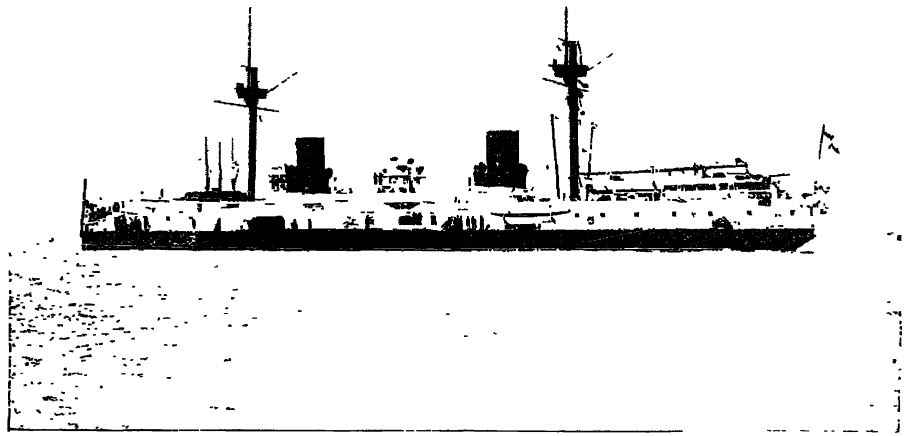


Fig. 29.—H.M.S. *Inflexible*.

fully demonstrated that the battleship of the future might depend wholly on steam propulsion; and although many naval officers and others continued to hold the view that sea-going ironclads must of necessity be rigged ships, in the designs which immediately followed sail power was omitted. In the *Inflexible* (Fig. 29, Plate VI.), and the sister ships *Ajax* and *Agamemnon*, the offensive power was concentrated mainly in two pairs of heavy guns, as it was in the *Devastation* and other turret ships which preceded them; but in them the armour defence also was concentrated over a comparatively small space amidships, the unprotected ends being formed into what was called raft bodies by belts of cork, within which was placed a portion of the ship's coal, &c. Thus the buoyancy was secured by a citadel amidships which could not be penetrated, and by ends which might be riddled, but which it was contended could not be destroyed. The arrangement is shown in Fig. 30, which represents the *Agamemnon*, but which may be taken as also representing the other vessels. Sir N. Barnaby described the design of the *Inflexible* in 1874 before the Institution of Naval Architects thus:—

Sir Nathaniel Barnaby.

"Imagine a floating castle 110 ft. long and 75 ft. wide, rising 10 ft. out of the water, and having above that again two round turrets planted diagonally at its opposite corners. Imagine this castle and its turrets to be heavily plated with armour, and that each turret has within it two guns of about 80 tons each—perhaps in the course of a few years guns of twice 80 tons each. Conceive these guns to be capable of firing, all four together, at an enemy ahead or on either beam, and in pairs towards every point of the compass.

"Attached to this rectangular armoured castle, but completely submerged, every part being 6 ft. to 7 ft. under water, there is a hull of the ordinary form, with a powerful ram bow, with twin screws and a submerged rudder and helm. This compound structure is the fighting part of the ship. Seaworthiness, speed, and shapeliness would be wanting in such a structure if it had no additions to it; there is therefore an unarmoured structure lying above the submerged ship and connected with it, both before and abaft the armoured castle; and as this structure rises 20 ft. out of the water, from stem to stern, without depriving the guns of that command of the horizon already described, and as it moreover renders a flying deck unnecessary, it gets over the objections which have been raised against the low freeboard and other features in the *Devastation*, *Thunderer*, and *Fury*. These structures furnish also most luxurious accommodation for officers and seamen. The step in advance has therefore been from 14 in. of armour to 24 in., from 35-ton guns to 80-ton guns, from two guns ahead to four guns ahead, from a height of 10 ft. for working anchors to 20 ft., and this is done without an increase in cost, and with a reduction of nearly 3 ft. in draught of water, &c."

The dimensions of the *Inflexible* were: length 320 ft., beam 75 ft., mean draught 26 ft. 4 in., and displacement 11,880 tons, and her speed was 12·8 knots. The dimensions of the *Ajax* and *Agamemnon*, begun in 1876, were: length 280 ft., beam 66 ft., mean draught 24 ft. 9 in., and displacement 8660 tons. They carried four 12½-in. guns; their citadels were 104 ft. long, protected with 18-in. armour, their turrets being protected by 16-in. armour; and their speed was 12 knots. The *Edinburgh* and *Colossus*, begun three years later, were of the same type, but were built of steel and were of 9480 tons displacement. Their citadels were longer, and their speed was 14½ knots. Compound armour, adopted in these two ships for the first time, gave them a great advantage in defensive power.

The *Collingwood*, begun in 1880, was the precursor of a new type of battleship, in which the main armament consists of four heavy guns mounted in pairs on the middle line of the ship, in fixed heavily protected gun-positions called barbettes, one at each end of an armoured central citadel, this main armament being associated with a secondary armament of lighter and more rapid-firing guns mounted on the broadsides between the barbettes. This arrangement of the armament, which is clearly illustrated in Fig. 31, has continued, with small modification, to be adopted in the battleships of the British navy down to the present day. The principal features of the *Collingwood* were as follows: length 325 ft., beam 68 ft., mean draught 27 ft., displacement 9500 tons. She carried 18-in.

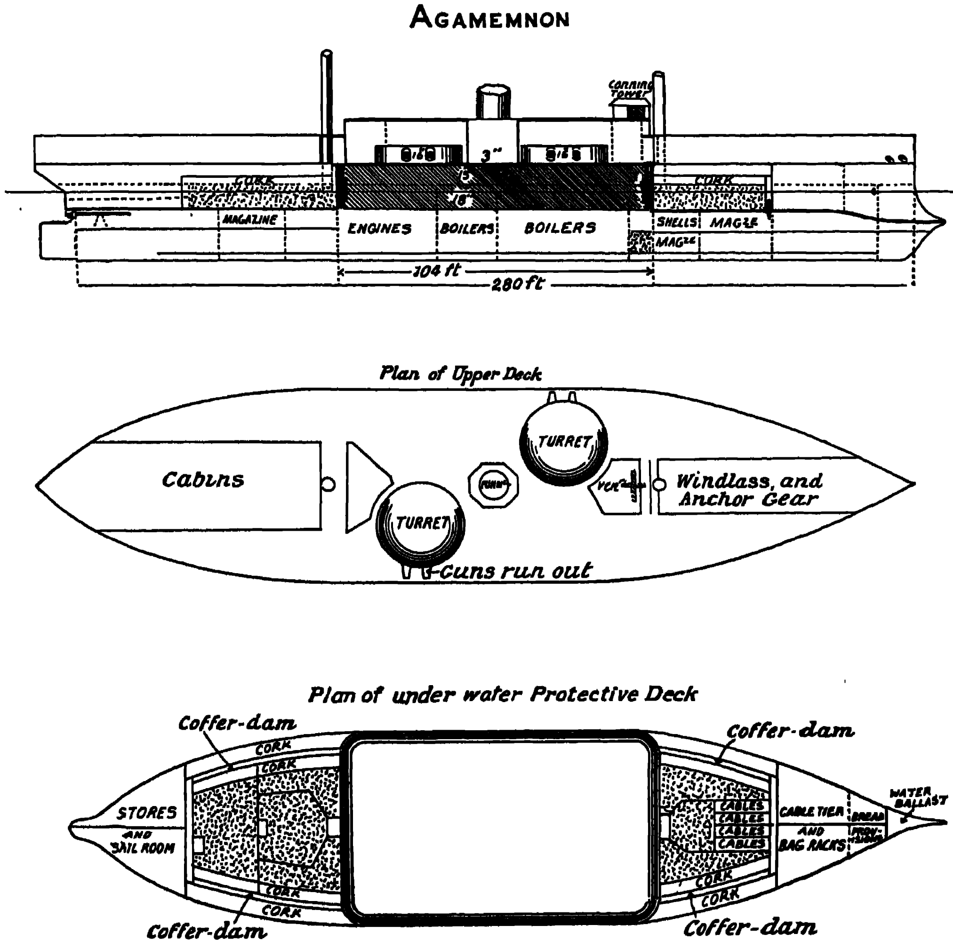


FIG. 30.—Arrangement of *Agamemnon*.

armour on her sides, 16-in. on bulkheads, 11½-in. on barbettes, and 12-in. conning towers. Her armament consisted of four 12-in. 45-ton guns, six 6-in. guns, and a number of smaller guns. Her speed was 16½ knots, and she carried 900 tons of coal, with capacity for 1200. She was followed two years later by the *Rodney*, *Howe*, *Benbow*, *Camperdown*, and *Anson*, which were of the same type, but larger. The two first named were of the same length and beam as the *Collingwood*, but of 800 tons more displacement; they carried 13½-in. guns against her 12-in., and had greater speed, namely, 16·8 knots. The last three were 5 ft. longer than the others, 6 in. broader, and were 300 tons heavier than the *Rodney* and *Howe*. The armament was the same, except in the *Benbow*, which had two 16¼-in. guns and ten 6-in. guns. These six ships constitute what is known as the *Admiral* class. A good idea of their general appearance is obtained from Fig. 32 (Plate VII.), which represents the *Camperdown*. The *Benbow* and the *Sans Pareil*, built a few years later, are the only ships in the British navy carrying 110-ton guns, the former having them in barbettes, the latter in a turret heavily armoured. The *Sans Pareil* and her

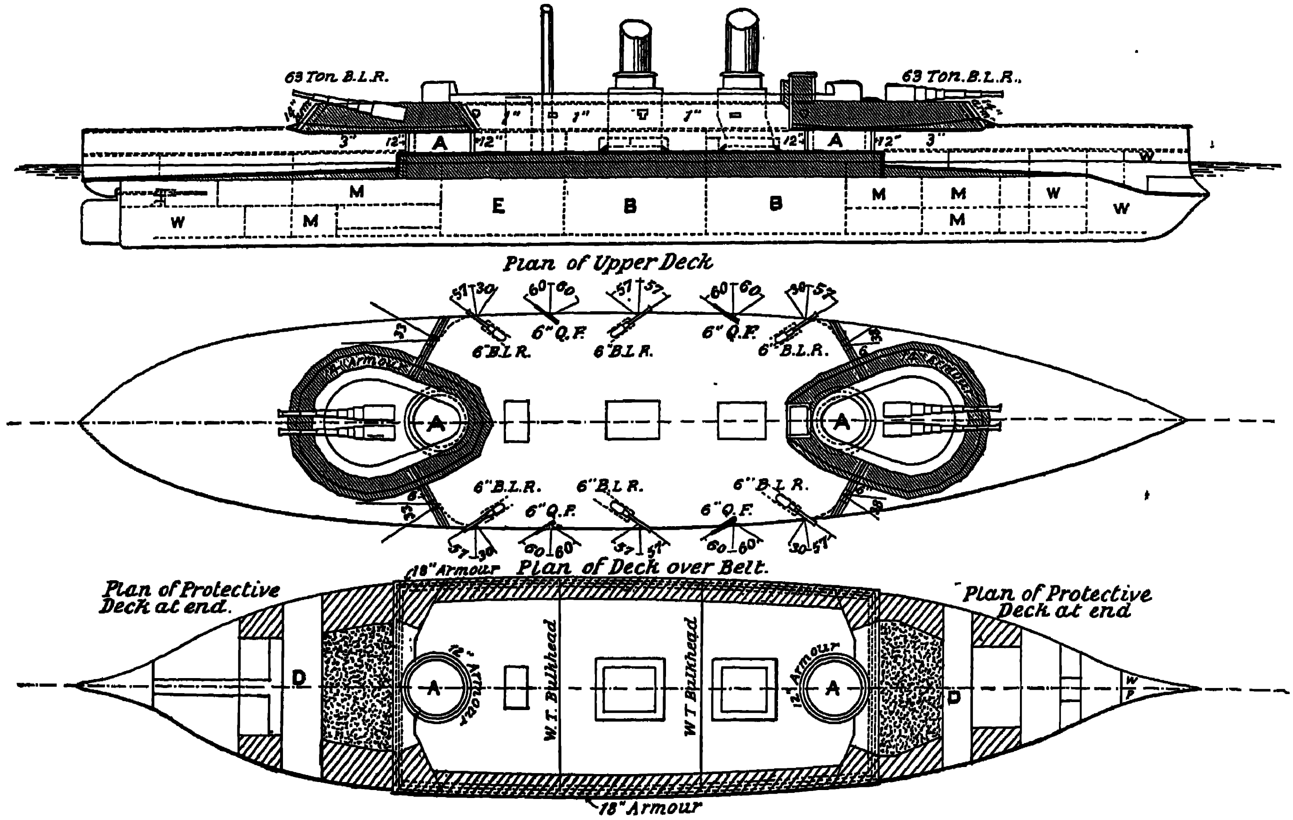


FIG. 31.—Arrangement of armament in *Collingwood*. A, communicating tubes; B, boiler-rooms; D, water-chambers; E, engine-room; M, magazines and shell-rooms; W, water-ballast.

ill-fated sister the *Victoria*,[1] begun in 1885, were a departure from the *Admiral* type in both disposition of armour and armament, and have not been repeated or developed.

Among the last of the ships designed for the British navy by Sir N. Barnaby were the *Nile* (Fig. 33, Plate VII.) and *Trafalgar*, which were begun in January 1886. The disposition of armament originated in the *Collingwood* was adopted in these vessels, but the heavy guns were placed in turrets instead of in barbettes. These vessels were of rather greater displacement than the *Inflexible*, and were thus the largest ships then built for the British navy. They were 11,940 tons displacement, 345 ft. long, 73 ft. beam, and 28 ft. 10 in. mean draught; had engines of 12,000 I.H.P., and a speed of 16¾ knots. Their armour-protection (see Fig. 34) consisted of a belt 230 ft. long and 20 in. thick, with bulkheads 18 in. and 14 in. thick. Above the belt was an armoured redoubt of 18 in. compound armour 141 ft. long at the sides of the ship, with parabolic ends which enclosed the turret bases. The turrets themselves had 18-in. armour, and between the turrets was an octagonal battery of 3 in. to 5 in. of steel containing the 4·7-in. Q.F. guns. The thickness of the protective deck was 3 in. The armament consisted of four 13·5-in. 67-ton B.L. guns, six 4·7-in. Q.F., eight 6-pdrs. Q.F., twelve 3-pdrs. Q.F., besides boat guns and six torpedo tubes. They carried 900 tons of coal at normal displacement, and had stowage for 1100.

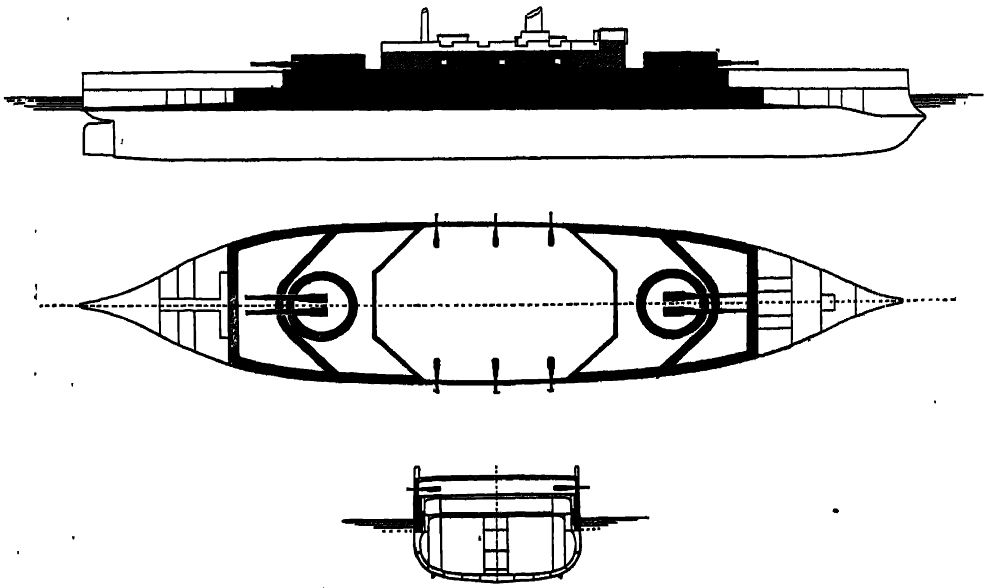


FIG. 34.—Armour of *Nile* and *Trafalgar*.

Sir Nathaniel Barnaby retired from office in 1885. During his term of office there were built for the British navy upwards of twenty armoured battleships of various classes, in addition to a much larger number of cruisers of all sizes. The fight for supremacy between the gun and the armour plate had begun in earnest when Sir N. Barnaby took office, the increased weight of projectile and penetrative power obtained by the concentration of the armament into a few heavy guns being followed by the concentration of the armour into a short belt. The concentration of guns and armour reached a limit in the *Inflexible* and her immediate successors; the later ships of Sir N. Barnaby's design carried a secondary battery of lighter guns in addition to the heavy main armament, and had much longer water-line belts. These changes, combined with the

[1] The *Victoria* was accidentally rammed by the *Camperdown* and sunk in a few minutes during the Mediterranean manœuvres of 1893.

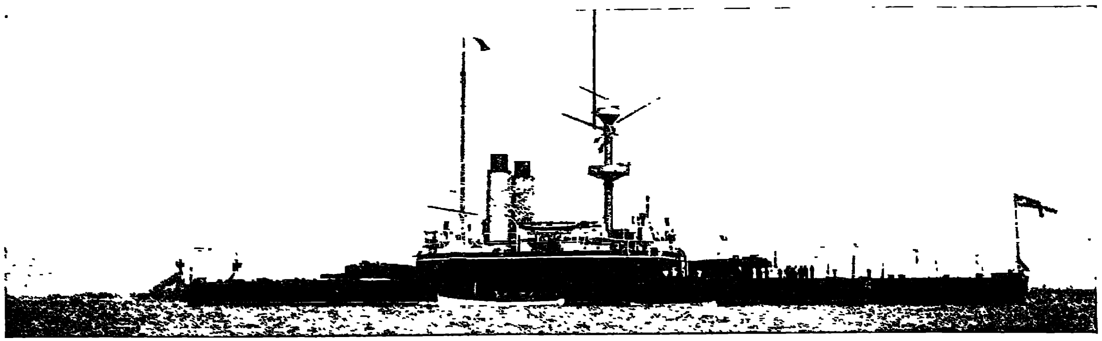


Fig. 33.—H.M.S. *Nile.*

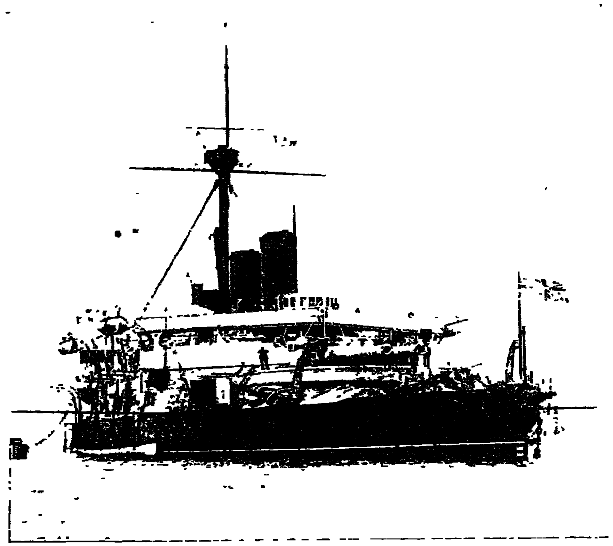


Fig. 32.—H.M.S. *Camperdown.*

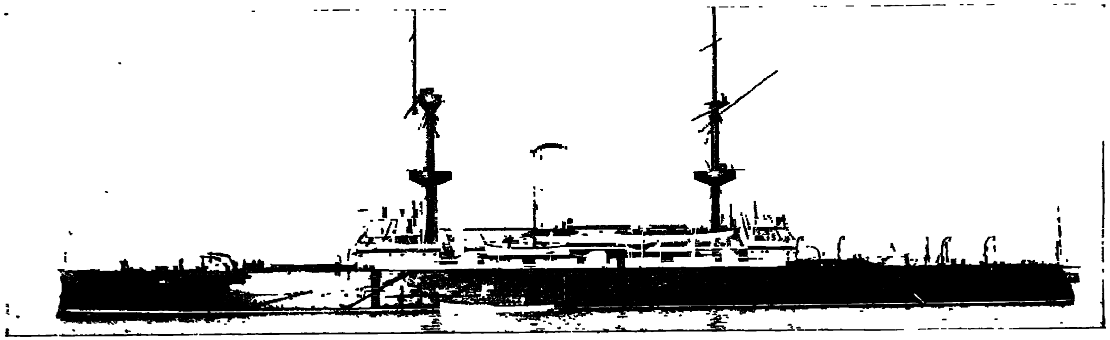


Fig. 35.—H.M.S. *Royal Oak.*

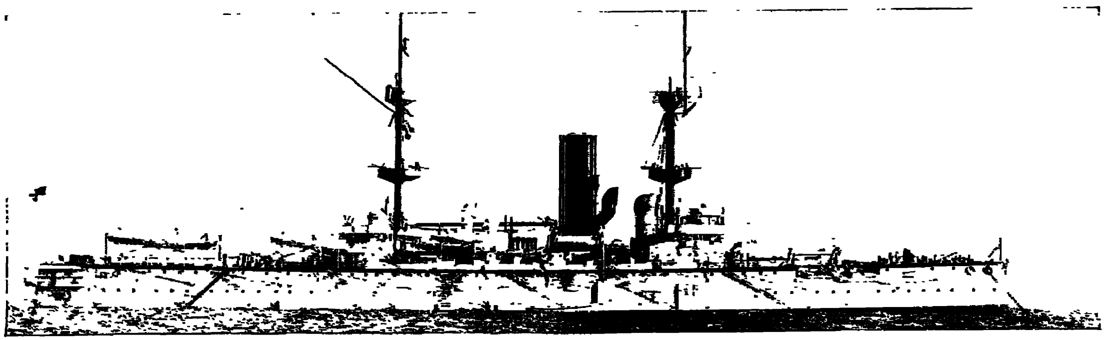


Fig. 37.—H.M.S. *Centurion.*

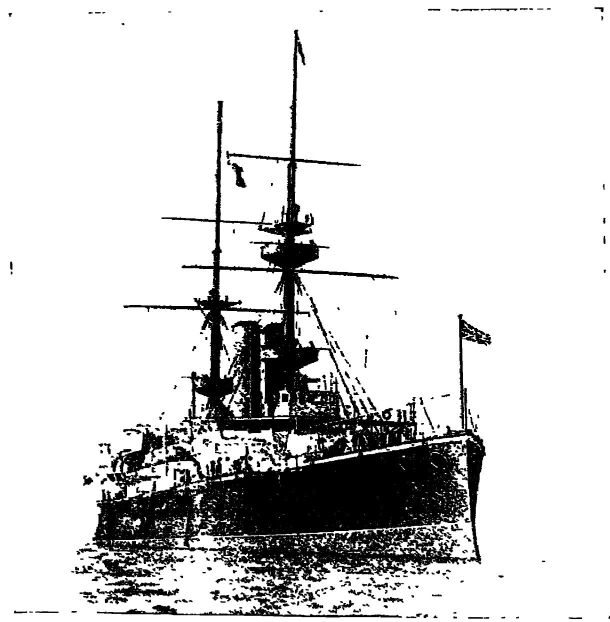


Fig. 38.—H.M.S. *Renown.*

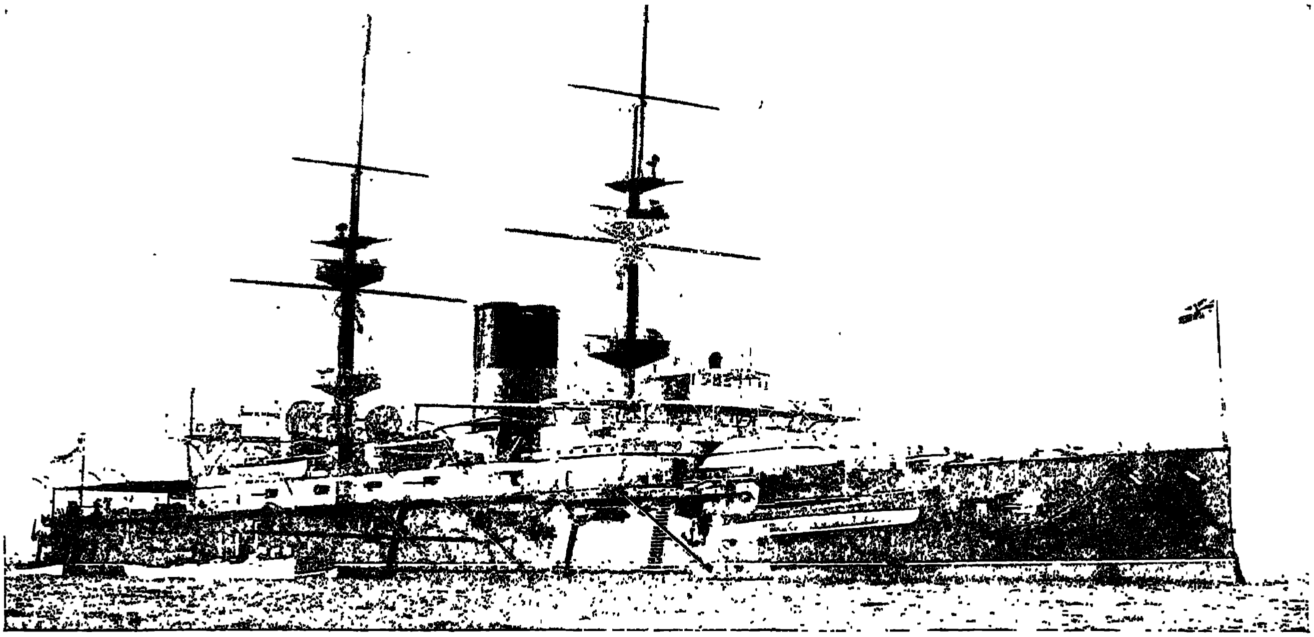


FIG. 39.—H.M.S. *Hannibal.*

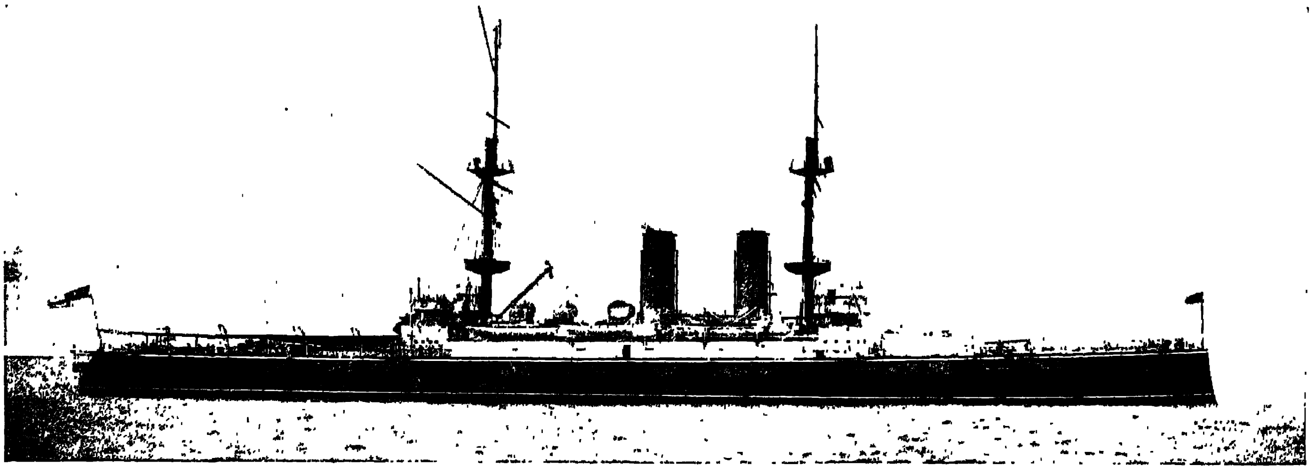


FIG. 40.—H.M.S. *Bulwark.*

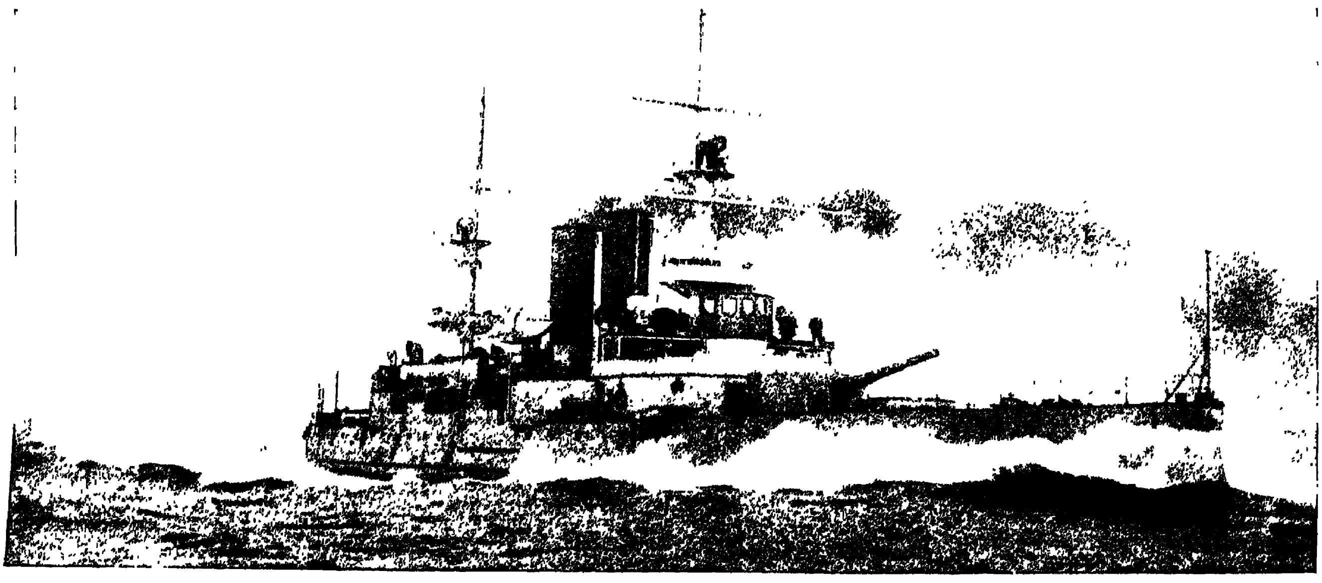


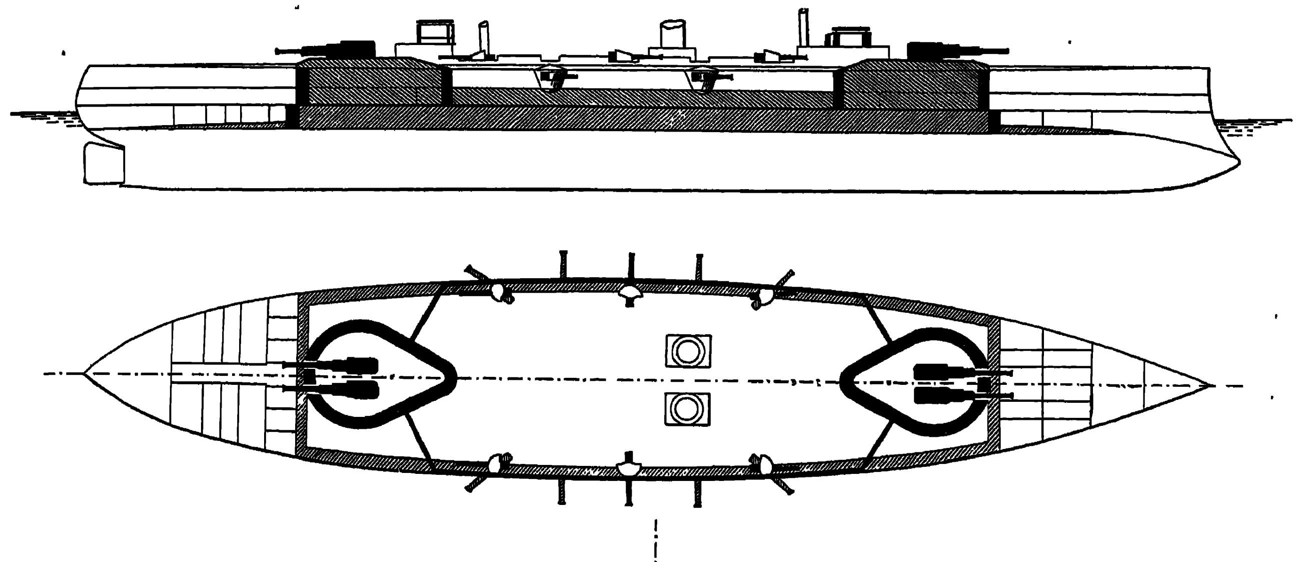
FIG. 47.—Norwegian *Norge.*

introduction of compound armour and the adoption of steel instead of iron for the building material, both of which date from this time, allowed of greater armour protection and of other advantages, including increased speed, &c. This rearrangement was first worked out in the *Collingwood*, and, as already stated, the principal features of this ship have, with few modifications, been reproduced down to the present time.

Sir William White.

Sir Nathaniel Barnaby was succeeded in October 1885 by Mr W. H. White, F.R.S. (afterwards Sir W. H. White), Dr Elgar, F.R.S., being shortly afterwards appointed Director of Dockyards, and Mr R. Sennett, Engineer-in-Chief. Dr Elgar resigned after holding office for five years, and was succeeded by Sir James Williamson, and in 1889 Mr Sennett was succeeded by Mr A. J. Durston (afterwards Sir John Durston). During Sir William White's tenure of office a very large number of ships were added to the British navy, some of which are considered below.

The *Royal Sovereign* class (see Fig. 35, Plate VII., which shows the *Royal Oak*) consisted of eight first-class battleships, built under the Naval Defence Act of 1889. With the exception of the *Hood*, which was a turret ship, the vessels of this class were all fitted with barbettes. They were of 14,150 tons displacement, were 380 ft. in length, 75 ft. beam, and 27½ ft. draught. They had 13,000 H.P. and a speed of 17½ knots. They carried 900 tons of coal at normal draught, with bunker space for 1450 tons. Fig. 36 shows the distribution of their armour, which consisted of a partial waterline belt 18 in. thick of compound armour, extending far enough forward and aft to receive the bases of the barbettes. A protective deck 3 in. thick formed a flat top to this belt, and at the level of the bottom of the belt, continued to the ends of the ship. Between the protective and main decks, extending from one barbette to the other, was an upper belt of 4 in. thickness, and above this the main deck 6-in. Q.F. guns were enclosed in casemates. The barbettes were 17 in. thick. The armament consisted of four 13½-in. B.L. guns in pairs in barbettes, ten 6-in. Q.F.—four in casemates and six in shields—sixteen 6-pdrs., twelve 3-pdrs., eight Maxims, and seven torpedo tubes. The *Royal Sovereign* established a record in quick building, having been laid down in September 1889 and launched in February 1891. The *Hood* differs from the others in having her 13½-in. guns in turrets, and the decks between the turrets and the extremities lowered to the level of the main deck in the other vessels of the class.



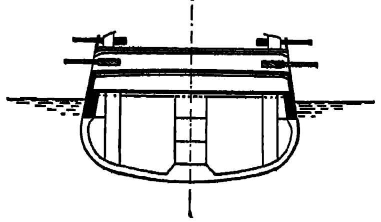


FIG. 36.—Armour of *Royal Sovereign*.

The *Centurion* (Fig. 37, Plate VII.) and *Barfleur*, begun in 1890, were smaller ships of the same general arrangement as the ships of the *Royal Sovereign* class, but with lighter armament and protection and higher speed. The 13½-in. guns of the *Royal Sovereign* are reduced to 10-in., and the 6-in. Q.F. to 4·7-in. Q.F. The belt thickness is reduced to 12 in., and the barbettes are 9 in. thick only, armour compound. The speed goes up from 17½ to 18¼ knots. The normal coal allowance was 750 tons, with stowage for 1150. Their principal dimensions were 360 ft. length, 70 ft. beam, 25 ft. 6 in. mean draught, 10,500 tons displacement. An important departure was made in these vessels in that they were sheathed and coppered. The *Renown* (Fig. 38, Plate VII.) was also sheathed and coppered; she was laid down in February 1893 and launched in May 1895. She may be described as coming between the *Royal Sovereign* and *Centurion*, but possessing the very great advantages that the adoption for the first time in the British navy of Harveyized armour conferred defensive power upon her. She was 12,350 tons displacement, length 380 ft., beam 72 ft., mean draught 25½ ft., and had an increased speed of 18½ knots. Her armament consisted of four 10-in. B.L. guns mounted in pairs in barbettes 10 in. thick, ten 6-in. Q.F. in 6-in. casemates—six on main deck, four on upper—twelve 12-pdr., and five torpedo tubes. The belt and bulkhead of this ship were of Harveyized armour 6 in. to 10 in. thick. She carried 900 tons of coal at the mean draught given above, but could stow 1200 in her bunkers.

A larger and more powerful class of battleship, known as the *Majestic* class, was begun about the same time as the *Renown*. It consisted of nine first-class battleships, the design of which constituted a great advance upon that of the *Royal Sovereign*. This advance was due mainly to the use of Harveyized armour. The 18-in. compound belt of the *Royal Sovereign* disappeared, and was replaced by a belt of about twice the breadth and 9 in. thick, this offering a resistance to penetration at least equal to the 18-in. compound belt. The protective deck was not carried flat across at the middle deck, but was above the L.W.L. at the middle line, and curved sharply down to the lower edge of the 9-in. belt, forming a strong arched roof to the vitals of the ship, to keep out any fragments of large shell which might come through the belt and burst; it was 2½ in. thick on the flat and 4 in. on the slopes. The 13½-in. guns of the *Royal Sovereign* were replaced by lighter but more powerful 12-in. wire-wound B.L. guns, disposed in the same general manner in barbettes 14 in. thick. The *Majestic* class carried two more 6-in. Q.F. guns, and all the twelve were in casemates 6 in. thick. There were sixteen 12-pdrs., besides smaller guns and five torpedo tubes. The speed was the same as *Royal Sovereign* class, and the coal carried 900 tons, with space for 2000 tons. The ships were of 14,900 tons displacement, 390 ft. long, 75 ft. beam, 27 ft. mean draught. The *Hannibal*, shown in Fig. 39 (Plate VIII.), is one of this class.

The *Formidable* and *London* classes, under construction in 1903, differ very slightly from each other, and for all practical purposes may be taken as identical, the main difference being in a rearrangement of the armour protection to the bow in the later ships (*London*). The former class consists of the three battleships *Formidable*, *Irresistible*, and *Implacable*, and the latter of the five battleships *London*, *Bulwark*, *Venerable*, *Queen*, and *Prince of Wales*. These classes represent a development of the *Majestic*

class, being 400 ft. long, 75 ft. beam, 26 ft. 9 in. draught, and 15,000 tons displacement, the belt being of the same general thickness and extent as in the *Majestic*, but of Krupp steel, and protection is given to the bow by 2-in. side-plating. In the *Formidable* the protective deck proper is formed as in the *Majestic*, but is thinner, being 2 in. to 3 in. thick, and a second protective deck, 1 in. thick, is formed at the main deck, giving a flat top to the box formed by the side belt. In the *London* class (Fig. 40, Plate VIII.) the lower protective deck is thinner and the upper one thicker than in the *Formidable* class, the belt protection being extended forward by thinner material, tapering to 2 in. at the bow, and the forward transverse armour bulkhead being omitted. The 12-in. guns in both classes are longer and heavier than in the ships of the *Majestic* class, and are in barbettes 12 in. thick; in addition, there are twelve 6-in. Q.F. guns—all in casemates—sixteen 12-pdrs., and four torpedo tubes. These eight battleships are each provided with 20 Belleville boilers, develop 15,000 H.P., and have a speed of 18 knots. They carry 900 tons of coal at their normal displacement, and have bunker space for 2200 tons.

The line of development, as traced above, may be taken to begin with the *Collingwood* and to run through the *Admiral* class, the *Nile* and *Trafalgar*, the *Royal Sovereign* class, the *Majestic* class, and the *Formidable* class, to the *London* class, which may be regarded as the most powerful type of warship yet constructed for the British navy.[1] Branching off from this line, at a time when battleships became much heavier (the *Royal Sovereign* class were of 2200 tons more displacement than the *Nile* and *Trafalgar*), we find a series of smaller, faster, and more lightly armed and armoured battleships than the series terminating with the *London* class. These began with the *Barfleur* and *Centurion*, which, though contemporary with the *Royal Sovereign* class, were of 1440 tons less displacement; they were followed by the *Renown*, the *Canopus* class, and the *Duncan* class. The last-named vessels now claim our attention.

The six ships of the *Canopus* class may be regarded as a development of the *Renown*. Begun in 1896, they are 12,950 tons in displacement, 390 ft. long, 74 ft. beam, and 26 ft. draught. They have a 6-in. Harveyized belt, 14 ft. broad and 195 ft. long; two protective decks (anticipating the *Formidable* in this respect); and 12-in. barbettes, carrying four wire-wound 12-in. guns, against the *Renown's* 10-in. They also carry twelve 6-in. guns in 5-in. casemates, ten 12-pdrs., a number of smaller and machine guns, and four submerged torpedo tubes. They were the first battleships of the British navy to be fitted with water-tube boilers; they have 20 Bellevilles, develop 13,500 H.P., and have a speed of 18¼ knots. They carry 1000 tons of coal at normal load, and have bunkers for 2300 tons. The ships of the *Duncan* class are longer and larger than those of the *Canopus* class. They were begun in July 1899, are of 14,000 tons displacement, 405 ft. long, 75 ft. 6 in. beam, 26 ft. 6 in. draught. They have a belt of Krupp steel, 7 in. thick amidships, tapering to 3 in. at bow, and two protective decks, as in the *Canopus*; they have two barbettes, 11 in. thick, with four 12-in. guns, and carry twelve 6-in. Q.F. guns in 6-in. casemates on the main and upper decks; also a number of smaller guns and four submerged torpedo tubes. They are provided with 24 Belleville boilers, will develop 18,000 H.P., and attain a speed of 19 knots. Their normal coal supply will be 900 tons, and they will have bunker capacity for 2000 tons. Six of these ships were under construction in 1902. In external appearance the *Canopus* and *Duncan* classes closely resemble the ships of the *London* class.

It will be seen that the advance in the two series of ships described above has been one of steady growth in size, power, and speed; and the scheme of building such a number of ships of each class as to form a powerful squadron of exactly similar ships has been given effect to in a large degree.

The principal changes that have conduced to the steady and rapid development of the battleship type since 1885 are:—(1) The successive improvements in armour by the introduction of the Harvey and Krupp processes, which have enabled either a saving of weight to be effected for the same degree of protection, or a greater degree of protection to be provided for the same weight. The choice has been principally in the direction of the latter alternative; the belt has been extended longitudinally and upward, shielding a greater portion of the hull and giving increased protection to the stability and to the secondary armament of the vessel. (2) Improvements in guns and explosives, by which more effective gun-fire has been obtained with guns of smaller calibre and decreased weight than those previously in use. The growth in importance of the secondary armament of quick-firing guns has exercised great influence on the development of the modern battleship. (3) Improvements in machinery. The adoption of higher steam pressures, lighter and faster-running machinery, and of water-tube boilers have effected great savings in weight for a given power, and enabled increased speed to be obtained in successive ships. Sir William White retired from the British Admiralty in February 1902, and was succeeded by Mr Philip Watts, F.R.S.

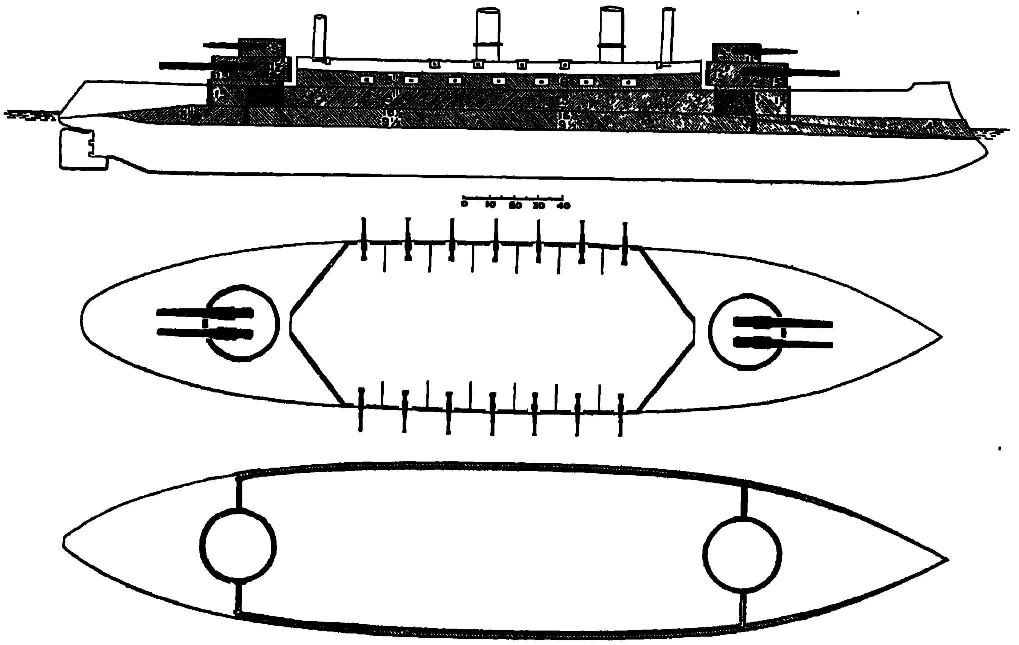


FIG. 41.—U.S. Battleship *Kearsarge*.

United States of America.—Fig. 41 shows the main features of the United States battleships *Kearsarge* and *Kentucky*. Their principal dimensions are: length 368 ft., beam 72 ft., mean draught 23 ft. 6 in., displacement 11,525 tons. They carry four 13-in. guns in turrets 15 in. thick, four 8-in. guns in turrets 9 in. thick, fourteen 5-in. Q.F. guns, twenty-seven smaller guns,

[1] In 1902 orders were placed for five battleships from Sir William White's design, to be called the *King Edward VII.* class, which are larger and more powerful than the *London*, being of 16,350 tons displacement, and carrying four 12-in. and four 9·2-in. guns in gun-houses on the upper deck, with ten 6-in. Q.F. guns in an armoured main-deck battery.

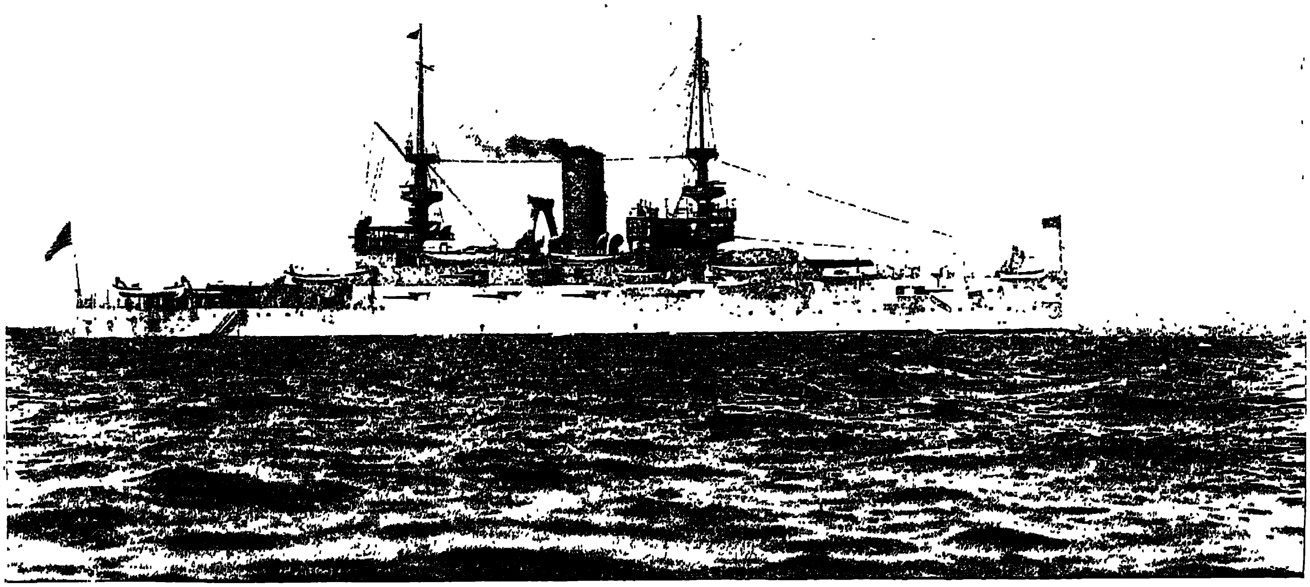


Fig. 43.—U.S.A. *Illinois.*

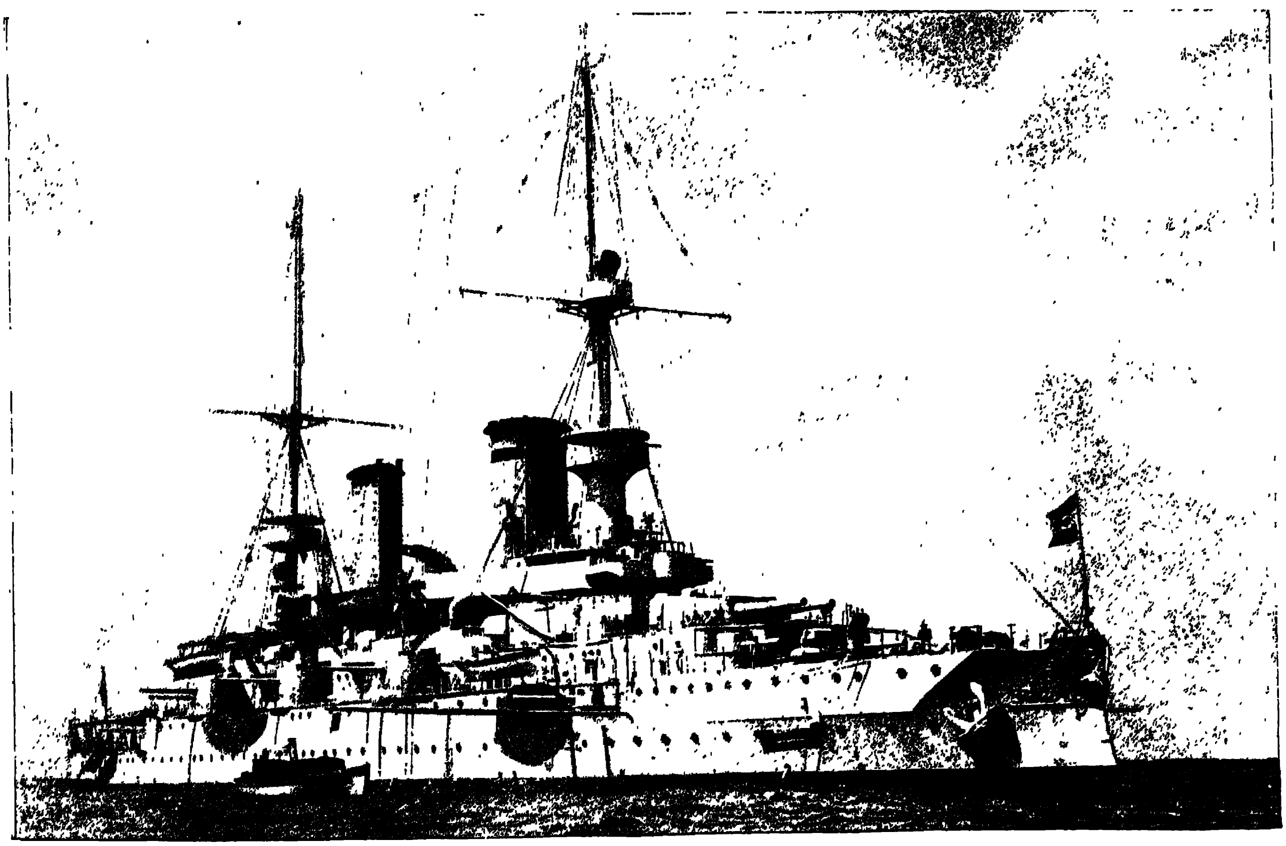


Fig. 44.—German *Kaiser Frederick III.*

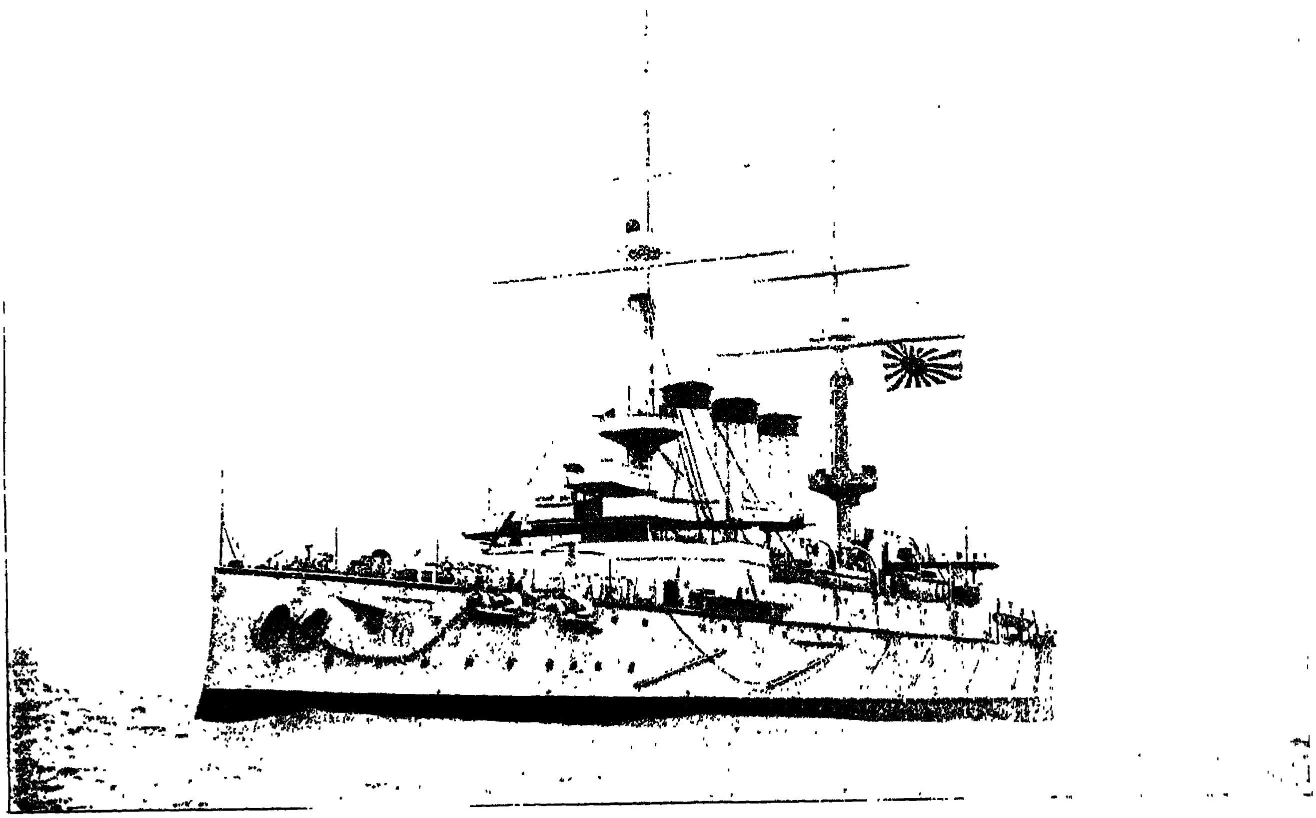


FIG. 45.—Japanese *Hatsuce.*

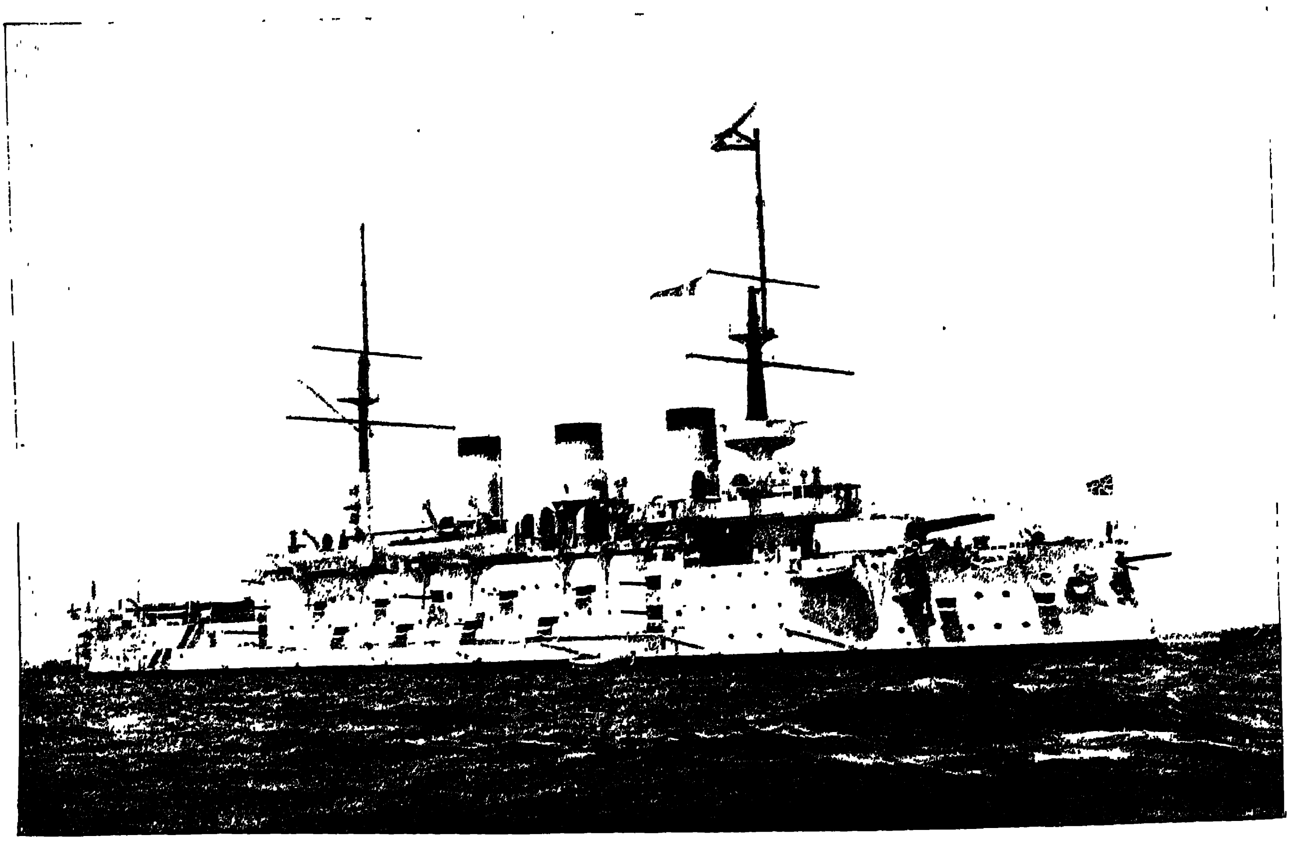


FIG. 46.—Russian *Pobyeda.*

and four torpedo tubes; and at the above displacement they carry 410 tons of coal, but can stow 1200. Their speed is 16 knots. They are worthy of special mention on account of the novelty introduced in them of the double-storeyed turret, two of which arrangements are provided in these ships, one forward and one aft. In this arrangement a second turret is superposed or built on the first, the structure so formed turning as a whole; a pair of 8-in. guns is mounted in the upper turret, and a pair of 13-in. guns in the lower. A later example of American design is furnished by the five first-class battleships of the *Georgia* class (Fig. 42), building in 1902, which have a displacement of nearly 15,000 tons, length 435 ft., beam 76 ft. 3 in., and a mean draught of 23 ft. 9 in; they have a complete water-line belt of Krupp armour, from 11 in. to 8 in. thick, tapering to 4 in. at the bow; above this belt there is a belt of lighter armour, 6 in. thick and 245 ft. long, forming a battery for the 6-in. Q.F. guns, which extends to the upper deck; there are also four turrets—two large double-storeyed turrets, as in the *Kentucky*, placed one forward and one aft, and two smaller turrets, placed on each side forward. The larger turrets carry each a pair of 12-in. guns and a pair of 8-in. guns, and are protected by a maximum thickness of 11-in. armour, and the smaller carry each a pair of 8-in. guns and are protected by 6½ in. armour. In addition to the four 12-in. and eight 8-in. guns thus disposed, there are also twelve 6-in. guns on the main deck and some forty-two smaller guns. These ships will develop 19,000 I.H.P. and have a speed of 19 knots. They will carry 900 tons of coal at normal displacement, and have capacity for stowing 1900 tons. The battleships which came between the *Kentucky* and the *Georgia* classes (*Alabama*, *Illinois* (Fig. 43, Plate IX.), *Wisconsin*, *Maine*, *Missouri*, and *Ohio*) had not the double-storeyed turrets, and it is understood that in the new and still larger class of battleships now to be proceeded with (*Pennsylvania* class) this feature will not be reproduced.

France.—The latest and largest battleship in the French navy is the *Suffren*, commenced in 1899. Her displacement is 12,728 tons, length 410 ft., beam 70 ft., and draught 27 ft. 6 in. She has a complete water-line belt of Harveyized steel armour of 11¾ in. maximum thickness, and above this, up to the main deck, similar armour, 5 in. thick, extending from the after turret to the bow; she has also a short armoured battery on the main deck which encloses the funnel uptakes. There are eight turrets on her upper deck—one forward and one aft, each carrying two 12-in. guns, and six arranged three on each broadside, each carrying a 6·4-in. gun. The armour of the larger turrets is of the same thickness as the armour belt, namely, 11¾ in., and that of the smaller turrets 5 in. She mounts eight 3·9-in. guns on the superstructure, and also has twenty-two smaller guns and four torpedo tubes, of which two are submerged. She has triple screws, engines of 16,000 I.H.P., and a speed of 18 knots.

The *République* and *Patrie*, examples of the latest French design, have a displacement of 14,865 tons, and are of 439 ft. length, 79 ft. 6 in. beam, and 27 ft. 6 in. extreme draught. They have three screws, develop 17,500 H.P., and are stated to be 18-knot ships, though if the power is realized the speed ought to be considerably more. They carry four 12-in. B.L. guns in pairs in turrets on the middle line, as in the British ships, twelve 6·4-in. Q.F. guns in pairs in turrets on the upper deck, six additional 6·4-in. Q.F. guns in casemates on main deck, twenty-six 3-pdrs., three above-water and two submerged torpedo tubes. There is a complete water-line belt of a maximum thickness of 12 in., the bow is protected by 4 in. and there is a partial 4-in. belt above the 12-in. belt. The protective deck is 4 in. on the slopes and the armour of the main turrets is 12½ in. thick, the whole armour being of Harvey quality.

Germany.—The latest battleships completed for the German navy are the five first-class battleships of the *Kaiser* class, the last of which, the *Kaiser Friedrich III.* (Fig. 44, Plate IX.), was finished in 1900. They have a displacement of 10,900 tons, a length of 377 ft., a beam of 66 ft. 10 in., and a draught of 25 ft. 9 in.; their engines are of 13,000 I.H.P. and their speed is 18 knots. They have belts of Krupp steel extending from the after barbette to the stem, with a maximum thickness of 12 in., tapering to 6 in. at the bow; there is no side armour above this belt. The main armament consists of four 9·4-in. guns, placed in pairs in barbettes, one forward and one aft, protected by 10-in. armour. On the main deck they have four 5·9-in. Q.F. guns in 6-in. armoured casemates, two on each side; and on the upper deck they have eight similar guns, protected in like manner, and six others in turrets—three each side; in all, eighteen 5·9-in. guns, besides twelve 3·5-in. and smaller guns. There are five vessels of the *Wittelsbach* class being built; these represent a development of the *Kaiser Friedrich III.* The *Wittelsbachs* are about 700 tons more displacement, are 15 ft. longer and 1½ ft. more beam, but are of shallower draught. They have 15,000 H.P. and a speed of 19 knots, or a knot more than their predecessors. Their armament is the same, but the 9·4-in. guns are better protected. The main armour belt is somewhat longer, but in other respects the thicknesses and general disposition of the protection are similar to the *Kaiser Friedrich III.* class.

Japan.—In 1902 the most recent Japanese battleships were the four ships of the *Hatsuse* class, built in Great Britain, of which the *Hatsuse* herself (Fig. 45, Plate X.), built at Elswick, may be taken as a representative in her main features. The displacement is 15,000 tons, length 400 ft., beam 75 ft. 6 in., mean draught 27 ft. The I.H.P. is 15,000, giving a speed of 18 knots. The armour-belt extends the full length of the ship at the water-line, and has a maximum thickness of 9 in. Between the top of this belt and the main deck, for a length of some 220 ft., is an upper belt 6 in. thick, which is continued by oblique bulkheads to the sides of the heavy-gun barbettes. The barbettes themselves, which are two in number, one forward and one aft, have armour 14 in. thick, and the conning-tower also is 14 in. thick. Krupp armour is used throughout. The armament consists of four 12-in. 49-ton B.L. guns, two mounted in each barbette and loading in any position; fourteen 6-in. Q.F. guns, all in 6-in. casemates, eight on the main deck and six on the upper deck; and twenty 12-pdrs., besides smaller guns and four submerged torpedo tubes. The *Mikasa*, building at Barrow in 1902, is a slight modification of the *Hatsuse* class design, being 200 tons heavier and 6 in. more in draught. The principal difference is that the eight 6-in. Q.F. guns on the main deck are increased to ten, and instead of being in separate casemates are in a 6-in. side-armoured central battery, screened from each other by 2-in. divisional bulkheads side and rear. The total number of 6-in. guns carried, however, is the same.

Russia.—The Russian battleship *Pobyeda* (Fig. 46, Plate X.) is of the lightly armed and high-speed type which are sometimes spoken of as "Intermediates," coming, as they do, midway between the heavy first-class battleship and the armoured cruiser. Her principal dimensions are: length 436 ft., beam 71½ ft., draught 27¼ ft., and displacement 12,670 tons. She has engines of 15,000 H.P. and a nominal speed of 19¼ knots, carries an armament of four 10-in. guns, mounted in pairs in turrets on the middle line forward and aft; eleven 6-in. guns, distributed five on each broadside and one in the extreme bow of the vessel; twenty 3-in. guns and twenty-six smaller pieces; and six torpedo tubes. She is protected by a complete water-line belt of Krupp armour, 9 in. thick amidships, tapering to 4 in. at the ends, reinforced by a protective deck 2¾ in.

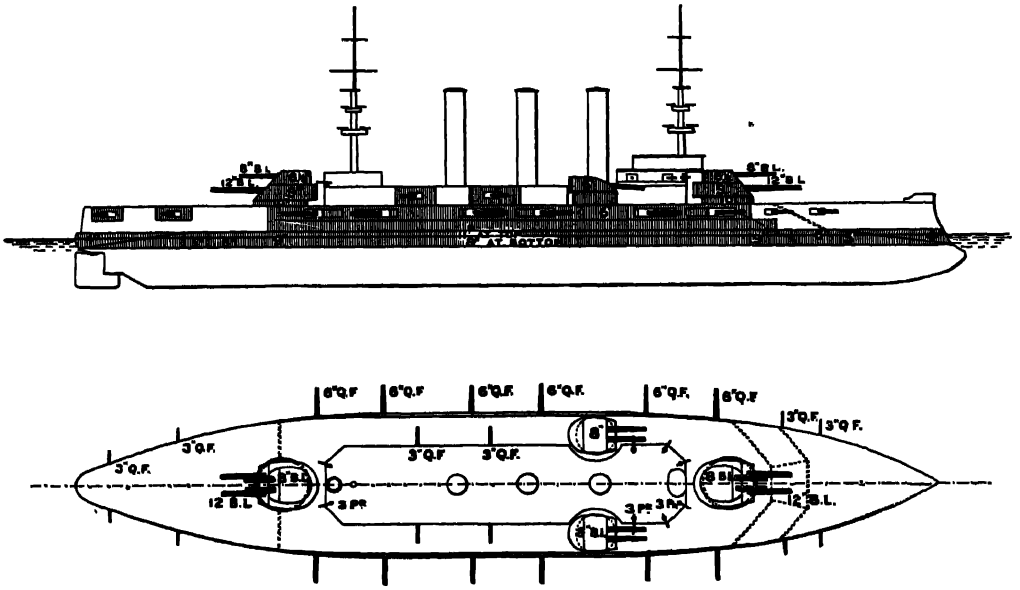


FIG. 42.—Gun and Armour Plan, *Georgia* Class (*Georgia*, *Nebraska*, *New Jersey*, *Rhode Island*, and *Virginia*).

TABLE VI.—*Development of some of the Leading Features of Armoured Battleships from 1860 to 1900.*

Vessel.	Date of Launch.	Hull.					Speed.	I.H.P.	Propulsive Machinery.			Armament (including Machine Guns).	Heavy Guns—where mounted.	Thickest Armour.	Cost (excluding Guns).	Remarks.
		Material.	Length.	Breadth.	Mean Draught.	Load Displacement.			No. of Screws.	Engines.	Boilers.					
			Ft.	Ft. In.	Ft. In.	Tons.	Knots.							Inches.	£	
Warrior. .	1860	Iron	380	58 0	26 7	9,210	12·75	4,000	1	Horizontal, trunk, jet-condensing 1 expansion 1 set of 2 cylinders; 112″ × 48″	10 rectangular 22 ℔ pressure	44 guns (several of these 100 pounders) 2 pivot guns	Broadside	$4\frac{1}{2}$	389,394	...
Agincourt .	1865	,,	400	59 3	28 2	10,690	12·0	4,000	1	Horizontal, jet-condens. 1 expansion 1 set of 2 cylinders; 101″ × 54″	10 rectangular	39	Broadside	$5\frac{1}{2}$	496,069	...
Bellerophon	1865	,,	300	56 1	26 0	7,550	12·4	4,000	1	Horizontal, trunk, surface-condensing 1 expansion 1 set of 2 cylinders; 104″ × 48″	Rectangular 26 ℔ pressure	10—14 tons 4—$6\frac{1}{2}$ tons	Central battery	6	447,618	Reconstructed later
Monarch .	1868	,,	330	57 6	26 0	8,845	15·2	8,000	1	Horizontal 1 expansion 1 set of 2 cylinders; 120″ × 54″	Rectangular $31\frac{1}{2}$ ℔ pressure	4—12″ 2—9″ 1—7″ 20 small guns	Turrets	Turrets, 10 Sides, 7	478,971	,,
Sultan . .	1870	,,	325	61 0	26 1	9,300	15·1	8,000	1	Horizontal, trunk, surface-condensing 1 expansion 1 set of 2 cylinders; 118″ × 54″	Rectangular 30 ℔ pressure	8—18 tons 4—$12\frac{1}{2}$ tons	Central battery	9	485,155	,,
Devastation	1871	,,	285	62 4	27 0	9,330	14·2	7,000	2	Horizontal, trunk, surface-condensing 1 expansion 2 sets of 2 cylinders; 88″ × 39″	8 rectangular 30 ℔ pressure	4—12″, 35 tons 10 smaller 2 torpedo tubes	Turrets	Turrets, 14 Sides, 12	430,746	,,
Inflexible .	1876	,,	320	75 0	26 4	11,880	12·8	6,500	2	Vertical 2 expansions 2 sets of 3 cylinders; 70″ + 2 @ 90″ × 48″	8 single-ended, oval 4 double ,, ,, 60 ℔ pressure	4—16″, 80 tons 8—4″, 22 cwts. 4—14″ torpedo tubes	Turrets	24	951,406	...
Benbow . .	1885	Steel	330	68 6	28 0	10,600	16·9	11,500	2	Vertical 2 expansions 2 sets of 3 cylinders; 52″ + 2 @ 74″ × 45″	12 oval	2—$16\frac{1}{4}$″, 111 tons 10—6″ 33 smaller 5 torpedo tubes	Barbettes	18	774,791	...
Royal Sovereign	1891	,,	380	75 0	27 4	14,150	17·5	13,000	2	Vertical 3 expansions 2 sets of 3 cylinders; 40″ + 59″ + 88″ × 51″	8 single-ended return tube 148 ℔ pressure	4—$13\frac{1}{2}$″, 67 tons 10—6″ 38 smaller 7 torpedo tubes	Barbettes	18	839,136	...

Cæsar	1896	,,	390	75	0	27	6	14,900	17·5	12,000	2	Vertical 3 expansions 2 sets	8 navy boilers	4—12″, 46 tons 12—6″ 38 smaller 5—18″ torpedo tubes	Hooded barbettes	Barbettes, 14 Side, 9 Harveyized	872,458	...
Kearsarge (United States)	1898	,,	368	72	3	23	6	11,525	16·82 16·0	11,674 10,500	2	Vertical 3 expansions 2 sets of 3 cylinders; $33\frac{1}{2}''+51''+78''\times48''$	Single-ended Double ,, Return tube 180 lb pressure	4—13″ } .... } 4—8″ } 14—5″ 32 smaller 4 torpedo tubes	Two-storeyed turrets	17 Harveyized nickel steel	462,345	...
Formidable	1898	,,	400	75	0	26	9	15,000	18·25	15,000	2	Vertical 3 expansions 2 sets of 3 cylinders; 250 lb pressure	20 Belleville, with economizers 300 lb pressure	4—12″, 46 tons 12—6″ 32 smaller 4—18″ torpedo tubes	Barbettes, hooded	Barbette, 12 Side, 9 Krupp	...	...
Kaiser Wilhelm der Grosse (German)	1899	,,	377	65	9	25	9	11,130	18	13,000	3	Vertical 3 expansions 3 sets of 4 cylinders	8 cylindrical and 4 Thornycroft 180 lb pressure	4—9·4″ 18—5·9″ 32 smaller 6 torpedo tubes	Turrets	12 Krupp steel	...	...
Hatsuse (Japanese)	1899	,,	400	76	6	27	0	15,000	18	14,500	2	Vertical 3 expansions 2 sets of 3 cylinders; $34''+53''+84''\times48''$ 210 lb pressure	25 Belleville, with economizers 270 lb pressure	4—12″, 49 tons 14—6″ 32 smaller 4—18″ torpedo tubes	Barbettes	14 Harveyized nickel steel	...	...
Suffren (French)	1899	,,	410	70	0	27	6	12,700	18	16,200	3	3 expansions 3 sets	Niclausse	4—12″ 10—6·4″ 8—3·9″ 26 smaller 4 torpedo tubes	Turrets	11·8	...	...
Imperator Alexander III. (Russian)	1900	,,	397	76	0	26	0	13,600	18	16,000	2	...	Belleville	4—12″ 12—6″ 49 smaller 6 torpedo tubes	Turrets	9	...	...
Albemarle	Bldg.	,,	405	75	6	26	6	14,000	19	18,000	2	Vertical 3 expansions 2 sets of 4 cylinders	24 Belleville, with economizers	4—12″ 12—6″ 26 smaller 4 torpedo tubes	Barbettes, hooded	Barbettes, 14 Sides, 7	...	...
Benedetto Brin (Italian)	,,	,,	426′ 6″	78	3	27	0	13,200	20	19,000	2	3 expansions 2 sets of 4 cylinders	Belleville	4—12″ 4—8″ 12—5·9″ 30 smaller and machine 4 torpedo tubes	...	10	1,109,778 (estimated)	...
Georgia (United States)	,,	,,	435	76	3	23	9	15,000	19	19,000	2	3 expansions 2 sets of 4 cylinders 250 lb pressure	24 water-tube	4—12″ } .... { 8—8″ { 4 } { 4 .... 12—6″ 42 smaller 2 torpedo tubes	Two-storeyed turrets Turrets	11	Not to exceed 739,751	...

thick. Above the belt, for a length of 185 ft. amidships, is a lighter belt of 5-in. Krupp armour, protecting the bases of the 6-in. guns, and terminated by transverse bulkheads. The 10-in. gun turrets are 10 in. thick, and the 6-in. guns are protected by casemates 5 in. thick. This vessel carries 30 Belleville boilers, and has storage for 2000 tons of coal. The disposition of her guns and the other main features of the vessel are readily seen in the figure. In 1902 the latest completed battleship for the Russian navy was the *Retvizan*, which was built at Cramp's, U.S.A. She is of 12,700 tons displacement, 376 ft. long, 72¼ ft. beam, and 26 ft. draught. She has four 12-in. B.L. guns in pairs in turrets, twelve 6-in. Q.F. guns in 5-in. casemates, twenty 12-pdrs., and twenty-eight smaller guns, besides four submerged and two above-water torpedo tubes. She is protected by a water-line belt extending from the after turret to the stem, and tapering in thickness from 9 in. to 2 in. Above this is a complete belt of 6 in. maximum thickness, and the main armament is protected by turrets 10 in. thick. She has 16,000 H.P. and a speed of 18 knots, and has stowage for 2000 tons of coal.

Italy has undertaken the building of three new battleships, two of which are already under construction. They are designated the *Vittorio Emanuele III.* class, and have a displacement of about 12,500 tons, a length of 435 ft., a beam of 75 ft. 6 in., and a draught of 25 ft. 7 in. They have twin screws and 19,000 I.H.P., giving them 21½ to 22 knots speed; they have partial water-line belts of Harveyized steel 9¾ in. thick, and a 1½-in. protective deck; the gun positions are protected by 8-in. armour. The armament consists of two 12-in. B.L. guns, twelve 8-in. B.L. guns, twelve 3-in. Q.F., with twelve smaller guns and four torpedo tubes. The 12-in. guns are mounted singly in middle-line turrets, one forward and the other aft, the aftermost gun being a deck lower than the foremost gun; and the 8-in. guns are mounted in pairs in turrets, of which there are three on each broadside between the 12-in. turrets, the amidship one each side being at the same level as the forward 12-in. gun, and the others at the same level as the after 12-in. gun. Although classed as battleships and having a very powerful armament, this type of ship aims at a speed little short of the armoured cruiser class of other navies.

Norway.—Fig. 47, Plate VIII. shows the completed Norwegian armour-clad *Norge* on her trial trip. This vessel and her sister the *Eidsvold*, with their predecessors *Harald Haarfagre* and *Tordenskjold*, were built at Elswick for the royal Norwegian navy, and completed in 1900. They have a displacement of 3850 tons, length 290 ft., beam 50 ft. 6 in., draught 16 ft. 6 in., and with twin-screw engines of 4500 horse-power have attained 16½ knots speed. They are heavily armed with two 8-in. B.L. guns in armoured gun-houses, one at each end of the vessel; six 6-in. Q.F. guns, four mounted in 5-in. nickel steel casemates and two in the open, with strong shields; eight 12-pdrs. and six 3-pdrs.; and two submerged torpedo tubes. The water-line is protected with 6-in. Krupp armour over a length of 170 ft., and bulkheads of the same thickness are provided at each end of the belt. These ships represent a class of vessels of small size which are well protected, heavily armed, and have a fair speed, which would prove formidable opponents to many larger armoured ships, and which are especially useful for coast-defence purposes.

Table VI. shows the development of the leading features of armoured battleships from the time of the *Warrior* to 1902. The particulars, it will be seen, are in a tabulated form, arranged in order of the date of launch, and to most of the ships therein mentioned reference will be found in the preceding pages.

Cruisers.

The cruiser type was primarily intended to co-operate with armour-clad fleets, in the same manner as sailing frigates did with fleets of sailing line-of-battleships, and the earliest cruisers were modelled directly upon the frigates which preceded them, the differences between the two being those incidental to the use of steam power and to the substitution of iron for wood as the building material. As steam propulsion grew in favour, engines of greater power were provided, and the rig and sail-spread were reduced till at the present day they have almost entirely disappeared. When the final adoption of iron led to the remodelling of the details of construction by Sir E. J. Reed, the new system of construction was applied to the cruisers of the day, but no attempt was made till much later to give these cruisers any protection, nor was the question of their armament given the importance which it afterwards came to have.

Lord Armstrong was one of the first to recognize the importance of developing this class of vessel. He considered the essential features of a cruiser to be high speed, protection without the use of side armour, a powerful armament, and minimum size and cost; and his views were adopted by the Elswick firm in a large number of cruisers for foreign Powers down to the introduction of high explosives, when side armour was advocated in place of, or in addition to, the armour deck. The cruisers built for the British navy prior to 1880—of which the principal were such vessels as the *Inconstant* (Fig. 48, Plate XI.), of 5780 tons (1866); the *Active*, of 3080 tons (1867); the *Raleigh*, of 5200 tons (1871); and the faster despatch vessels *Iris* and *Mercury* (Fig. 49, Plate XI.), of 3730 tons (1875)—had been almost entirely unprotected; and although the *Comus* and *Leander* classes (see Fig. 50, Plate XI., and particulars in Table VII.) had been given a partial protective deck, the Elswick-built *Esmeralda* (1883) (see Fig. 51, Plate XI.) may be quoted as the first vessel in which the important features of a complete protective deck and good protection to the guns were combined with high speed and a powerful armament. On the other hand, the *Impérieuse* and *Warspite* (Fig. 52, Plate XII.), completed in 1881, of much greater displacement than the *Esmeralda*, were provided with a partial belt of 10-in. compound armour in combination with a protective deck. Thus the necessity for protecting cruisers led to the introduction of two types—the "protected" cruiser, of which the *Esmeralda* may be taken as the pioneer, and the "armoured" cruiser, of which the *Impérieuse* and *Warspite* are early representatives; but while in the British navy the "protected" cruiser type was repeated and developed, the "armoured" type was discontinued, and with the exception of the *Orlando* class (Fig. 53, Plate XII.), built shortly afterwards, the whole of the cruisers built for the British navy for another fifteen years were of the "protected" type. In France and Russia, however, the armoured cruiser continued in favour, the *Dupuy de Lôme* of 1890, for the former, and the *Rurik* of 1892, for the latter, being vessels of this type (see Table VII.).

The reintroduction of side armour in British-built cruisers came about 1895, when, it should be observed, the improvement of armour by the development of the Harvey and subsequently Krupp processes of manufacture enabled more efficient protection to be provided in this way with a much thinner belt than had previously been possible. The Elswick cruiser *Esmeralda* (second), built for the Chilian Government in 1895, was one of the first in which the use of side armour was revived. She was followed by other vessels of the armoured type built by the same firm for the Chilian and Japanese navies. In 1898 the *Cressy* class (Fig. 54, Plate XII.) was begun for the British navy, and since this date all cruisers of 10,000 tons and above for the British navy have been provided with side armour.

In the United States the adoption of armour belts of the new material for cruisers came somewhat earlier than it did in the British navy, the *Brooklyn* (Fig. 55, Plate XII.), built in 1895 (see Table VII.), being so protected; and the development of the type has been similar to its development in Great Britain, the tendency being to go to larger displacements, in order to provide greater protection and heavier armaments, with each new class of vessel. Indeed, the first-class armoured cruiser of the present day might be described as a high-speed battleship with a light primary armament.

Coming to more detailed descriptions of existing ships, we find in the British navy, as might be expected, that the demand for vessels to meet the varied and diverse requirements that necessarily arise in a fleet of such magnitude has led to the production of a number of classes, each adapted to their special duties. They may

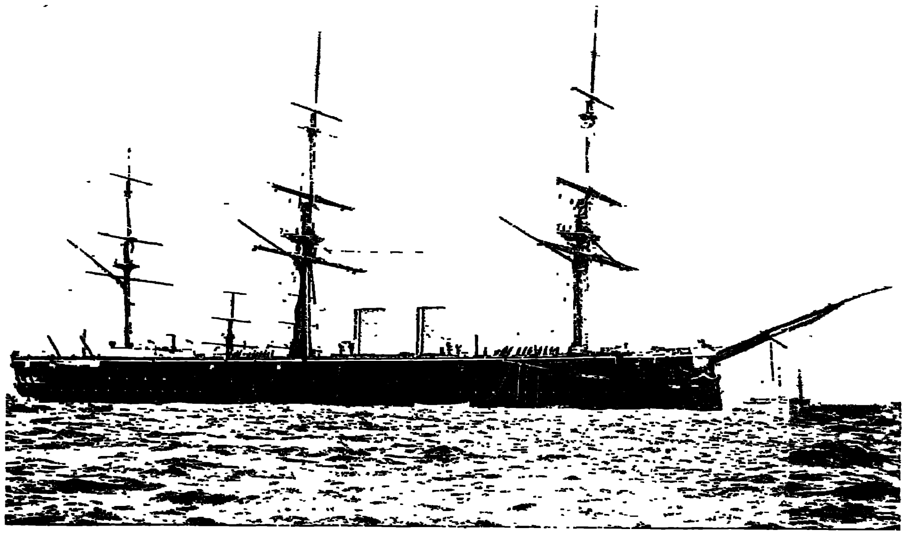


Fig. 48.—H.M.S. *Inconstant.*

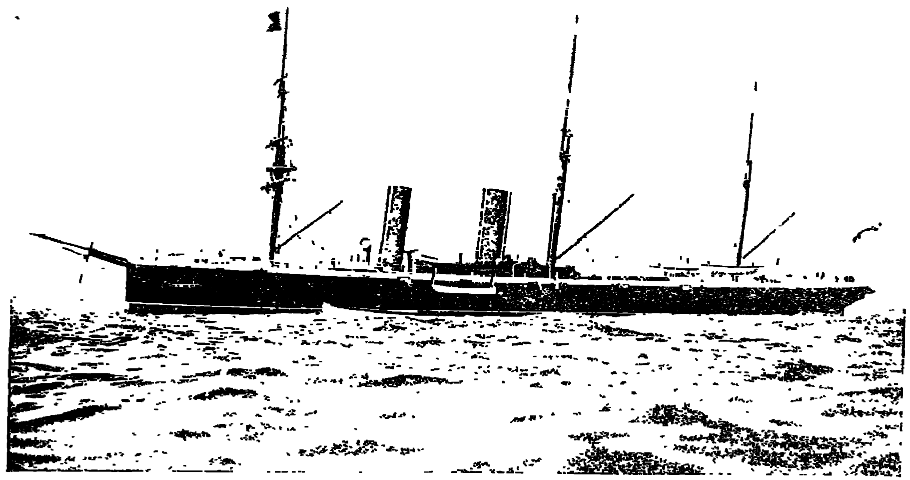


Fig. 49.—H.M.S. *Mercury.*

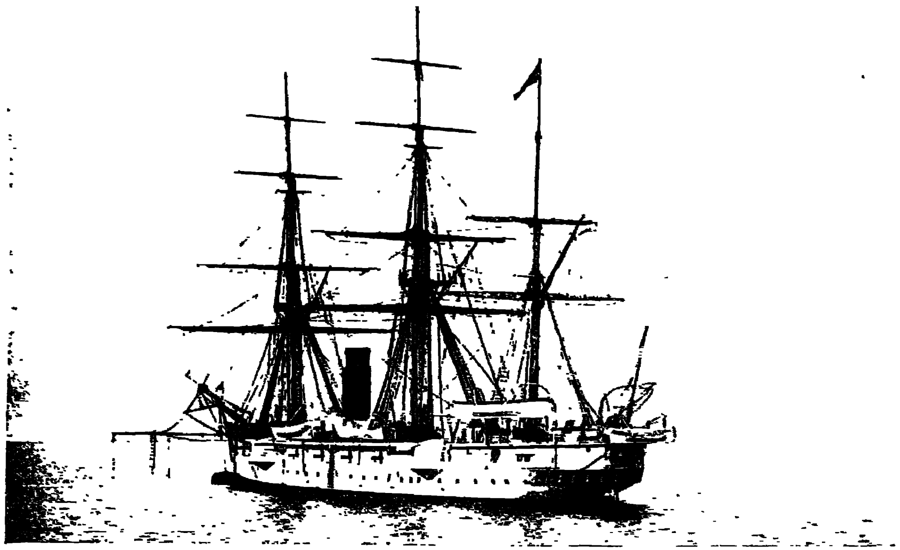


Fig. 50.—H.M.S. *Comus.*

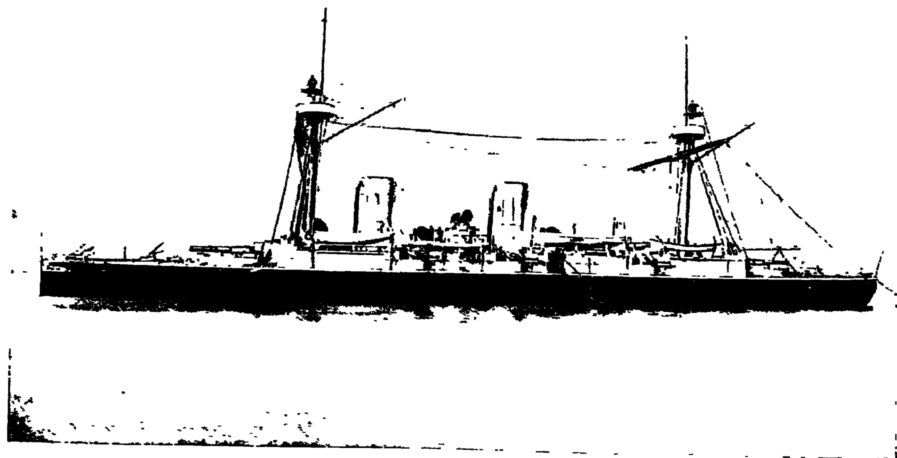


Fig. 51.—Japanese *Esmeralda.*

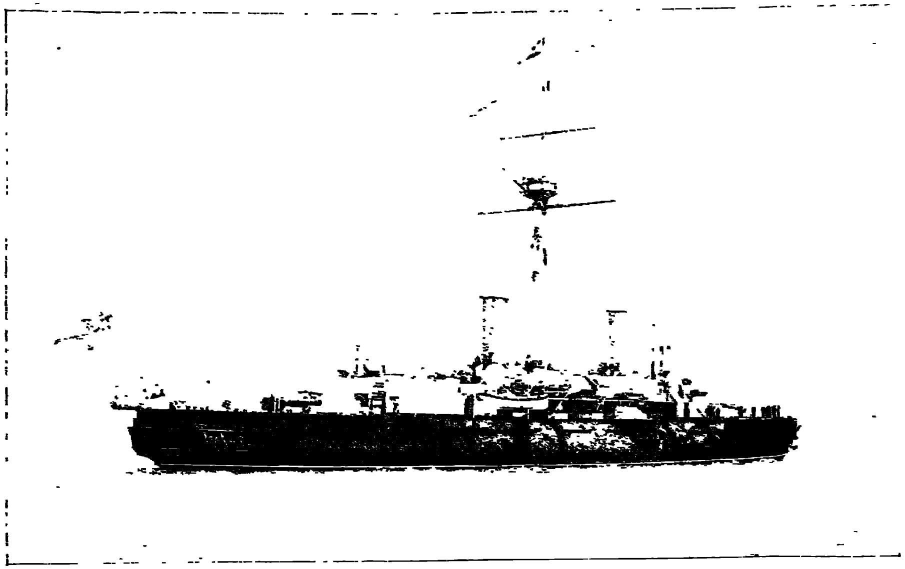


Fig. 52.—H.M.S. *Impericuse.*

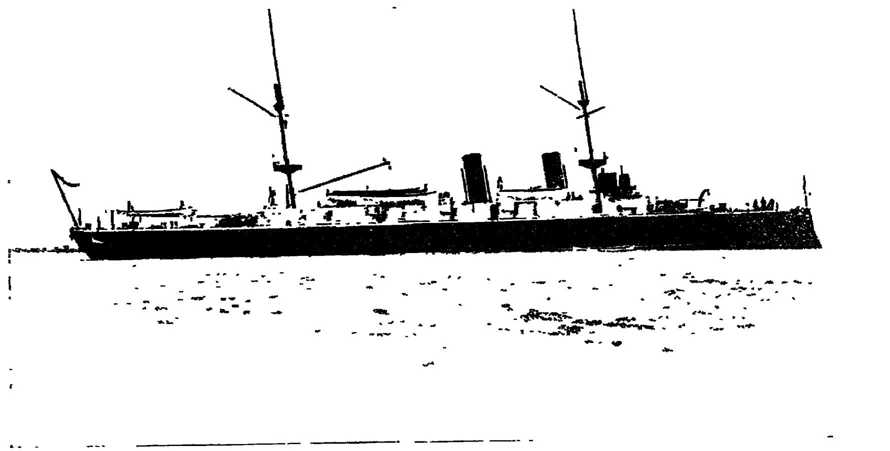


Fig. 53.—H.M.S. *Orlando.*

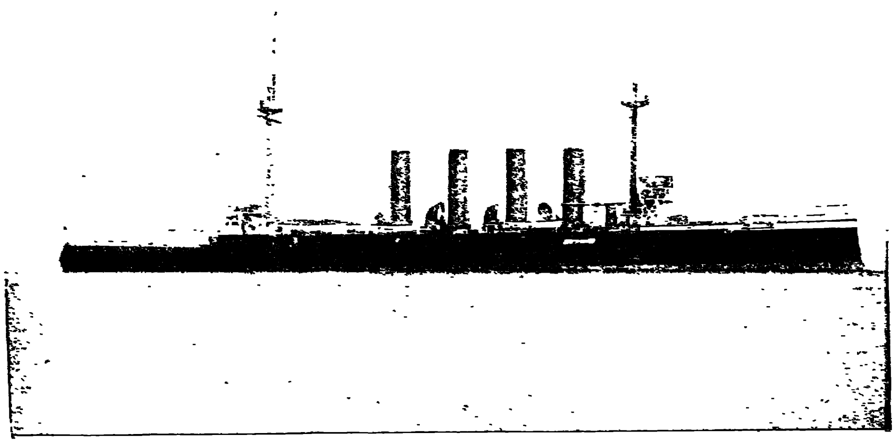


Fig. 54.—H.M.S. *Cressy.*

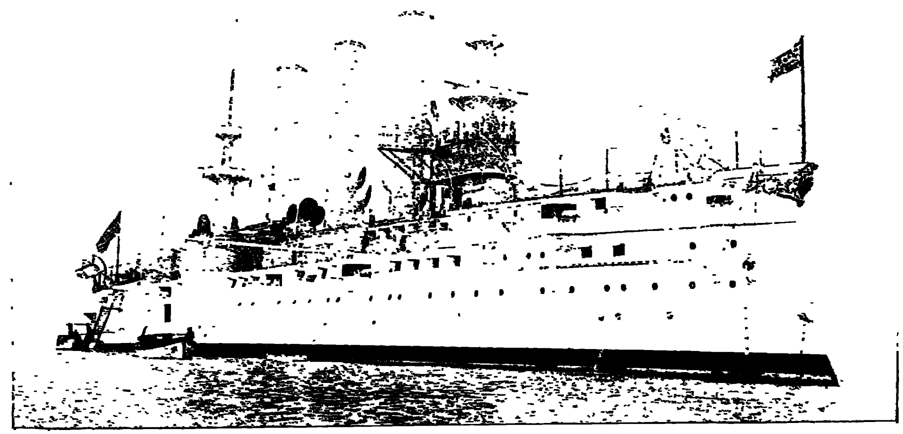


Fig. 55.—U.S.A. *Brooklyn.*

be classified as (1) unprotected cruisers; (2) protected cruisers of first, second, and third classes; and (3) armoured cruisers. Unprotected cruisers have neither side armour nor other protection against loss of buoyancy from injury by shot and shell. Protected cruisers have no side or vertical armour, but they have horizontal armour decks with strong sloping sides in the vicinity of the water, upon which coal is carried in minutely divided bunker compartments. Armoured cruisers have side or vertical armour.

Each of these classes includes a number of groups of sister ships, but we shall confine ourselves to a brief description of the main features of a representative ship in a few of the most important groups comprising each of the classes defined above.

The protected cruiser of medium displacement affords a convenient starting-point, as it so happens that the latest vessels of this type are of about the same displacement as the largest first-class cruisers of thirty years before, and a comparison of representative ships of these classes illustrates the great advances made in thirty years in ships of approximately the same size; while a further comparison of these second-class cruisers (as the vessels of medium displacement are styled) with the first-class protected cruisers and the armoured cruisers of the present day shows the growth in size and power of the largest units of the cruiser type during the same period. It should, however, be noted that while the most recent second-class cruisers are of such a displacement (5600 tons) as to allow of this comparison being made, the great bulk of the vessels of this class are smaller, particularly those which have been in service for some years. Thus the *Mersey* (Fig. 56, Plate XIII.) is an example of a vessel of this class which has seen considerable service. Begun in 1883, her principal dimensions are: length 300 ft., beam 46 ft., mean draught about 20 ft., and displacement 4050 tons. Protection to the vitals of the ship is provided for by means of a protective deck a little above the level of the water-line, 2 to 3 in. in thickness, in combination with a system of coal-stowage in bunkers along the water-line. She carries two 8-in. and ten 6-in. B.L. guns and four torpedo tubes. Her horse-power is 6000 (forced draught) and speed 17·3 knots, and she carries 750 tons of coal at normal draught, with capacity for 900 tons. The *Astræa* (Fig. 57, Plate XIII.), begun in 1890, may be taken as representing the average of the various modern vessels classified as second-class cruisers. She is built of steel, sheathed and coppered, is 320 ft. long, 49 ft. 6 in. beam, 21 ft. 6 in. mean draught and 4360 tons displacement, and carries two 6-in. Q.F. guns and eight 4·7-in. Q.F. guns, all on the upper deck and protected by shields, together with four torpedo tubes. She is protected by a steel deck 1 in. to 2 in. thick, and the engine cylinders, which project through this deck, are shielded by 5-in. sloping coamings. The coal bunkers in the neighbourhood of the water-line are minutely subdivided, and the stowage is arranged so as to make full use of the coal protection. Her engines develop 9000 H.P. (under forced draught) and her speed is 19·3 knots. Her coal stowage is 1000 tons.

Second-class cruisers.

The *Hermes* (Fig. 58, Plate XIV.) represented in 1902 the latest type of second-class cruiser added to the Royal Navy. She is 350 ft. long, 54 ft. beam, 20 ft. 6 in. mean draught, and 5600 tons displacement. She presents a striking contrast compared with the *Inconstant* (Fig. 48), built in 1866, of almost the same displacement. The *Inconstant* was fully rigged, and sailed almost as fast as she steamed; while the *Hermes* has no sail, and steams 20 knots, or 6 knots faster than did the older vessel. The *Inconstant* was entirely unprotected, and carried her guns on the broadside, with very limited arcs of training; whilst the *Hermes* has all-round fire, the fire ahead and astern is a very large percentage of that on the broadside, and her guns all train through large arcs (120° and above), and are well protected by enveloping shields, and the ship herself is protected by a steel deck 1½ to 3 in. thick, besides having coal protection. The *Inconstant's* main armament consists of ten 9-in. and six 7-in. M.L. guns; the *Hermes'*, of eleven 6-in. Q.F. guns, each firing probably ten rounds to one of the *Inconstant's* 9-in., and with a perforation of wrought iron of about one-third as much again. A glance at the pictures of the two ships (Figs. 48 and 58) shows a great difference in appearance. The line of the topsides of the *Inconstant* is unbroken from stem to stern; the *Hermes* has a forecastle forward, and amidships she has a large number of ventilators and funnels; and the contrast extends to all the principal features of the ships. The *Hermes* is built of steel, sheathed and coppered. She carries, in addition to her eleven 6-in. Q.F. guns, eight 12-pdrs. and six 3-pdrs., besides machine-guns and two submerged torpedo tubes. She has Belleville boilers, developing 10,000 H.P. and giving her a speed of 20 knots as long as her coal lasts.

Somewhat similar to the *Hermes* in external appearance, the four vessels of the *Arrogant* class (Fig. 59, Plate XIV.) possess certain features of special interest which distinguish them from all other second-class cruisers, in which class they are usually included. They are of 150 tons greater displacement than the *Hermes*, are 30 ft. shorter, but have 3 ft. 6 in. more beam and 6 in. more draught. They are built of steel and are unsheathed, have Belleville boilers, and engines giving 10,000 H.P. and a speed of 19 knots. They have an armament of four 6-in. Q.F. guns, three of which fire right ahead and one right astern; six 4·7-in. Q.F. guns, three on each broadside; eight 12-pdrs.; nine smaller guns; and two submerged torpedo tubes. All the guns are mounted on the upper deck in shields. The protective deck is of nickel steel, and varies from 1½ in. to 3 in. in thickness. The bow is protected by a belt of 2-in. nickel steel extending about 40 ft. back from the ram, the top of this belt being level with the main deck, and the bottom edge sloping downwards to strengthen the ram. The bow spaces are packed with a water-excluding material, and a cofferdam formed by two water-tight transverse bulkheads about 3 ft. apart, and extending from keel to main deck, separates the bow from the rest of the vessel. The *Arrogants* are fitted with tandem rudders, and the deadwood at the after end of the ship is cut away, the manœuvring power being greatly increased by these means. The strong bow fire, bow strengthening and protection, and great manœuvring power render these vessels specially adapted for use as rams.

The protected cruisers of greater displacement, or first-class cruisers, as they are called, may be divided into four well-marked classes: *Blake* and *Blenheim* class, *Edgar* class (Fig. 60, Plate XV.), *Powerful* and *Terrible* class (Fig. 61, Plate XV.), and the *Diadem* class (Fig. 62, Plate XV.). The *Blake* and *Blenheim*, begun in 1888, were amongst the earliest cruisers designed for the British navy by Sir William White in his capacity of Director of Naval Construction: they are of 9000 tons displacement, 375 ft. long, 65 ft. beam, and 27 ft. draught. They carry two 9·2-in. B.L. guns, one firing directly ahead and the other directly astern, protected by shields 6 in. thick; ten 6-in. Q.F. guns, of which four are on the main deck, protected by casemates of 6 in. compound armour, and six on the upper deck in shields; sixteen 3-pdrs.; two submerged and two above-water torpedo tubes. Their protection consists of a complete armour deck of steel 3 in. to 6 in. thick, with a dome or coaming over the tops of the cylinders 4 in. to 8 in. thick. Their machinery arrangements are somewhat unusual, consisting of four independent sets of vertical triple-expansion engines, two on each shaft, for which steam is provided from six double-ended cylindrical boilers. The aggregate power of their machinery is 20,000 H.P. under forced draught, giving them a speed of 21 knots; with open stokeholds their power is 13,000 H.P., which gives them a speed of 19¼ knots. They carry 1500 tons of coal. The *Edgar* class (Fig. 60), begun in 1889, are vessels of 7350 tons displacement, 360 ft. long, 60 ft. beam, and 23 ft. 9 in. mean draught. Their armaments consist of two 9·2-in. Q.F. guns and ten 6-in. Q.F., disposed and protected in the same way as the corresponding guns of the *Blake*, with twenty-four smaller and machine guns, two submerged and two above-water torpedo tubes. The protective deck has a maximum thickness of 5 in., and the cylinders are protected by a raised coaming on this deck, with sloping sides 6 in. thick. They have six double-ended cylindrical boilers and two sets of vertical triple-expansion engines, developing with forced draught 12,000 I.H.P. and giving a speed of 20 knots. They carry 850 tons of coal at normal draught, with storage for 1250 tons. Nine vessels of this class have been built, four of them being sheathed with wood and coppered, the remaining five, including the *Edgar*, being unsheathed. The *Powerful* (Fig. 61), with her sister the *Terrible*, was in 1902 the largest protected cruiser afloat. They were begun in 1894. They are of steel, sheathed with wood and coppered, are of 14,200 tons displacement, 500 ft. length, 71 ft. beam, and 27 ft. mean draught. They are armed with bow and stern 9·2-in. B.L. chasers, and twelve 6-in. Q.F. guns, of which eight are in 6-in. Harveyized casemates on the main deck and four in similar casemates on the upper deck. They have also seventeen 12-pdrs. Q.F. guns, twelve 4-pdrs., nine machine-guns, and four submerged torpedo tubes. The 9·2-in. guns are protected by a shallow ring of 6-in. Harveyized steel, surmounted by a 6-in. shield enveloping the gun and crew. The ship herself is protected by a complete deck at the water-line level of Harveyized steel plates 3 in. to 6 in. in thickness, and by a double line of coal bunkers above it. The machinery arrangements constitute the striking feature of these ships. They have no less than forty-eight Belleville boilers in eight boiler-rooms, with two sets of triple-expansion 4-cylinder engines, developing 25,000 H.P. with open stokeholds and giving the ships a speed of 22 knots. The large boiler power and the great size of these ships enable them to maintain continuously at sea a

First-class cruisers.

speed closely approaching their maximum. They carry as a normal supply 1500 tons of coal, and their bunkers will hold 3000 tons.

The *Diadem* class (Fig. 62) were in 1902 the latest first-class protected cruisers added to the British navy. There are eight vessels of this class, but in the four last-built vessels, of which the *Spartiate* was one, some changes were made. The first vessel of the *Diadem* class was begun in 1895, is of 11,000 tons displacement, 435 ft. length, 69 ft. beam, 25 ft. 3 in. mean draught, and is built of steel, sheathed and coppered. Her principal armament consists entirely of 6-in. Q.F. guns, of which there are sixteen, twelve being protected by 5-in. casemates of Harveyized steel, and the others disposed, two on the forecastle as bow chasers, and two on the quarter deck as stern chasers, all in separate shields. She also carries thirteen 12-pdrs., eleven smaller guns, including machine-guns, and two submerged torpedo tubes. The protection consists of a steel deck, whose slopes are 4 in. thick and horizontal portions 2½ in. thick, upon which is stowed the 1000 tons of coal which the vessel ordinarily carries, the full coal capacity being 2000 tons. She is provided with 30 water-tube boilers of the Belleville type, and her machinery develops 16,500 H.P., giving her a speed of 20·5 knots. All the ships of the class are similar to the *Diadem*, except that in the four *Spartiates* the casemates are 6 in. thick, and the machinery is of greater power, viz., 18,000 I.H.P., giving a speed of a quarter of a knot higher.

Third-class protected cruisers include vessels varying in displacement from 1500 to 3000 tons. The advances which enable modern second-class cruisers to compare so favourably with vessels of the same size built thirty years previously also enable vessels of even smaller displacement to be provided with the essential features of a cruiser to a considerable degree. With a reduction of displacement come reduction of initial cost and cost of upkeep, a smaller crew, a shorter time for building, and the many advantages attendant upon reduced size and draught of water. It has been found possible to embody in a ship of about 2000 tons displacement many of the most important requirements of a modern cruiser, and a large number of vessels of this class have been added to the fleet. Among these may be mentioned the *Barham* (Fig. 63, Plate XV.), a typical small cruiser, which was built in 1889 of steel, of 1830 tons displacement; she is 280 ft. long between perpendiculars, 35 ft. broad, and 12 ft. 8 in. draught of water. As originally completed, this vessel had cylindrical boilers and a H.P. of 4700, giving a speed of 19 knots. In 1898 she and her sister, the *Bellona*, were reboilered with water-tube boilers of the Thornycroft type, and with these a H.P. of 6000 is obtained, and the vessel reaches a speed of nearly 20 knots. The protection afforded is in the usual form of a protective deck, 1 in. thick on the flat, and sloping sharply downwards near the water-line, where the thickness is increased to 2 in.; and above this deck the coal stowage is arranged in subdivided bunkers. She carries an armament of six 4·7-in. Q.F. guns in shields on the upper deck, four 3-pdrs., two machine-guns, and two above-water torpedo tubes. She carries 140 tons of coal in her normal condition, and her bunkers will take 250 tons. She has a light fore-and-aft rig. The latest type of third-class cruiser added to the British navy in 1902 may be regarded as a development of the *Barham*. It is known as the *Pioneer* class, which might be taken to include the *Pelorus* class, the differences between them being small. Of the two classes eleven vessels have been built. The *Pioneer* is 305 ft. long, 36 ft. 9 in. broad, 13 ft. 6 in. mean draught, and 2200 tons displacement. She has water-tube boilers of the small tube type, and engines of 7000 H.P., giving her a speed of 20 knots. She carries 250 tons of coal at the above displacement, and has stowage for 550 tons. She has eight 4-in. Q.F. guns in shields on the upper deck, eight 3-pdrs., four machine-guns, and two above-water torpedo tubes. Her protection consists of a 2-in. steel deck, having sloping sides extending a few feet below the water-line, and upon which coal is stowed in the usual subdivided bunkers.

Third-class cruisers.

The *Impérieuse* and *Warspite*, built in 1881 from designs by Sir Nathaniel Barnaby, may be described as the first armoured cruisers built for the British navy. The *Impérieuse* is shown in Fig. 52, and the *Warspite* is a sister vessel. They are of 8000 tons displacement, 315 ft. long, and are protected by a partial belt amidships of 10-in. compound armour over a length of about 140 ft., with a protective deck above it 1½ in. thick, and transverse bulkheads at the ends of the belt 9 in. thick, the protective deck from these bulkheads to the ends of the ship being 3 in. thick. They have machinery of 10,000 H.P. and a speed of 16¾ knots. They rank in the Navy List of to-day as first-class armoured cruisers, and carry four 9·2-in. B.L. guns in separate barbettes—one forward, one aft, and one on each beam—besides ten 6-in. guns, twenty-six smaller and machine guns, and six torpedo tubes. They are sheathed and coppered, and are thus able to keep the sea for a long period without docking. The next vessels of the type were the *Orlando* class (Fig. 53), commenced in 1885. Seven of these were launched in 1886 and 1887. They are much smaller than the *Impérieuse*, being only 5600 tons displacement, 300 ft. long, 56 ft. beam, and 24 ft. 8 in. draught. They have a water-line belt of compound armour, 10 in. thick and nearly 200 ft. long, closed in at the ends by bulkheads 16 in. thick; extending over the top of this, and sloping down forward and aft to the ends of the ship, is a deck 2 in. to 3 in. thick. Their armament consists of two 9·2-in. B.L. guns—one forward and one aft—instead of the four carried in the *Impérieuse* and *Warspite*, but is in other respects the same as the armament of the latter ships. They have engines of 8500 H.P. and a speed of over 18 knots, are unsheathed, and carry 750 tons of coal, with bunker space for 950 tons.

Armoured cruisers.

As already stated, between 1885 and 1898 no armoured cruisers were added to the British fleet. The *Cressy* class (Fig. 54, Plate XII.), commenced in 1898, consists of six vessels of 12,000 tons displacement, 440 ft. length, 69 ft. 6 in. beam, and 26 ft. 3 in. mean draught. They are built of steel, sheathed and coppered, have a belt of Harveyized steel 11 ft. 6 in. wide, 230 ft. long, and 6 in. thick, with bulkheads 5 in. thick, and 2 in. protective plating on the sides from the forward bulkhead to the stem. They carry two 9·2-in. B.L. guns in barbettes and gun-houses 6 in. thick, mounted on the middle line forward and aft, twelve 6-in. Q.F. guns in 6-in. casemates, and twenty-five 12-pdr. and small guns, with two submerged torpedo tubes. Their H.P. is 21,000 with natural draught, steam being supplied by 30 Belleville boilers, and their speed is 21 knots. They carry 800 tons of coal at normal draught, with capacity for 1600 tons.

The four vessels of the *Drake* class (see Fig. 64, Plate XVI.), laid down in 1899, were in 1902 the largest armoured cruisers yet begun. They are of 14,100 tons displacement, are 500 ft. long, 71 ft. beam, and 26 ft. mean draught. They are unsheathed, are protected by a Krupp steel 6-in. belt extending from barbette to barbette, and from 5 ft. below water to the height of the main deck, completed at the after end by a 5-in. bulkhead, and carried forward to the bow by 2-in. plating extending right up to the upper deck. There are two protective decks, the lower being 3 in. to 2 in. in thickness, and the main deck, which is 1 in. thick. Their armament consists of two 9·2-in. B.L. guns in barbettes and gun-houses 6 in. thick on the middle line forward and aft, sixteen 6-in. Q.F. guns in 6-in. casemates, fourteen 12-pdrs., twelve smaller and machine guns, and two submerged torpedo tubes. Their speed was superior to anything in the British navy up to the time of their design, being 23 knots.[1] They have engines of 30,000 H.P., the boilers being of the Belleville type. They carry 1250 tons of coal, with bunker capacity for 2500 tons.

A consideration of the above features will illustrate the difficulties of the classification of modern ships. The *Drake* is called an armoured cruiser, but she is superior to the battleships *Renown*, *Barfleur*, and *Canopus* in armour protection and in her secondary quick-firing armament, as well as in speed and coal endurance, and is somewhat inferior to them only in the number, weight, and protection of primary armament. If 10-in. guns were given to this vessel in lieu of her 9·2-in., she would probably be called a first-class battleship, and would be a 23-knot battleship at that. Each successive increase of size has given the battleship more speed and the armoured cruiser heavier guns and armour, thus tending to merge the two types in one.

The *Monmouth* class are smaller and more lightly armed and armoured vessels than their predecessors, but not inferior in speed. They are of 9800 tons displacement, length 440 ft., beam 66 ft., mean draught 24 ft. 6 in. They are armoured with a belt of 6 in. of Krupp steel over the main part of the length, diminishing in thickness towards the extremities; they carry fourteen 6-in. Q.F. guns, of which ten are in 4-in. casemates, and the others mounted in pairs in turrets and gun-houses 4 in. thick, forward and aft; they also carry ten 12-pdrs., eleven small and machine guns, and two submerged torpedo tubes. Their horse-power is 22,000, giving them a speed of 23 knots. In six vessels of this class, begun in 1901, the pairs of 6-in guns are replaced by 7·5-in. guns, and the thickness of the belt is increased to 6 inches.

With regard to cruisers of other navies than the British, it may be said that the vessels constructed at Elswick have by their success exercised considerable influence in the development of such cruisers, as well as of those of the British navy. The *Esmeralda* of 1883 (Fig. 51, Plate XI.), built for the Chilian Government, but bought by Japan in 1895, was of 2950 tons displacement, had 6000 H.P. and 18·3 knots speed, was protected by a complete 1-in. steel deck, and carried the very heavy armament of two 10-in. B.L. guns, six 6-in. Q.F., two 6-pdrs., seven smaller guns, and three torpedo tubes. The *Piemonte* (Fig. 65, Plate XVI.), built for the Italian navy in 1888, had a displacement of only 2640 tons, but was of 13,000 H.P. and had a speed of nearly 22½ knots. She was protected by a steel deck of 3 in. maximum thickness, and carried six 6-in. Q.F., six 4·7-in. Q.F., ten 6-pdrs.,

[1] The *Drake* herself in September 1902 obtained on trial a speed over 24 knots.

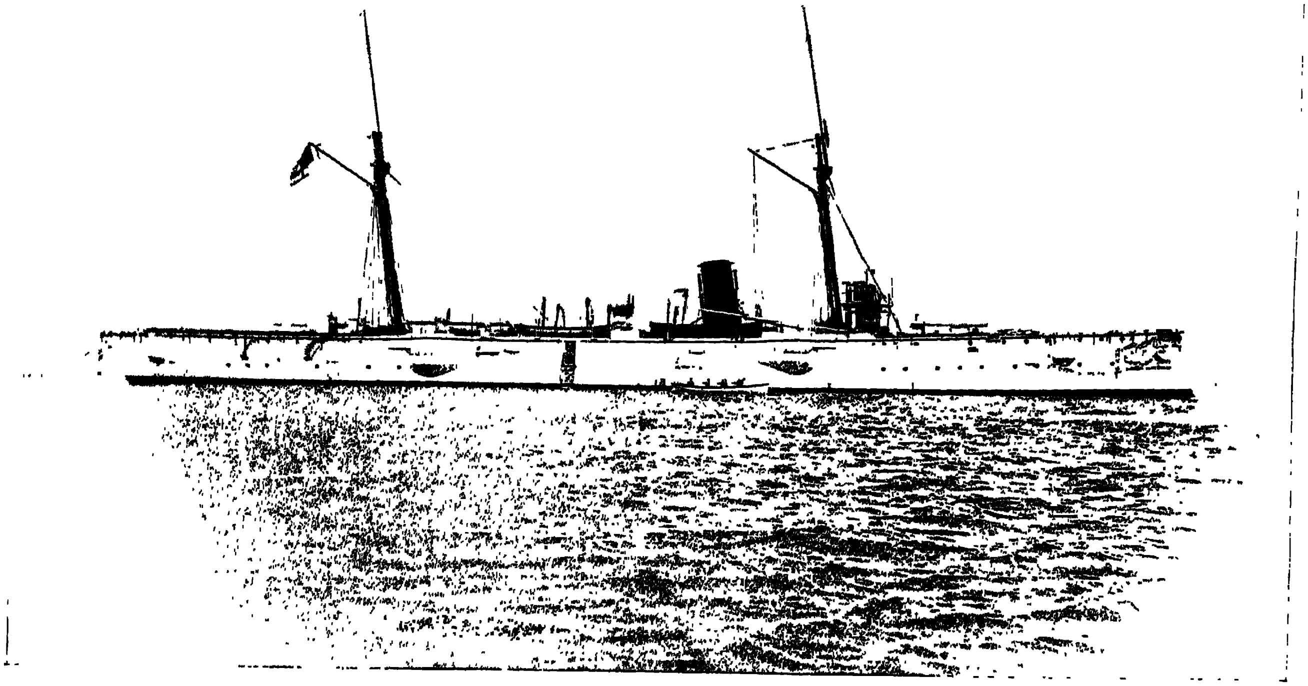


FIG. 56.—H.M.S. *Mersey*.

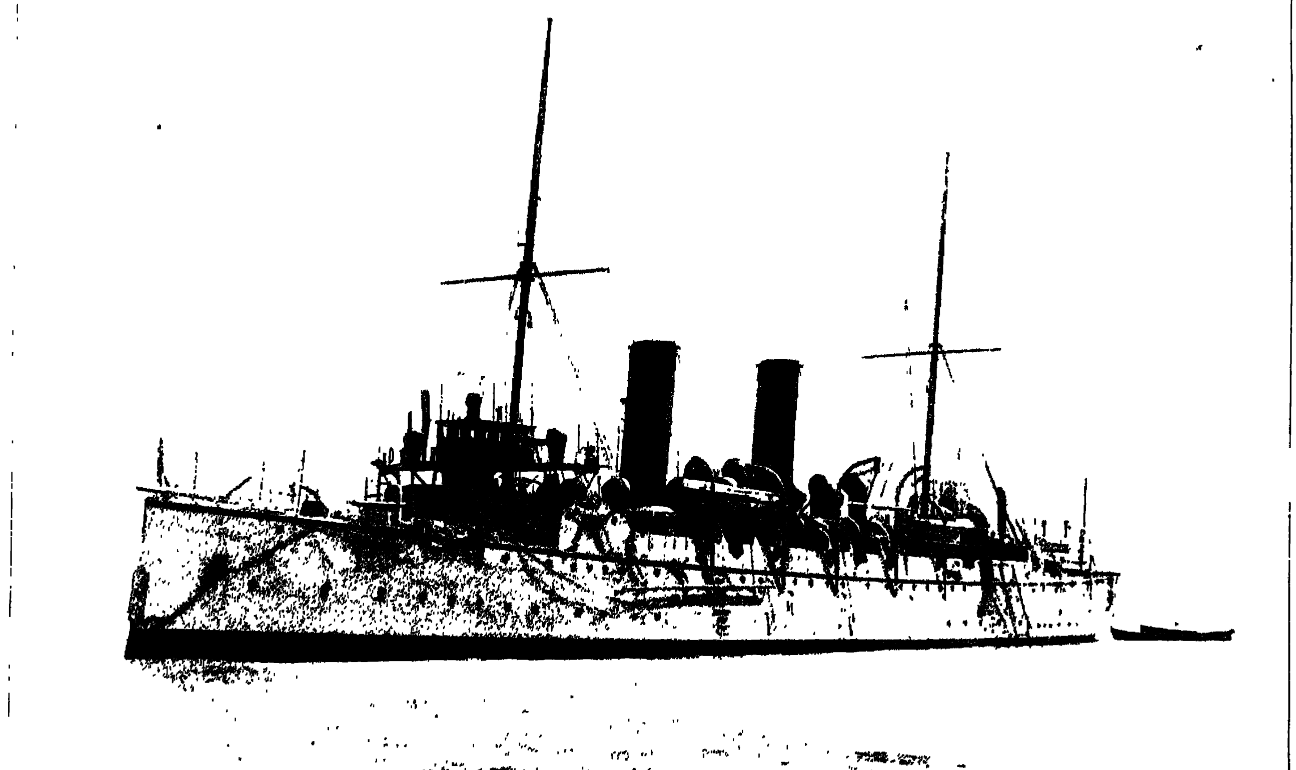


FIG. 57.—H.M.S. *Astræa*.

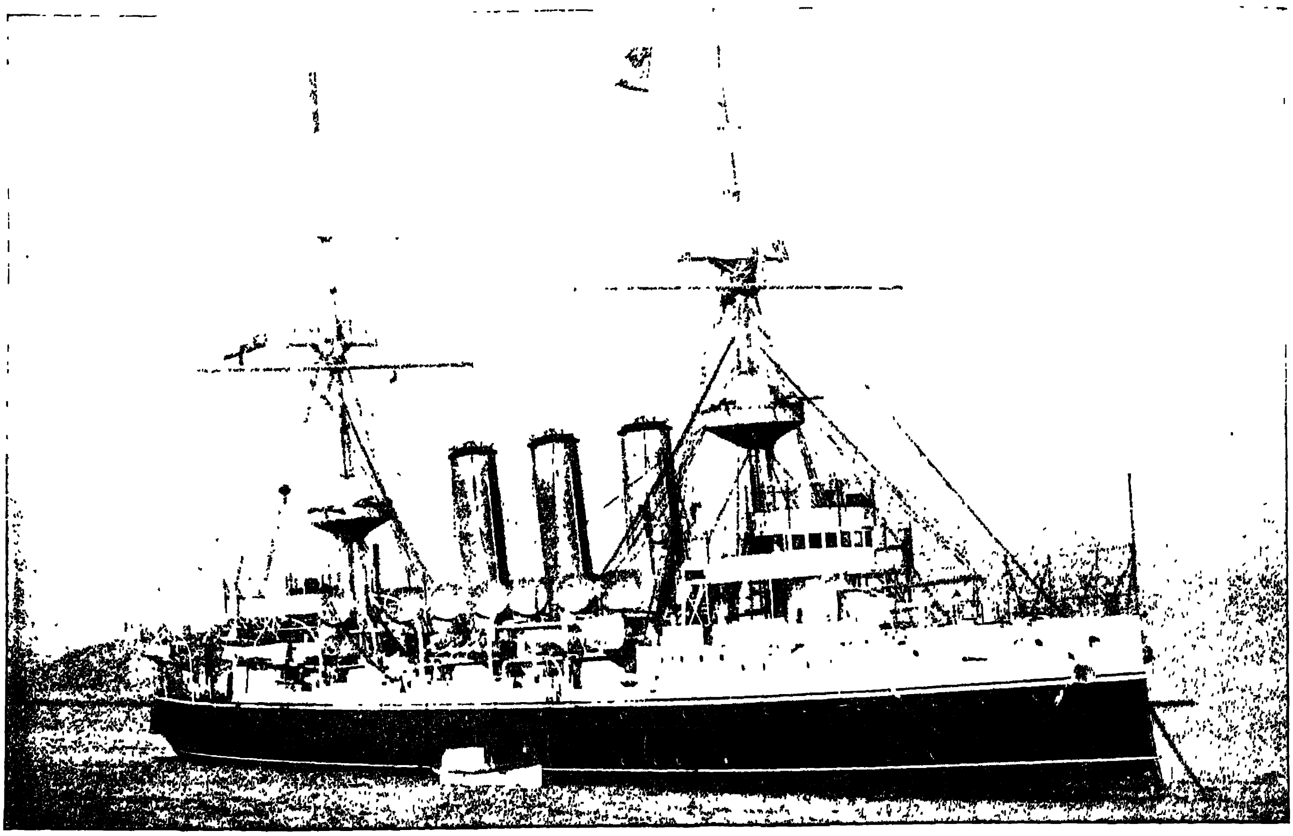


FIG. 58.—H.M.S. *Hermes.*

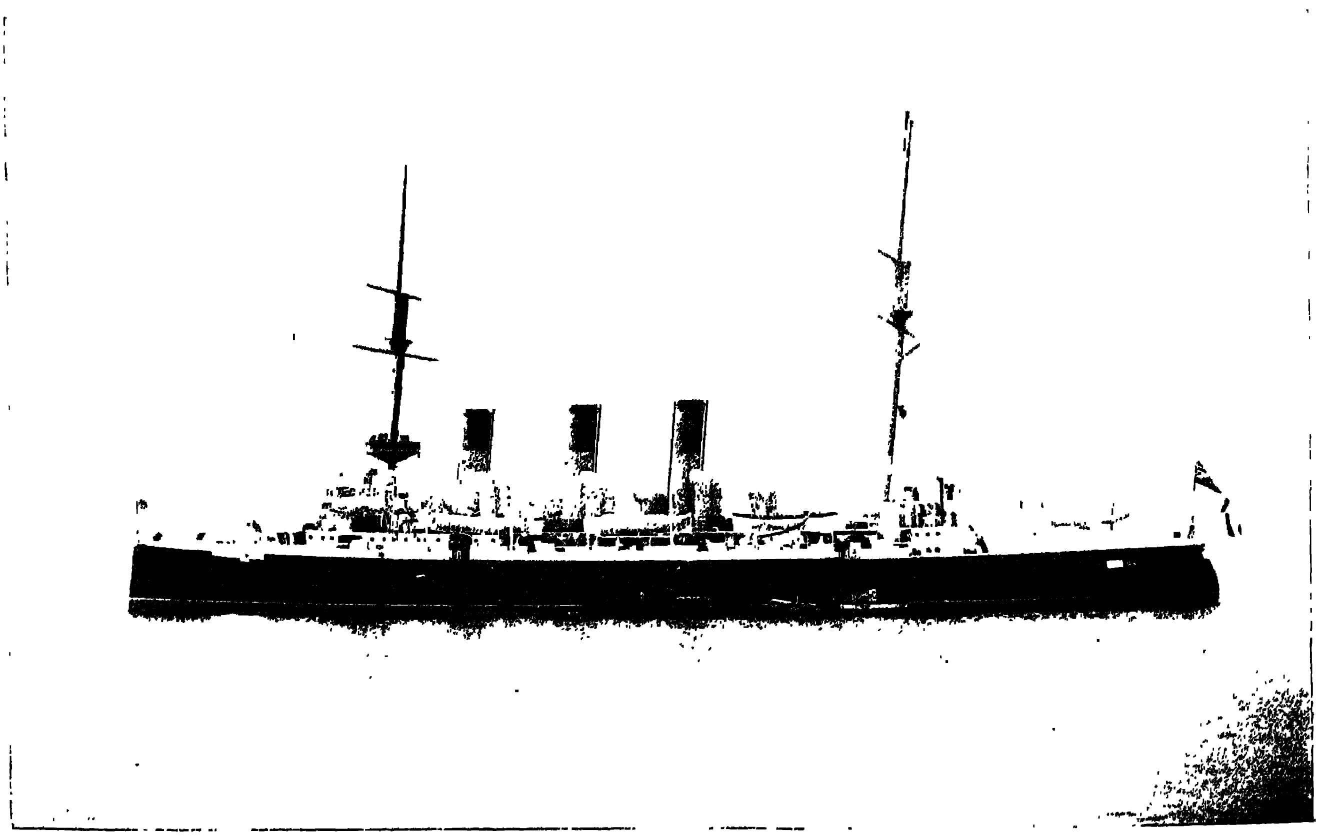
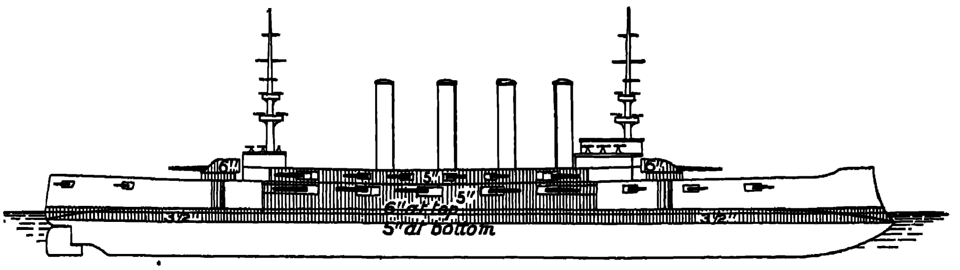


FIG. 59.—H.M.S. *Arrogant.*

eleven smaller guns, and three torpedo tubes, an armament which, as pointed out by Lord Armstrong, was capable of discharging in a given time twice the weight of shot and shell that could be fired by the largest war vessel then afloat. The *Buenos Aires*, built in 1895 for the Argentine Republic, is a later example of Elswick design. She is 396 ft. in length and of 4800 tons displacement, her machinery developing 13,300 horse-power with open stokeholds, and giving her a speed of 23·2 knots. She is protected by a complete deck 1½ in. to 3 in. thick, and carries a powerful armament of quick-firing guns, consisting of two 8-in., four 6-in., six 4·7-in., twenty-two smaller guns, and five torpedo tubes. Her normal coal supply is 350 tons, and she can stow 1000 tons in her bunkers. Rather smaller than the *Buenos Aires*, but of still later build (1901), is the Chilian cruiser *Chacabuco* (Fig. 66, Plate XVI.). She is a characteristic Elswick cruiser in design and general appearance, being heavily armed, fast, and of moderate displacement. Her dimensions are: displacement 4500 tons, length 360 ft., breadth 46 ft., and draught 18 ft. She carries an armament of two 8-in. Q.F. guns, mounted on the middle line forward and aft, and protected by well-armoured gun-houses, ten 4·7-in. Q.F. guns in shields on the broadsides, and nineteen smaller guns, including machine-guns. She is protected by a strong armoured deck 1¾ in. thick on the flat to 4½ in. on the slopes, and by the 1000 tons of coal which forms her normal supply. Her engines develop nearly 16,000 H.P., and her speed is 23 knots.

In the matter of armoured cruisers also Elswick has taken a leading place, the policy which has been so successful in the case of protected cruisers being followed with these also, with the difference that in the armoured cruisers the main protection takes the form of side armour instead of, or rather in combination with, protective deck-plating. From what has been said previously as to the functions of armoured cruisers, it might be expected that the displacements of these ships built at Elswick would be greater than the protected cruisers, but with these also the endeavour was to keep displacement at the minimum. Examples of Elswick designs are found in the *Esmeralda* (second), of 7000 tons, begun in 1895 for Chile; the *O'Higgins*, of 8500 tons, begun in 1896 for the same state; the *Asama* and *Tokiwa*, of 9700 tons, begun in 1897 for Japan; and the *Idzumo* and *Iwate*, begun 1899, also for Japan. The *Idzumo* (Fig. 67, Plate XVII.) is 9750 tons displacement—or about the same as the English *Monmouths*—400 ft. long, 68 ft. 6 in. beam, 24 ft. 3 in. draught. She has 16,000 H.P. and a speed of 22 knots; is protected by a complete belt of Krupp steel 7 in. thick, tapering to 3½ in. at the ends, a 2½-in. steel deck with a citadel above it 5 in. thick, and carries an armament of four 8-in. Q.F., fourteen 6-in. Q.F., twelve 12-pdrs., seven smaller, and four torpedo tubes. The 8-in. guns are in pairs in 6-in. barbettes and hoods, while the 6-in. guns are ten in 6-in. casemates and four in shields. She carries, with bunkers full, 1300 tons of coal. Particulars of some further examples of Elswick cruisers will be found in Table VII.

United States.—In the United States navy the proportion of "protected" cruisers is smaller than in the British navy, as the "armoured" type established itself at an earlier date. The *Philadelphia*, begun in 1888, may be taken as an example of the U.S. protected cruiser. She is 4345 tons in displacement and 327 ft. long, has twin screws and a horse-power of 8800, giving her a speed of 19·6 knots. She is protected by a steel deck 2½ in. to 4 in. thick, and carries twelve 6-in. B.L. guns (later converted to Q.F.), seventeen smaller guns, and five torpedo tubes. She has bunker capacity for 1175 tons of coal. The *Brooklyn* (Fig. 55, Plate XII.), begun in 1893, is of the "armoured" type. She is of 9215 tons displacement and 400 ft. long, has twin screws and develops 16,000 horse-power with forced draught, giving a speed of 21 knots. She is protected by a steel belt for two-thirds of her length 8 ft. broad and 8 in. to 3 in. thick, and a complete steel deck 6 in. to 3 in. thick. She carries eight 8-in. B.L. guns in pairs in



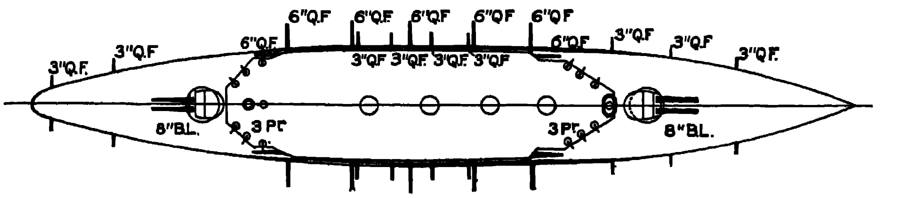
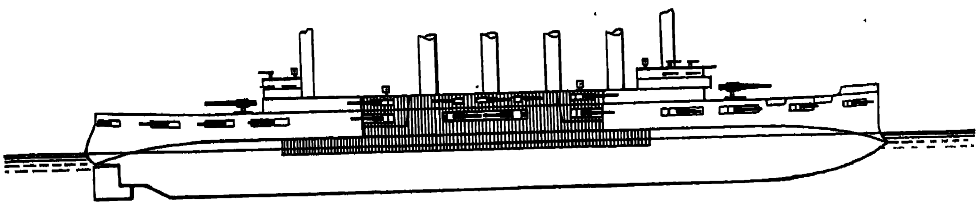


FIG. 68.—Plan of *California*.

15-in. barbettes—disposed one forward, one aft, and one on each beam—twelve 5-in. Q.F. guns in 4-in. shields, twenty smaller guns, and five torpedo tubes. Her normal coal stowage is 900 tons, and she can stow 1650 tons in her coal spaces.

In 1902 there were building, or projected, six armoured cruisers of the *California* class (Fig. 68), of 13,700 tons, and three of the *St Louis* class (Fig. 69), of 9700 tons. The former are vessels 502 ft. in length 70 ft. beam, and 26 ft. 6 in. draught, have machinery developing 23,000 indicated horse-power, and a speed of 22 knots. The latter are 424 ft. in length, 66 ft. beam, and



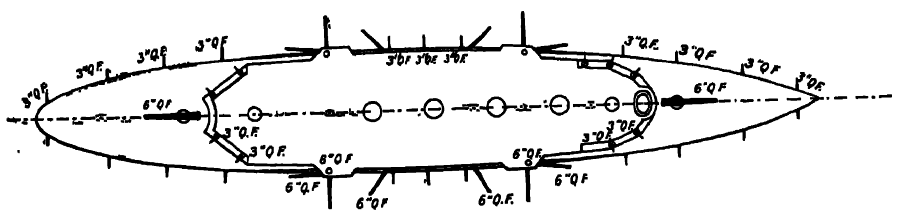


FIG. 69.—Plan of *St Louis*.

23 ft. 6 in. draught, with engines of 21,000 indicated horse-power, and the same estimated speed, namely, 22 knots. Both classes have fourteen 6-in. Q.F. guns, but the larger vessels have in addition four 8-in. guns in two 6½-in. turrets, besides a heavier battery of smaller Q.F. guns. The *California* class are completely belted with armour having a thickness of 6 in. over half the length amidships and 3½ in. to the ends, and a battery of 5-in. armour enclosing the 6-in. Q.F. guns, and extending to the upper deck. The *St Louis* class have only a water-line belt for about one-half the vessel's length, with a similar battery above it, the whole of the armour being 4 in. thick of Krupp quality. The *California*

TABLE VII.—*Showing Particulars of some of the Principal Types of Cruisers from the Time of the "Inconstant" to that of the "Monmouth."*

Country.	Name of Ship or Class.	Principal Dimensions. Displacement.	Length.	Beam.	Draught.	Indicated Horse-Power.	Speed.	Type of Machinery, &c.	Armament.	Protection. Deck.	Heavy Guns.	Secondary Guns.	Belt.	Date of Launch.	Remarks.
		Tons.	Feet.	Ft. In.	Ft. In.		Knots.								
Great Britain	Inconstant	5,780	337	50 8	24 3	4,200	14	Horizontal, trunk, surface-condensing Low-pressure boilers Single screw	10—9-in. R.M.L. 6—7-in. R.M.L. 6—20-pdrs.	...	...	...	...	1868	Unprotected
France	Duguay Trouin	3,661	296	43 4	21 10	4,400	15·9	Horizontal Single screw	5—6·4-in. B.L. 5—5·5-in. B.L. 4—3-pdrs.	...	...	...	...	1876	Unprotected
Great Britain	Comus	2,380	225	44 6	18 6	2,000	12·75	Horizontal, compound Single screw	4—6-in. B.L. 8—5-in. B.L. 8 machine-guns 2 torpedo tubes	Partial, 1½ in.	...	...	...	1878	Class, *Comus* herself 10—6-in. B.L. No 5-in.
Great Britain	Leander	4,300	300	46 0	19 6	5,000	16·6	Horizontal, compound Twin screw	10—6-in. Q.F.C. 4—3-pounders 12 small	Partial, 1½ in.	...	...	...	1882	Partially protected
France	Sfax	4,730	289	49 2	23 0	6,500	16·7	Horizontal, compound Twin screw	6—6·4-in. Q.F. 10—5·5-in. Q.F. 16 smaller 5 torpedo tubes	1½ in.	Shields	Shields	...	1884	Protected
Great Britain	Archer	1,770	225	36 0	14 9	3,500	16·5	Horizontal, compound Twin screw	6—6-in. Q.F.C. 8—3-pounders 2 machine 8 torpedo tubes	...	...	...	...	1885	Unprotected
Great Britain	Barham	1,830	280	35 0	12 7	4,700	19·0	Vertical. 3 expansion Twin screw	6—4·7-in. Q.F. 4—3-pounders 2 torpedo tubes	2 in.	Shields	...	...	1889	Protected Reboilered 1898
France	Dupuy de Lôme	6,700	374	51 6	23 6	14,000	20·0	2 sets, horizontal. 1 set, vertical. 3 expansion. 3 cylinder Three screws	2—7·5-in. B.L. 6—6·4-in. Q.F. 20 smaller 2 torpedo tubes	1½ in.	Turrets on beam, 4 in.	Shields	Complete, 4·7 in.	1890	Armoured
Great Britain	Apollo	3,400	300	43 0	16 6	9,000	20·0	Vertical. 3 expansion Twin screw	2—6-in. Q.F. 6—4·7-in. Q.F. 8—6-pounders 4 torpedo tubes	2 in.	Shields	Shields	...	1891	Protected
Japan	Yoshino	4,150	360	46 6	17 0	15,750	23·0	Vertical. 3 expansion Twin screw	4—6-in. Q.F. 8—4·7-in. Q.F. 22—3-pounders 5 torpedo tubes	4 to 5 in.	Shields	Shields	...	1892	Protected Elswick cruiser
Russia	Rurik	10,940	426	67 0	29 9	13,500	18·7	4 sets. 3 expansion Twin screw	4—8-in. B.L. 1—6-in. Q.F. 6—4·7-in. Q.F. 6 torpedo tubes	2 to 7 in.	Armoured sponsons	None	5 to 10 in.	1892	Armoured
United States	Columbia	7,375	412	58 2	23 0	21,300	22·8	3 sets, vertical. 3 expansion Boilers, 8 double-, 2 single-ended Three screws	1—8-in. B.L. 2—6-in. Q.F. 8—4-in. Q.F. 20 smaller 4 torpedo tubes	4 in.	Shields	2 in. to 4 in.	...	1892	Protected

Great Britain .	Powerful .	14,200	500	71 0	27 0	25,000	22·1	Vertical. 3 expansion. 4 cylinder Belleville boilers Twin screw	2—9·2-in. B.L. 12—6-in. Q.F. 16—12-pounders 4 torpedo tubes	6 in.	Rings and gun-houses, 6 in.	Casemates, 6 in.	...	1895	Protected
United States .	Brooklyn .	9,215	400	64 11	25 7	16,000	21·9	4 sets, vertical. 3 expansion Twin screw	8—8-in. B.L. 12—5-in. Q.F. 20 smaller 5 torpedo tubes	6 in.	Barbettes, 4. No 15-in. to 6·5-in.	4-in. Shields	3 in. to 8 in.	1895	Armoured
Great Britain .	Arrogant .	5,750	320	57 0	21 0	10,000	19·0	Vertical. 3 expansion Belleville boilers Twin screw	4—6-in. Q.F. 6—4·7-in. Q.F. 8—12-pounders 2 sub. tubes	3 in.	Shields	Shields	Bows only, 2 in.	1896	Protected
Russia . . .	Rossia .	12,200	464	68 0	26 0	18,000	20·2	3 sets, vertical. 3 expansion Belleville boilers Three screws	4—8-in. B.L. 16—6-in. Q.F. 12—12-pounders 36 smaller	2·7 in.	...	4 in.	Nearly complete, 9·8 in. H.	1896	Armoured
Germany . .	Fürst Bismarck	10,650	394	66 10	26 0	14,000	19·0	3 sets. 4 cylinder. 3 expansion Boilers, ¾ cylinder, ¼ water tube Three screws	4—9·4-in. B.L. 12—5·9-in. Q.F. 10—3·4-in. Q.F. 18 smaller 6 torpedo tubes	3 in.	Turrets, 8 in.	Turrets and casemates, 4 in.	Complete, 4 in. to 8 in.	1897	Armoured
Great Britain .	Hyacinth .	5,600	350	54 0	20 6	10,000	20·0	2 sets. 4 cylinder. 3 expansion Belleville boilers Twin screw	11—6-in. Q.F. 9—12-pounders 12 smaller 2 torpedo tubes	3 in.	Shields	Shields	...	1898	Protected
Japan . . .	Asama .	9,750	408	67 0	24 8	20,550	23·0	Vertical. 3 expansion Cylinder boilers Twin screw	4—8-in. B.L. 14—6-in. Q.F. 12—12-pounders 7 smaller 5 torpedo tubes	2 in.	Barbette, 6 in.	Casemates, 6 in.	5 in. above 7 in.	1898	Armoured Elswick cruiser
Germany . .	Gazelle .	2,800	328	39 0	14 0	9,000	20·2	2 sets. 4 cylinder. 3 expansion. Niclausse boilers. Twin screw	10—4·1-in. Q.F. 18 smaller 2 torpedo tubes	2 in.	...	...	...	1898	Protected
France . . .	Chateau Renault	8,000	443	55 9	22 6	23,000	23·0	3 sets. 3 expansion Normand - Sigaudy boilers Three screws	2—6·4-in. Q.F. 6—5·5-in. Q.F. 15 smaller 2 torpedo tubes	3 in.	Shields	Casemates, 1½ in.	...	1898	Protected
Italy . . .	Garibaldi .	7,400	344	59 8	23 4	13,500	20·0	2 sets. 3 expansion Niclausse boilers. Twin screw	1—10-in. B.L. 2—8-in. B.L. 14—6-in. Q.F. 10—12-pounders 8 smaller 4 torpedo tubes	1·0 in. and 1·6 in.	Barbettes, 6 in.	Shields	Complete, 3·2 in. to 6 in.	1899	Armoured
France . . .	Jurien de la Gravière	5,600	449	49 2	22 9	17,500	23·0	3 sets. 3 expansion Normand boilers Three screws	8—6·4-in. Q.F. 18 small 2 torpedo tubes	1·8 in.	Shields	...	...	1899	Protected
France . . .	Condé .	about 10,000	453	66 3	24 6	20,500	21·0	3 sets, vertical. 3 expansion Niclausse boilers Three screws	2—7·5-in. Q.F. 8—6·4-in. Q.F. 6—3·9-in. Q.F. 28 smaller 2 torpedo tubes	1·4 in. and 2 in.	Turrets, 6 in.	Turrets and casemates, 4 in.	2 in. 4 in. 6 in.	1900	Armoured
Great Britain . .	Drake .	14,100	500	71 0	26 0	30,000	23·0	2 sets. 4 cylinder. 3 expansion Belleville boilers, with economizer Twin screw	2—9·2-in. B.L. 16—6-in. Q.F. 14—12-pounders 12 smaller 2 torpedo tubes	Main, 1 in. Prot., 3 in.	Barbettes, 6 in.	Casemates, 5 in.	6 in.	1900	Armoured
Great Britain .	Monmouth	9 800	440	66 0	24 6	22,000	23·0	2 sets. 4 cylinder. 3 expansion. Belleville boilers, with economizer. Twin screw	14—6-in. Q.F. 10—12-pounders 11 smaller 2 torpedo tubes	¾ in. and 1¼ in.	Turrets, 4 in.	Casemates, 4 in.	4 in.	1901	Armoured

class comes between the English *Cressy* and *Drake* classes. The *St Louis* class is practically the English *Monmouth*, with about a knot less speed, bow-plating omitted, and a 4-in. battery added.

France.—A good example of the modern French cruiser is afforded by the *Jeanne d'Arc*, launched in 1899 at Toulon. She is about 11,300 tons displacement, 477 ft. in length, 63 ft. 8 in. beam, and 24 ft. 8 in. mean draught, has engines of 28,500 indicated horse-power, and a speed of 23 knots. In accordance with the usual practice of the French navy, she has a complete water-line armour belt of Harveyized steel, having a maximum thickness of 6 in., and the bow is also protected as far aft as the bow guns with $1\frac{1}{2}$ in. steel to the upper deck. Her armament consists of two 7·5-in. guns, fourteen 5·5-in. Q.F., twenty-two smaller guns, and two submerged torpedo tubes. Of more recent date than the *Jeanne d'Arc*, but smaller in size, is the *Montcalm* (Fig. 70, Plate XVII.), an armoured cruiser launched in March 1902, of 9500 tons displacement, 453 ft. length, 63 ft. 8 in. beam, and 24 ft. 6 in. draught. She carries an armament of two 7.6-in. guns in separate turrets of Harveyized steel 6 in. thick forward and aft, eight 6·4-in. Q.F. guns in casemates on the broadsides, four 3·9-in. Q.F. guns in shields on the broadsides, twenty-two smaller guns, and two submerged torpedo tubes. She is protected by a water-line belt $6\frac{1}{2}$ ft. deep which extends from the bow to within 30 ft. of the stern, where it is terminated by a transverse bulkhead 4 in. thick; amidship this belt is 6 in. thick at its upper edge, diminishing to 2 in. at its lower edge, where it meets the 2-in. protective deck, but the maximum thickness tapers to 3 in. at the forward and after ends. Above this main belt is a thinner one extending over the same length, but only $3\frac{3}{4}$ in. maximum thickness and of about 4 ft. depth. The *Montcalm* has 20 water-tube boilers of the Normand-Sigaudy type, and engines of 19,600 H.P., giving her a speed of 21 knots. She carries 1000 tons of coal and some oil fuel. Her engine-rooms are placed between the two sets of boiler-rooms, instead of abaft them, as is usual, her peculiar appearance, with two pairs of funnels widely separated, being thus accounted for. There were also in hand in France in 1902 three armoured cruisers of the *Gambetta* class, of about 12,400 tons displacement, length 480 ft., beam 70 ft. 3 in., draught 26 ft. 3 in., with an indicated horse-power of 27,500 and an estimated speed of 22 knots. These ships approach in size and type to the *Drake* class in H.M. navy, particulars of which are given on page 566. They compare very favourably so far as water-line protection is concerned, but there is considerable difference in the armament, the *Drake* having two 9·2-in. against four 7·6-in. in the *Gambetta* for main armament, and sixteen 6-in. Q.F. against sixteen 6·4-in. Q.F. for secondary armament.

Russia.—In 1902 the latest armoured cruiser added to the Russian navy was the *Bayan*, launched at La Seyne, June 1900. She has a displacement of 7800 tons, and is 445 ft. in length, 56 ft. 9 in. beam, and 22 ft. mean draught. Her armament consists of two 8-in., eight 6-in. Q.F., twenty 2·9-in. and seven 1·8-in. guns, and six torpedo tubes. Her armour consists of a water-line belt, having a maximum thickness of 8 in. Above the belt, and for a length of 335 ft. from forward, she is protected with 3-in. steel, which encloses the forward 8-in., six 6-in. Q.F., and the eight 2·9-in. guns, the two aft 6-in. Q.F. and aft 8-in. gun being separately protected. She has 26 Belleville boilers, engines of 16,500 I.H.P., and a speed of 21 knots, which it is expected will be maintained on a 24 hours' trial. The *Bogatyr* (Fig. 71, Plate XVII.), of 6570 tons, was launched at Stettin for the Russian Government in January 1901; she is a somewhat similar vessel to the *Variag*, of 6500 tons, built by Messrs Cramp, Philadelphia, in 1899. These two vessels are protected cruisers; the latter obtained a speed of 24·6 knots on the measured mile, and maintained a continuous speed of over $23\frac{1}{2}$ knots for $7\frac{1}{2}$ hours before leaving the builders' hands. Two more vessels of the *Bogatyr* type were building, and another was projected. Three other ships of approximately the same displacement, *Pallada* class, have also been added to the Russian navy, but these have a speed of only 20 knots. The *Gromoboi*, armoured cruiser of 12,336 tons, length 473 ft., beam $68\frac{1}{2}$ ft., and draught 26 ft., was launched in 1899. She has an indicated horse-power of 14,500, a speed of 20 knots, and carries an armament of four 8-in. Q.F., sixteen 6-in., twenty-four 3-in., and eight small Q.F. guns, &c., with four torpedo tubes. She has a partial armour belt of 6 in. Harveyized steel, and the main gun positions are also protected by 6-in. armour. A special type of vessel recently evolved, and now building for the Russian Government, is the light cruiser or enlarged torpedo-boat destroyer *Novik*, of which the following particulars have been published. Principal dimensions: displacement 3000 tons, length 361 ft., beam 40 ft. 1 in., draught 19 ft., armament six 4·7-in. Q.F. guns, nine smaller guns, and six above-water torpedo tubes. She has a 2-in. protective deck, 16 Belleville boilers, engines of 17,000 indicated horse-power, and a speed of 25 knots. Particulars of the armoured cruisers *Rurik* and *Rossia*, which excited so much attention at the time they were built, are given in Table VII., and the latter ship is shown by Fig. 72 (Plate XVII.).

Table VII. gives in chronological order particulars of the leading types of cruisers—armoured, deck-protected, and unprotected—of various nations, from the *Inconstant* of 5780 tons to the *Drake*, 14,100 tons, and *Monmouth*, 9800 tons, and shows the progress made in this type of warship during the period 1866–1900.

Gunboats and Torpedo Craft.

Gunboats include numerous small vessels which, even in times of general peace amongst the great maritime nations, have important duties allotted to them. For the patrolling of rivers and islands, protection of fisheries, &c., a battleship or a cruiser, from its size, would be unsuitable, and for the performance of these and other duties special vessels have been built. These types, and those included in the torpedo-craft division, may for our purposes be conveniently grouped under three headings, as follows:—

I. Sloops.
II. Gun-vessels and Gunboats.
III. Torpedo-Boats, Torpedo Gunboats, and Torpedo-Boat Destroyers.

Sloops. The *Wild Swan* class (Fig. 73, Plate XVIII.), the first of which was launched in 1876 for the British navy, represents one of the earliest of the sloop type. She was a single-screw composite-built vessel of 1130 tons displacement and 170 ft. length, with a speed under steam of $10\frac{1}{2}$ knots and an armament of two 6-in., six 5-in. B.L. guns, and four smaller guns. This proved a very useful class of ship, and in all sixteen of them were built. The *Beagle* class (Fig. 74, Plate XVIII.), commenced in 1889, represented an advance on the *Wild Swan*. They were built of steel, sheathed with wood and coppered, and had twin screws. Their displacement was 1170 tons, and they were 195 ft. long, steamed at 13 knots, and carried eight 5-in. B.L. guns and eight machine-guns. They were followed, at an interval of five years, by the *Torch* and *Alert*, the immediate forerunners of the *Condor* class, which were of 960 tons displacement, 180 ft. long, steamed at $13\frac{1}{4}$ knots, and carried an armament of six 4-in. Q.F. guns, four 3-pdrs., and two machine-guns. They were single-screw vessels, built of steel, sheathed and coppered. The *Condor* class, which comprises six vessels built between 1898 and 1901, are very slightly modified *Torches*, having 20 tons more displacement and 6 in. more beam, with the same length, speed, and armament. They are able, however, to maintain a higher continuous speed, being fitted with water-tube boilers. In 1902 there were under construction four sloops of the *Fantôme* class, which are larger vessels than the *Condors*, being 1075 tons displacement and 185 ft. long. They are twin-screw vessels, built of steel, sheathed and coppered. They have water-tube boilers, giving 1400 H.P., and will attain a speed of $13\frac{1}{4}$ knots. Their armament is similar to that of the *Condor*. All the foregoing vessels are fitted as sailing vessels as well as steam. The *Beagle* is schooner-rigged, the others all barque-rigged. In their general arrangements the differences between the above-described classes of vessels are not great, and the illustrations given of the *Wild Swan* and *Beagle* will serve to give a fair idea of the general appearance of all of them.

Gunboats. Of the gun-vessel or gunboat type, one of the earliest built for the British navy is represented by the *Staunch*, a twin-screw vessel designed by Mr G. W. Rendel, and built at Elswick in 1867. The guiding principle in the design of this vessel was that she should simply be a floating gun-carriage, propelled by steam and provided with plenty of manœuvring power. The 9-in. 12-ton gun which constituted her armament was arranged to sink into and be raised from a well by means of hydraulic power. She was only 180 tons in displacement and 75 ft. long, and had a speed of $6\frac{1}{2}$ knots. The *Medina* class (Fig. 75, Plate XVIII.), consisting of twelve gunboats built about 1876, were twin-screw vessels of 363 tons displacement and 110 ft. length, and had a speed of $8\frac{1}{4}$ knots. Their armament was light, consisting only of three 64-pdrs. and three machine-guns. They were fitted with bow rudders in addition to those at the stern, in order to increase their manœuvring power. In the *Cockchafer* class (1881) and the *Thrush* class (1889) successive increases of size and speed were made. The former, of which four were built, are composite-built single-screw ships of 465 tons displacement and 125 ft. length, with a fore-and-aft rig and a speed under steam of $9\frac{1}{2}$ knots. The latter, of which there are nine, are schooner-rigged composite vessels of 805 tons displacement and 165 ft. length, with a single screw and a speed of $13\frac{1}{2}$ knots. The armament of the *Cockchafers* consisted of two 64-pdr. R.M.L. guns, two 20-pdr. R.B.L. guns, and two machine-guns; that of the *Thrush* (Fig. 76, Plate XVIII.) consisted of six 4-in. B.L. guns and four smaller guns. The *Bramble*, launched in 1898, is a

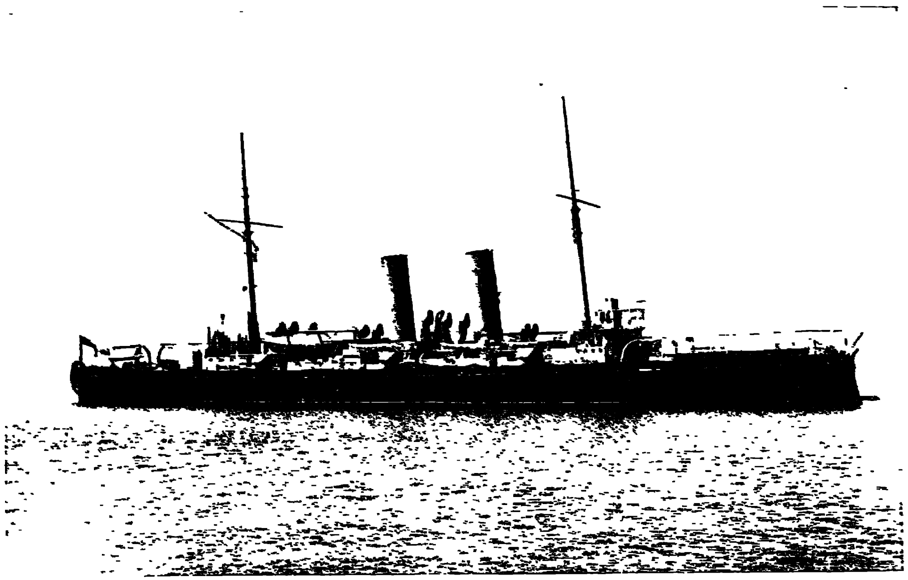


Fig. 60.—H.M.S. *Edgar.*

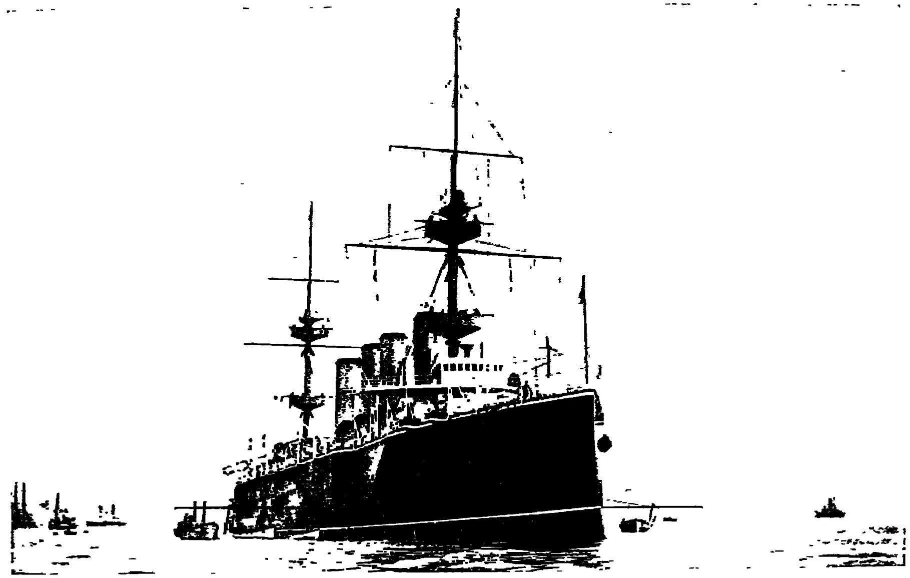


Fig. 61.—H.M.S. *Powerful.*

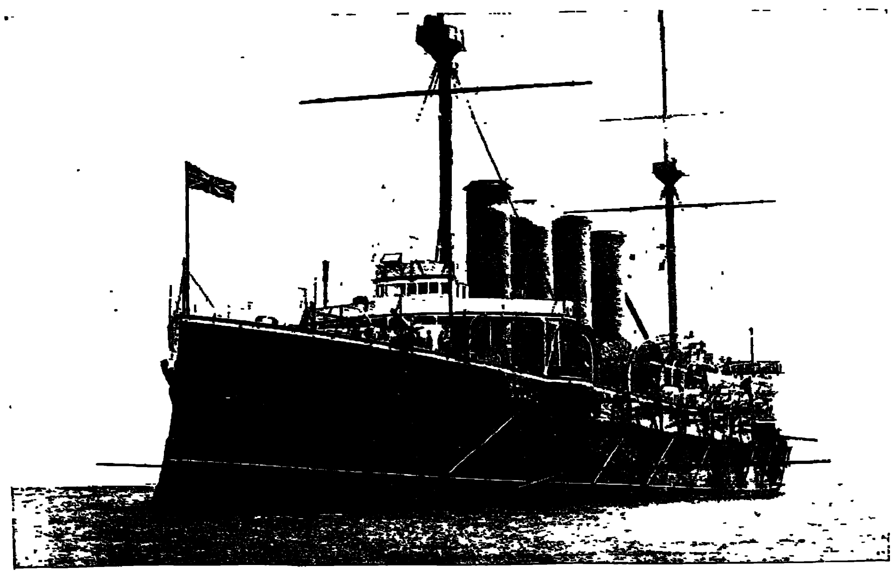


Fig. 62.—H.M.S. *Diadem.*

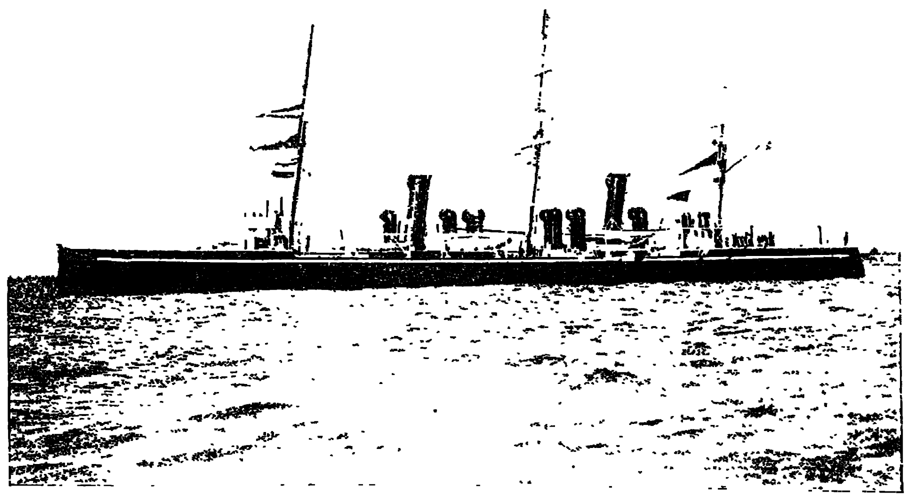


Fig. 63.—H.M.S. *Barham.*

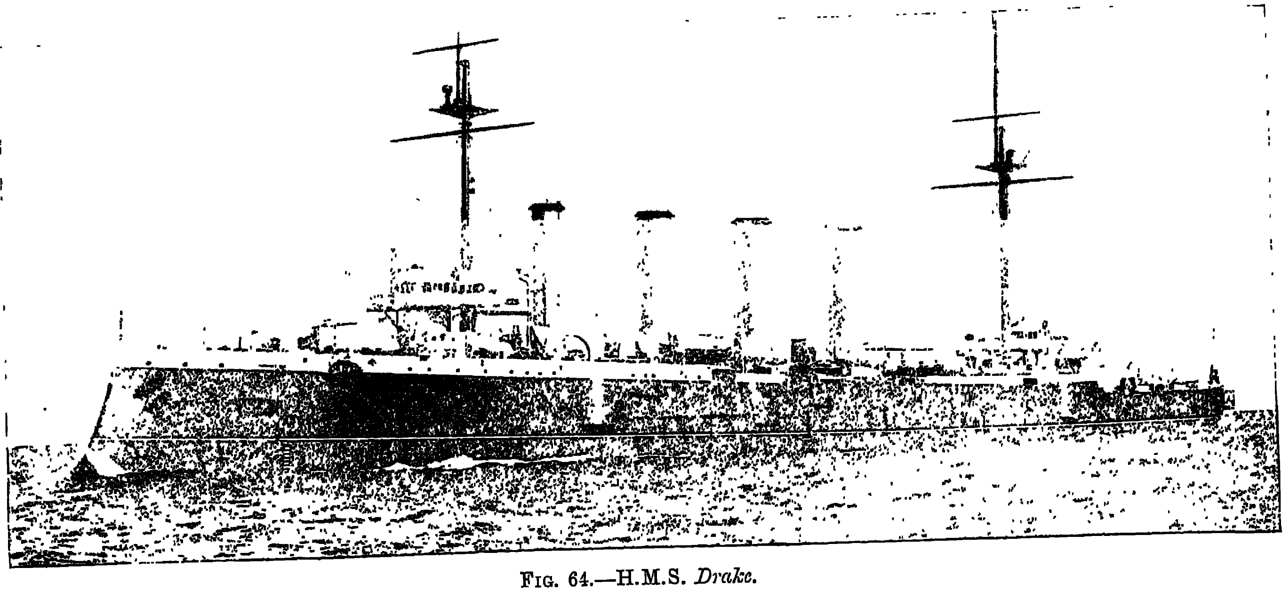


FIG. 64.—H.M.S. *Drake*.

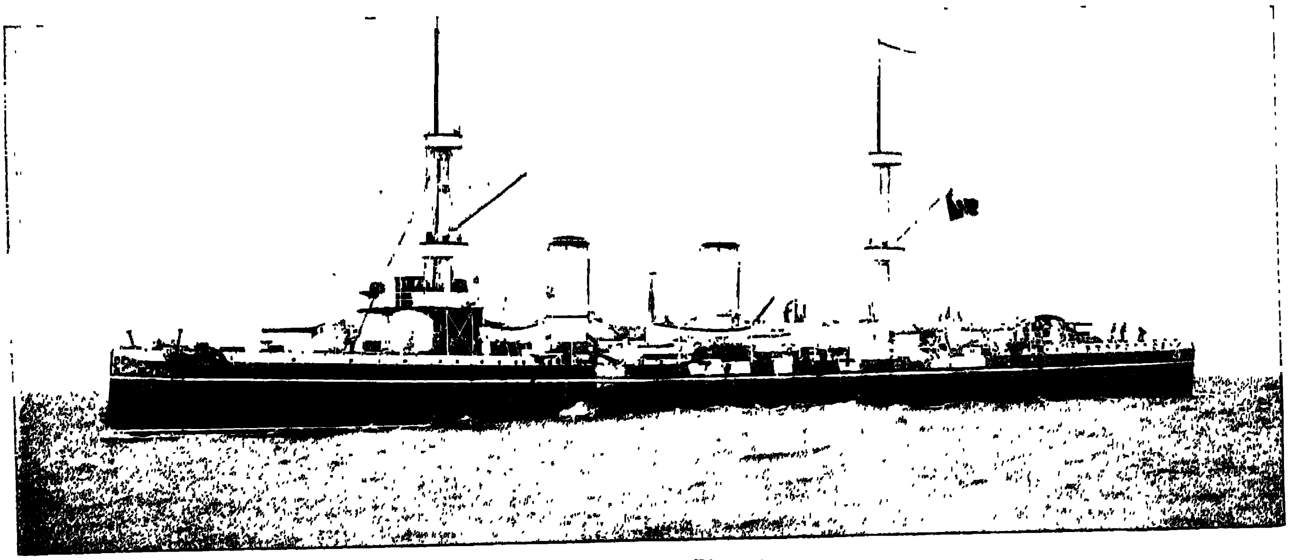


FIG. 65.—Italian *Piemonte*.

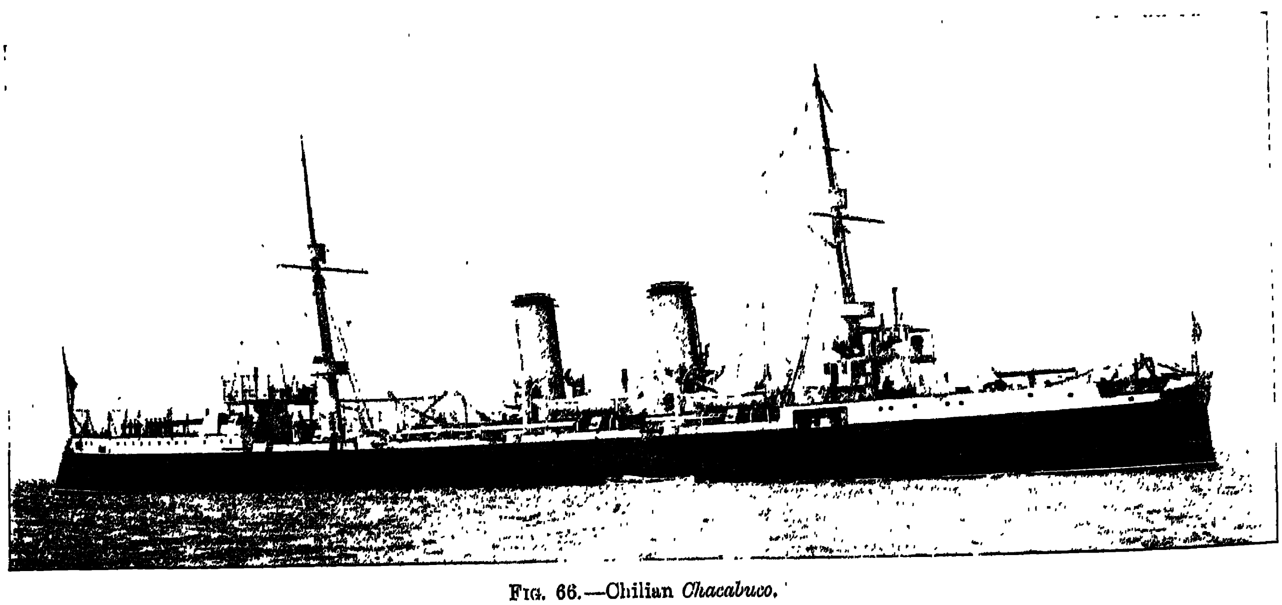


FIG. 66.—Chilian *Chacabuco*.

representative of the most recent type of first-class gunboat. Her displacement is 700 tons, or 105 less than the *Thrush*. She is 180 ft. long and has a speed of 13½ knots, is built of steel, sheathed and coppered, and carries two 4-in. Q.F. guns, 4 12-pdrs., and ten machine-guns. She has water-tube boilers, twin screws, and a light fore-and-aft rig. Four of these vessels have been built.

A number of gun-vessels have been designed for special services, among which may be mentioned the *Mosquito* and *Herald* (Fig. 77, Plate XVIII.), two stern-wheel steamers for the Zambezi built by Messrs Yarrow in 1890. They are of 80 tons displacement and 77 ft. long, having a speed of 10½ knots and carrying an armament of four 3-pdrs. and eight machine-guns. They are built in sections, each of which forms a separate pontoon, so that the whole vessel can be readily taken to pieces for transport and easily put together in the water. Built for somewhat similar service but of different design are the six shallow-draught river gunboats of the *Sandpiper* class. They are steel twin-screw boats, built in 1897, also by Messrs Yarrow. They are 88 tons in displacement, 100 ft. long, and 20 ft. broad, and carry an armament of two 6-pdrs. and four machine-guns. Their speed is 9 knots, and they draw only 2 ft. of water, their screws working in arched tunnels, the summits of which are above the water-level outside. These arches always remain full of water, and serve the double purpose of enabling sufficiently large screws to be fitted for the economical propulsion of the vessel without increasing the draught, and of protecting them from damage. Two of these boats have been in service on the Niger, two in South Africa, and two on the Chinese station. In appearance they are somewhat similar to the *Mosquito*. The *Woodcock* and *Woodlark* are larger vessels of the same type, designed for service on the rapid and shallow rivers of China. They were built by Messrs Thornycroft in 1897, are 120 tons in displacement, 145 ft. long, 23 ft. beam, and 2 ft. draught of water. They have twin-screws, also carried in arched tunnels, and their speed is 15 knots. They carry the same armament as the *Sandpiper* class. In 1902 the two latest examples of this type of vessel built for the British navy, the *Teal* and *Moorhen*, designed for service in China, were also constructed in sections, but are considerably larger than either the *Mosquito* or the *Woodcock*, being about 180 tons displacement. They are twin-screw vessels, the propellers being in tunnels, as in the *Woodcock*, and their speed is over 13 knots. Their furnaces will burn wood. They carry two 6-pdrs. and four machine-guns.

Figs. 78 and 79 (Plate XVIII.) show a light-draught gunboat of the *Sultan* class, of which several have been built for service on the Nile. She has a displacement of 140 tons, a length of 143 ft., a beam of 24 ft. 6 in., a draught of only 2 ft., and a speed of 12 knots. Her armament consists of one 12-pdr., one howitzer, and four Maxims, and she is protected by a ⅛-in. bullet-proof breastwork.

Other Countries.—The gunboats of other navies are generally similar to those described above. Fig. 80 (Plate XIX.), which represents the *Iota*, is typical of eleven twin-screw gunboats built at Elswick for the Chinese Government between the years 1876 and 1881, and named after letters of the Greek alphabet, but afterwards given Chinese names. They were of 440 tons displacement and 126 ft. long, and had a speed of 10¼ knots; they carried one 11-in. 35-ton gun forward and two 12-pdrs. aft. The 35-ton gun could only be trained by moving the boat, but it could be loaded and elevated by hydraulic power. The *Palumah* and *Gagundah* (Fig. 81, Plate XIX.) were built at Elswick in 1884 for the Queensland Government. They have a displacement of 360 tons and are 115 ft. in length, were schooner-rigged, but had twin screws and a speed under steam of 10 knots. They carried one 8-in. B.L. gun forward, which was mounted behind a breastwork and had a considerable arc of training; one 6-in. gun, which was mounted aft; and three machine-guns. The *Protector* was a more important craft. Built for the Government of South Australia in 1884, she was 920 tons in displacement and 180 ft. long, had twin screws and a speed of 14 knots under steam. She carried one 8-in. B.L. gun forward, mounted as in the *Palumah*, five 6-in. 4-ton guns, and five Gatlings. The Brazilian twin-screw gunboat *Tiradentes*, built in 1892, of steel sheathed with teak and coppered, was only 165 ft. long and 800 tons displacement, but attained a speed of 14·5 knots. She had an armament of four 4·7-in. guns, three 6-pdrs., and four machine-guns, and carried a considerable spread of canvas.

In torpedo gunboats and torpedo craft generally, possibly the last thirty years of the 19th century showed more development and greater diversity than in any other type of war vessel now existing. The first small high-speed boat we have any record of is the *Miranda*, built by Messrs Thornycroft early in 1872. She was 45 ft. in length, 6½ ft. beam, and 2½ ft. draught, and attained a speed of 16·4 knots with a single screw, the engine running at 355 revolutions per minute and indicating 58 H.P. The results obtained with her attracted much attention, and the following year Messrs Thornycroft launched for the Norwegian Government a somewhat larger boat, armed with a spar torpedo, which attained a speed of 15 knots. The first torpedo-boat for the British navy was built by Messrs Thornycroft four years later; she was called the *Lightning*, was 75 ft. in length and 34 tons displacement, had engines giving nearly 500 H.P., and obtained a speed of 19 knots. She was armed with a single torpedo tube. The boats which followed varied somewhat as regards size and speed, but on the whole pursued the usual course of growing larger and more powerful with each new design. By 1885 the length had gone up to 150 feet, the displacement to 125 tons, and the speed to 20 knots. This last was not the highest that had been obtained, some of the earlier and smaller boats having reached 21½ knots; but the boats of 1885 carried a heavier armament, consisting of six 3-pdrs. and three torpedo tubes, and were more serviceable and seaworthy craft.

Torpedo craft.

The torpedo-boat thus established was primarily a weapon of offence, the only two elements of a protective nature in its design being those of small size and high speed; but even these were also necessary for purposes of offence. The deadly nature of their attack, and the difficulty of meeting it in the ship attacked, led to the construction of special vessels intended, among other duties, to

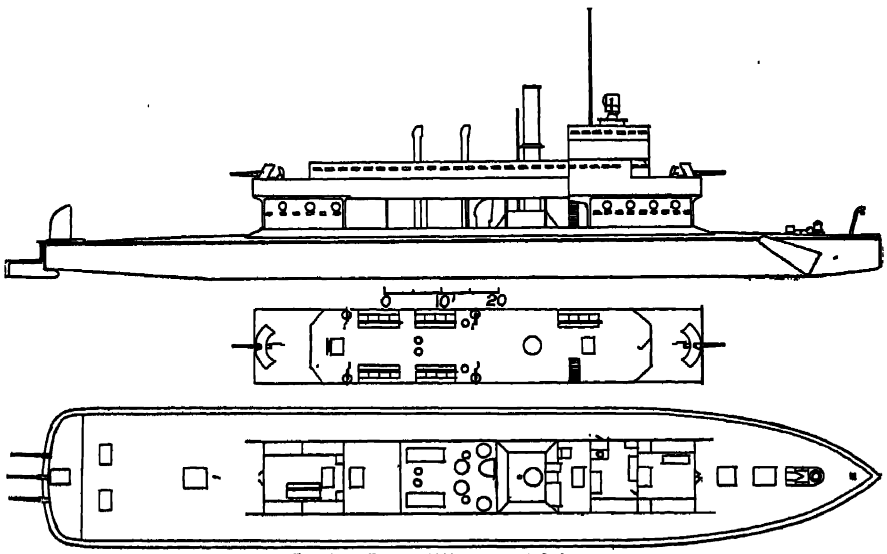


FIG. 78.—Plan of Nile gunboat *Sultan*.

meet and destroy them. The French *Bombe* (1885) was one of the earliest of these; and the *Rattlesnake* and three sister vessels, the first of the English torpedo gunboats, came closely after her. The *Rattlesnake* (Fig. 82, Plate XIX.) was launched in 1886, was of 525 tons displacement, and had a speed of 19¼ knots. She carried a more powerful armament than the torpedo-boats, namely, one 4-in. gun, six 3-pdrs., and 4 torpedo tubes. She was followed in 1888 by the *Sharpshooter*, with ten sister vessels, which were still larger and more heavily armed. They were 230 ft. long and 735 tons displacement, had engines developing 3500 H.P., giving a speed of 19 knots, and carried two 4·7-in. Q.F. guns, four 3 pdrs., and two torpedo tubes. Fig. 83 (Plate XIX.) shows one of this class, the *Karrakatta*, built at Elswick for service in Australian waters. The *Niger* (Fig. 84, Plate XX.) class of 1892, which included eleven vessels, were repeats of the *Sharpshooters*, except that they carried an additional torpedo tube and three machine-guns, with certain hull additions and more durable machinery, the displacement being increased by these causes to 810 tons, and the speed being reduced by a quarter of a knot. In 1893 a fourth series of this class of vessel was begun, known as the *Dryad* class, and considerably larger than the *Nigers*, being 250 ft. long and of 1070 tons displacement. They are of 3500 I.H.P., have a speed of 18¼ knots, and carry an armament of two 4·7-in. Q.F. guns, four 6-pdrs., and three torpedo tubes. Five vessels of this class were built, the difference between their general appearance and that of the preceding classes being illustrated by Fig. 85 (Plate XX.), which shows the *Hazard*, a vessel of this class, now employed on special service in connexion with the reception and trials of British submarines. In these thirty-one vessels of the torpedo

gunboat class the elements of strength and seaworthiness are developed at the expense of speed, and they combine in themselves some of the functions of the torpedo-boat with many of the most important features of the small cruiser. The successive increases of displacement are very largely due to additions to the hull, giving greater habitability and trustworthiness for continuous work at sea. It will be noticed that the speed shows a continuous falling off; but the *Sharpshooter* class and subsequent vessels are being refitted with water-tube boilers in lieu of the locomotive boilers originally fitted, and some of them are in addition being re-engined, with the result that a speed of 21 knots is now obtained; this, in the ordinary weather met with at sea, would probably enable them to overtake craft of lighter types possessed of considerably greater smooth-water speeds.

Torpedo-Boat Destroyers were primarily, as their name implies, intended to meet and destroy torpedo-boats, their larger size, greater coal capacity, heavier armament, and higher speed enabling them to overtake such boats before they could complete their attack; but it soon became evident that these additional powers also enabled the destroyer to perform the duties of the torpedo-boat more efficiently than the boat herself, and with the advent of the destroyer the production of the smaller boat declined. At the present time it is doubtful whether the offensive power of the destroyer, regarded as a torpedo-boat for use against an enemy's fleet or ports, is not of more importance than her protective power to the fleet or port to which she is attached.

The pioneers of this type of vessel were the *Daring*, *Decoy*, *Havock*, and *Hornet*, the construction of which was entered upon in July 1892, the two first-named at Messrs Thornycrofts and the other two at Messrs Yarrows. They were thus contemporary with the *Dryads*, the last of the torpedo gunboats. The *Daring* and *Decoy* were 185 ft. long, 19 ft. broad, 6½ ft. mean draught, and 265 tons displacement, had 4200 H.P., and reached a speed of 27 knots. They were armed with one 12-pdr., three 6-pdr. Q.F. guns, and three torpedo tubes. The *Havock* and *Hornet* were somewhat smaller, being 5 ft. shorter, 6 in. less beam, and 25 tons less displacement, and they carried the same armament. The *Havock* developed 3000 H.P. and had a speed of 26 knots; the *Hornet*, 3800 H.P. and 27 knots. The success of these four vessels was followed with great interest, and in the following year (1893) six others were begun, three of 26 knots speed and three of 27 knots; but the size went up to a displacement of 250 to 290 tons, and a length of 190 to 200 ft., while the power ranged between 3000 and 4400 H.P. A much greater number of destroyers (32 in all), nearly the whole of which were of 27 knots speed, were laid down in 1894. The sizes of these boats varied considerably, the displacement ranging from 265 to 295 tons and the length from 190 to 208 ft., while the power varied between 3600 and 4500 H.P. The succeeding year (1895) saw a great advance in size, power, and speed, thirteen destroyers being laid down, for each of which the contract speed was 30 knots. The displacement varied from 300 to 360 tons, the lengths from 208 to 215 ft., and the power from 5700 to 6200 H.P. Since 1895 these 30-knot destroyers have been built in considerable numbers; and although in 1896 an attempt was made to realise

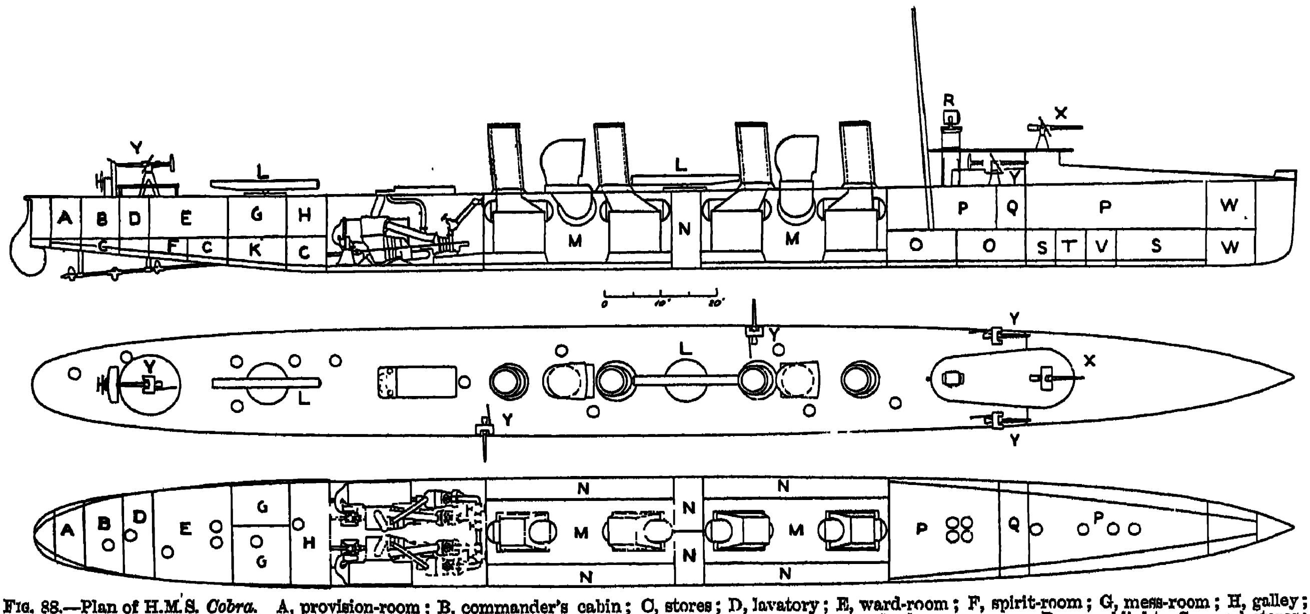


FIG. 88.—Plan of H.M.S. *Cobra*. A, provision-room; B, commander's cabin; C, stores; D, lavatory; E, ward-room; F, spirit-room; G, mess-room; H, galley; K, torpedo heads; LL, torpedo tubes; MM, boiler-rooms; N, coal; O, magazines; P, crew's space; Q, dynamo-rooms; R, searchlight; S, naval stores; T, provision-room; V, slop-room; W, chain locker; X, 12-pdr. Q.F. gun; Y, 6-pdr. guns.

even greater speeds than this, it was found that the power and cost necessary for the addition of a few knots were disproportionate to the value of the results obtained, and the attempt has not been followed by any general increase of speed above 30 to 31 knots. The general appearance of a typical modern destroyer is shown by Fig. 86 (Plate XX.), which represents the *Albatross* at full speed. She was built in 1896 at Messrs Thornycrofts' works, is 225 ft. long, 21¼ ft. broad, 7½ ft. mean draught, and about 380 tons displacement. Her I.H.P. is 7500, and she has a speed of 31¼ knots, which makes her the fastest destroyer at present in the British navy. She carries one 12-pdr., five 6-pdrs., and two torpedo tubes.

Particulars of some other destroyers will be found in Table VIII., which also gives particulars of many other British and foreign torpedo vessels of various types which have been built between the time of the *Miranda* and that of the *Cobra*, some of which are not described in the text.

Turbine-Steamers.—While, however, the attempt to obtain speeds greater than 31 knots from torpedo-boat destroyers by the expedient of putting into them the lightest and most powerful boilers and reciprocating engines has not been completely successful, considerably greater speeds have been actually obtained by the adoption of turbine machinery. Experience with the marine steam turbines, the invention of the Hon. C. A. Parsons, dates only from the time of the *Turbinia* (Fig. 87, Plate XXI.), which made her successful trials in 1898 after much investigation and preliminary work on the part of the inventor. This boat had a length of 100 ft., a breadth of 9 ft., a draught amidships of 3 ft., and a displacement of 44½ tons, and she attained a speed of 34½ knots with 2200 revolutions per minute and an estimated H.P. of 2300. The turbine machinery consisted of three separate turbines directly coupled to three screw shafts and working in series, one turbine being high pressure, one intermediate, and one low pressure. Each screw shaft carried three propellers, the total number of propellers thus being nine; the weight of main engines was approximately 3 tons 13 cwt., and the total weight of machinery and boiler, screws and shafting, tanks, &c., 22 tons. The boilers are of the water-tube type, with a working pressure of 225 ℔ per square inch.

The *Turbinia* was followed by the *Cobra* (Fig. 88) and *Viper* torpedo-boat destroyers, which had a length of 210 ft., a breadth of 21 ft., and a mean draught of 6 ft. 9 in. The machinery of these boats consisted of two sets, one on each side of the ship; each set had two expansions and drove two shafts (making four shafts in all), and the outer shaft on each side was driven by a high-pressure turbine, from which the steam passed to a low-pressure turbine on the inner shaft and thence to the condenser; on the inner shaft also was a small turbine, added for going astern, the steam turbine not being adapted for reversal. Steam was supplied by water-tube boilers of the express type. These vessels attained a speed of upwards of 34 knots, the revolutions of the engines approaching 1200 and the power being estimated at about 12,000 H.P. At the time of their completion these were the fastest vessels of any type afloat, but both were unfortunately lost at sea,

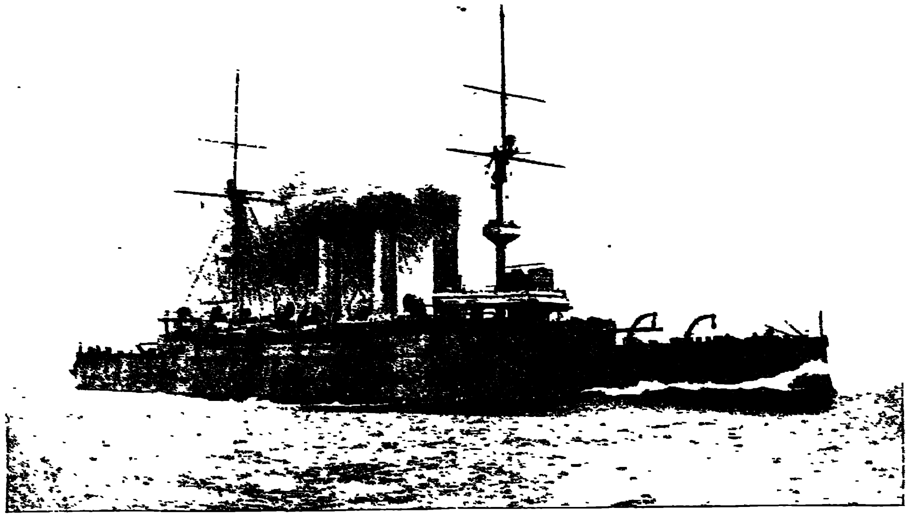


FIG. 67.—Japanese *Idzumo.*

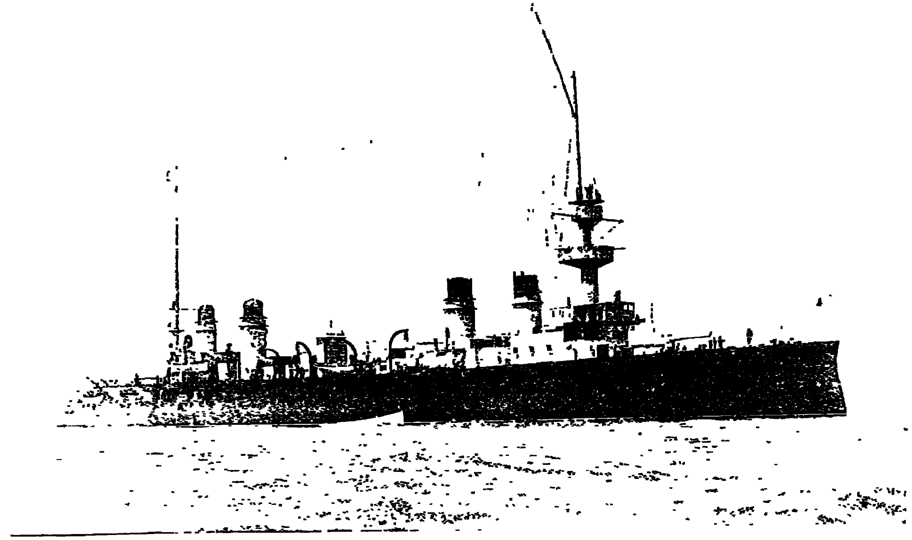


FIG. 70.—French *Montcalm.*

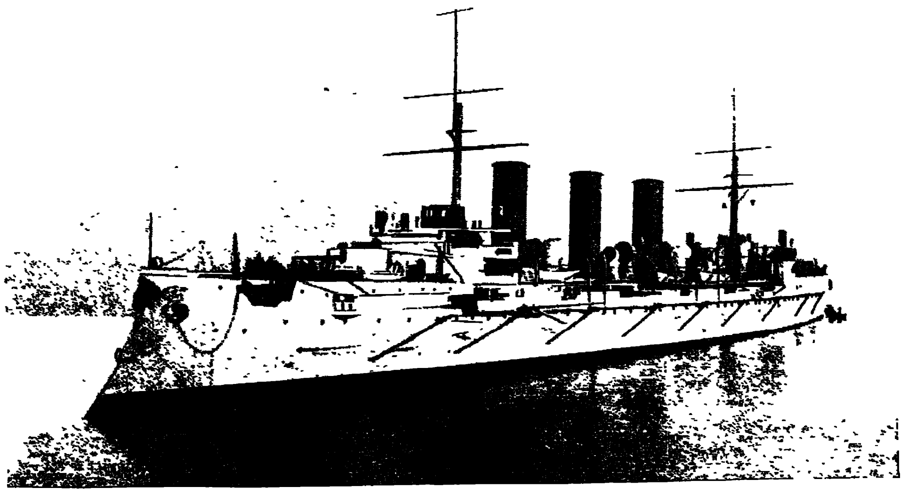


FIG. 71.—Russian *Bogatyr.*

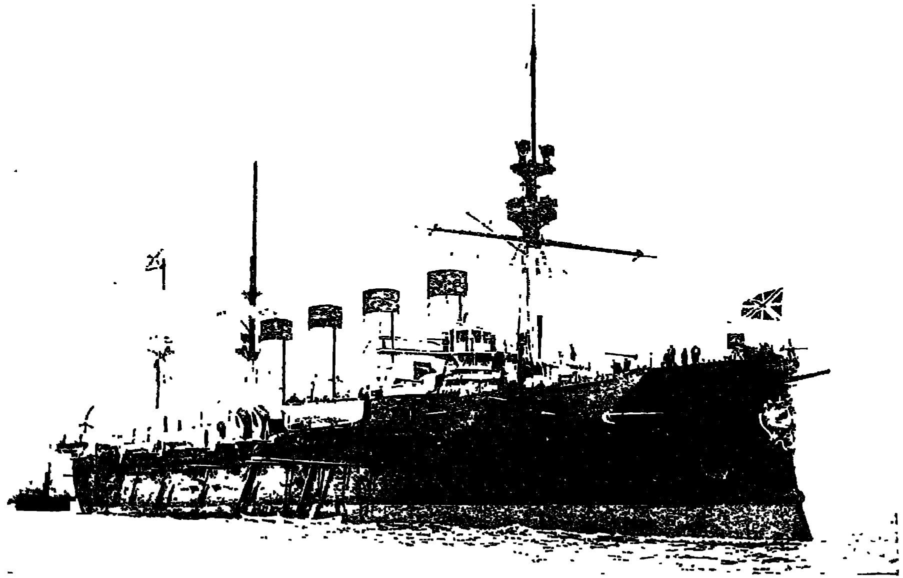


FIG. 72.—Russian *Rossia.*

PLATE XVIII.

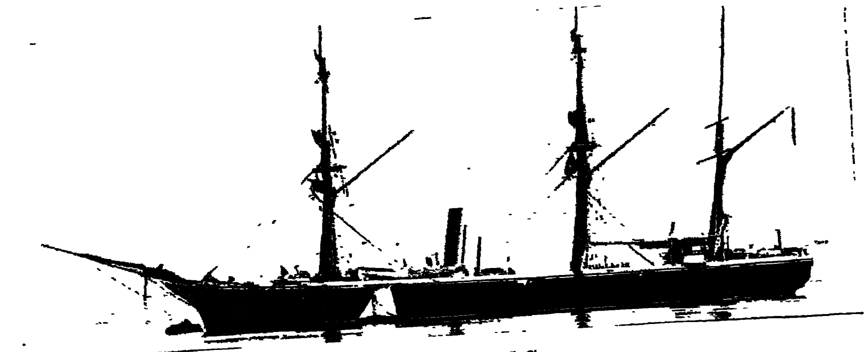


FIG. 73.—H.M.S. *Wild Swan.*

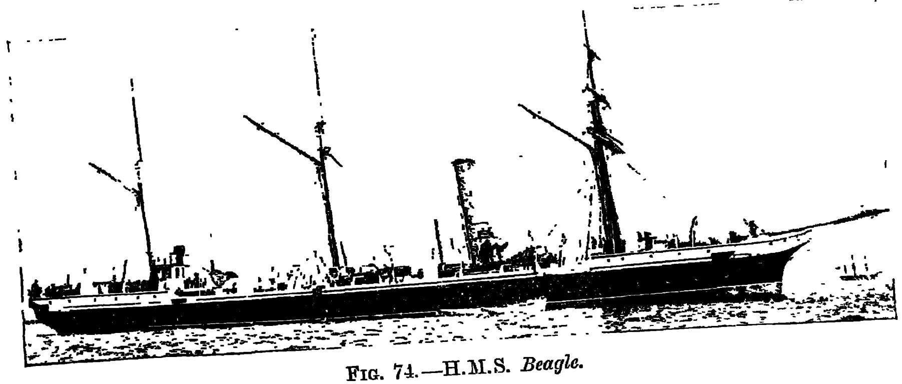


FIG. 74.—H.M.S. *Beagle.*

FIG. 75.—H.M.S. *Medina.*

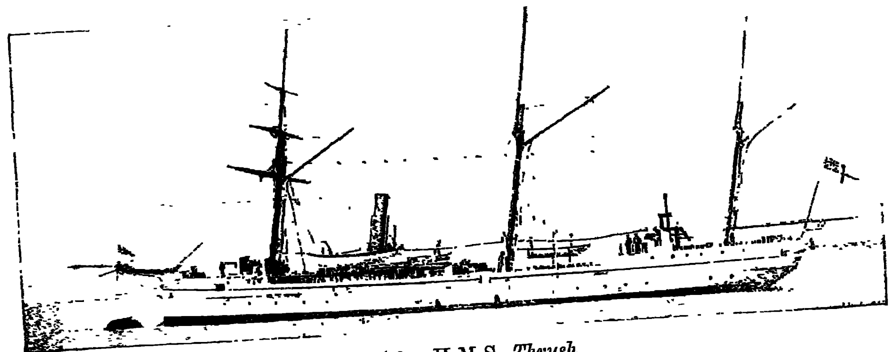


FIG. 76.—H.M.S. *Thrush.*

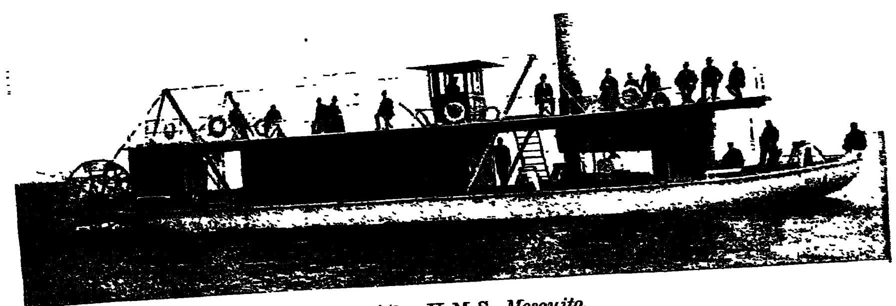


FIG. 77.—H.M.S. *Mosquito.*

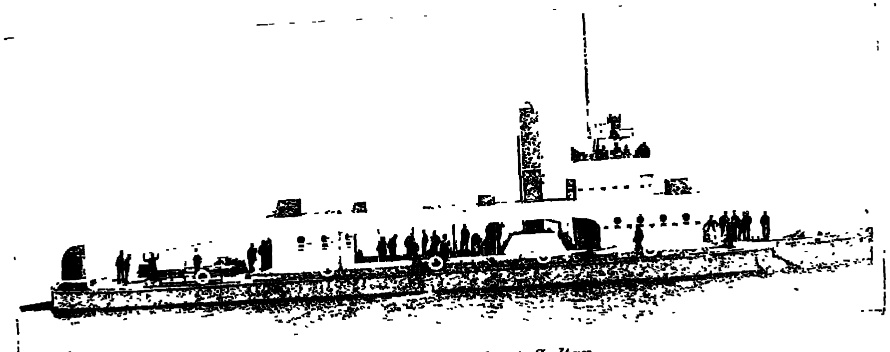


FIG. 79.—Nile Gunboat *Sultan.*

the *Viper* after a very short period of service being run upon the Renouquet Rock in the Channel Islands, and the *Cobra* being lost at sea on her first voyage from the contractor's works.

While the idea of the torpedo-boat destroyer originated in Great Britain, and the first boats of the type were built for the British navy, foreign Powers were not slow in availing themselves of the results obtained, and large numbers of torpedo-boat destroyers have been added to the fleets of foreign navies, the boats built by Messrs Schichau of Germany and Normand of France having especially achieved success in the attainment of high speeds on trial, while the boats of the *Bainbridge* class, built for the U.S. navy by Neafie and Levy of Philadelphia, William R. Trigg and Co., Richmond, Va., the Union Iron Works of San Francisco, and other American firms, are among the largest, fastest, and most seaworthy of the class afloat. Fig. 89 (Plate XXI.) shows the general appearance of these vessels; they are 245 ft. long, 23 ft. 7 in. wide, draw 6 ft. 6 in. of water, and have a displacement of 420 tons. Their sea-going speed is 29 knots, and their armament consists of two 18-in. torpedo tubes, two 3-pdr. Q.F. guns, and five 6-pdrs. The Japanese navy possesses in the *Niji* class (Fig. 90, Plate XXI.) a number of very fast and seaworthy destroyers. They are of approximately the same dimensions as the most recent British vessels of this type, were built by Messrs Yarrow, and obtained on trial speeds in excess of 31 knots.

Table IX. shows warships effective, building, or projected for the principal navies of the world. This table shows there are now built or projected 1346 torpedo-boats, having an average displacement of 76 tons, of which France owns 317, Russia 188, Italy 151, Germany 121, Great Britain coming fifth with 107, and of these 107 only four have been added since 1885. Further reference to this table shows that Great Britain takes the lead with torpedo-boat destroyers and torpedo gunboats in a very marked manner.

Submarine Boats.

Since about 1880 much attention has been paid by several of the naval Powers to the development of the submarine boat. The United States and France, in particular, have given special encouragement to workers in this direction; and this encouragement, combined with the fascination which the subject has for many minds, has led to the construction of a number of boats and to many experiments.

The history of the subject goes back at least 300 years, but the first undoubted success with a submarine vessel

TABLE VIII.—*Particulars of Various Types of Torpedo Craft from 1872 to 1900.*

Vessel's Name.	Country.	Where built.	Date of Launch.	Principal Dimensions, &c.							No. of Screws.	Horse-power.	Speed.	Armament, &c.
				Length.		Beam.		Draught.		Displ.				
				Ft.	In.	Ft.	In.	Ft.	In.	Tons.			Knots.	
Miranda	Great Britain	Messrs Thornycroft, London	1872	45	0	6	6	2	6	...	1	58	16·4	*Nil.* Experimental boat.
1st Torpedo-Boat built	Norway	,,	1873	57	0	7	6	3	0	...	1	...	15·0	1 spar torpedo.
Lightning (afterwards No. 1 T.B.)	Great Britain	,,	1877	75	0	10	10	5	0	34	1	477	19·0	Single torpedo tube.
No. 10 Torpedo-Boat	,,	,,	1880	90	6	10	10	4	0	28	1	450	21·7	1 torpedo tube.
Swift (afterwards No. 81 T.B.)	,,	Messrs J. S. White & Co., Cowes	1885	150	0	17	6	...		125	1	...	20·0	6—3-pdrs., 3 torpedo tubes.
Falke	Austria	Messrs Yarrow, London	1885	135	0	13	9	5	8	95	1	900	22·4	2 mach. guns, 2 torp. tubes.
Bombe	France	Havre	1885	196	10	21	7	5	11	420	2	1,800	19·0	3—3-in. Q.F., 3 mach., 2 tubes.
El Destructor	Spain	Messrs J. & G. Thomson, Clyde	1887	192	6	25	0	7	0	385	2	3,800	22·7	1—4-in. Q.F., 4—6-pdrs., 3 tubes.
1st-class Torpedo-Boat	China	Elbing	1886	144	4	16	5	7	6	128	1	1,500	24·2	4—1-pdr., 2 torp. tubes.
Rattlesnake	Great Britain	Messrs Laird Bros., Birkenhead	1886	200	0	23	0	9	0	550	2	2,700	19·25	1—4-in., 6—3-pdrs., 4 tubes.
Sharpshooter	,,	Devonport	1888	230	0	27	0	8	3	735	2	3,500	19·0	2—4·7-in. Q.F., 4—3-pdrs. 2 tubes.
Kazarsky	Russia	Elbing	1890	190	0	24	0	8	6	400	2	3,500	23·0	9—1·8-in. Q.F., 3 tubes.
Niger	Great Britain	Vickers, Sons & Maxim, Barrow	1892	230	0	27	0	9	0	810	2	3,500	18·75	2—4·7-in. Q.F., 4—3-pdrs., 3 mach., 3 tubes.
Dryad	,,	Chatham	1893	250	0	30	6	9	0	1070	2	3,500	18·25	2—4·7-in. Q.F., 4—6-pdrs., 3 tubes.
Daring	,,	Messrs Thornycroft, London	1893	185	0	19	0	7	0	240	2	4,300	27·5	1—12-pdr., 3—6-pdrs., 3 tubes.
Swordfish	,,	Armstrong, Whitworth, Elswick	1895	200	0	19	0	6	0	260	2	4,500	27·6	1—12-pdr., 5—6-pdrs., 2 tubes.
Sokol	Russia	Messrs Yarrow	1895	190	0	18	6	7	0	240	2	4,400	29·7	1—12-pdr., 8 others, 2 tubes.
Forban	France	Messrs Normand	1895	144	2	15	2	10	0	135	2	3,200	31·2	2—1-pdrs., 2 tubes.
Corrientes	Argentina	Messrs Yarrow	1896	190	0	19	6	7	4	280	2	4,000	27·4	1—14-pdr., 2 tubes.
Chamois	Great Britain	Messrs Palmer	1896	215	0	20	9	7	3	360	2	6,333	30·2	1—12-pdr., 5—6-pdrs., 2 tubes.
Express	,,	Messrs Laird Bros.	1897	235	0	22	0	9	0	430	2	9,500	31·0	,, ,,
Gipsy	,,	Messrs Fairfield Co.	1897	227	6	22	0	9	0	300	2	6,000	30·0	...
Turbinia	,,	Hon. C. A. Parsons	1897	100	0	9	0	3	0	$44\frac{1}{2}$	6	2,100	32·75	*Nil.* Experimental boat.
Albatross	,,	Messrs Thornycroft	1898	227	6	21	3	8	6	360	2	8,000	31·5	1—12-pdr., 5—6-pdrs., 2 tubes.
Cobra	,,	Armstrong, Whitworth, Elswick	1899	210	0	21	0	6	9	350	8	12,000	34·0	1—12-pdr., 5—6-pdrs., 2 Hotchkiss, 2 tubes.
Bailey	United States	Morris Heights	1899	205	0	19	0	6	0	235	2	5,000	30·0	4—6-pdrs., 2 tubes.
Lawrence	,,	Weymouth, Mass.	1900	242	3	22	3	6	2	400	2	8,400	30·0	2—12-pdrs., 5—6-pdrs., 2 tubes.

TABLE IX.—*Warships—Effective, Building, and Projected.*

		Battleships.						Cruisers. 1st Class.						Cruisers. 2nd and 3rd Classes.					
		Great Britain.		France.		Russia.		Great Britain.		France.		Russia.		Great Britain.		France.		Russia.	
		Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.
Dates of Launches.	Before 1881	10	85,520	9	77,216	1	9,891	..	..	..	..	..	..	2	7,460	..	..	4	18,908
	1881–1885	7	70,140	9	76,076	..	..	2	16,800	..	..	1	8,524	11	36,100	2	6,358	3	15,451
	1886–1890	4	44,950	4	42,982	6	58,218	3	25,350	1	6,304	1	6,675	44	134,055	11	35,430	1	5,817
	1891–1895	16	221,050	8	82,208	7	74,726	10	88,600	..	..	1	10,933	26	110,880	14	57,122	..	..
	1896–1899	16	227,300	6	67,382	3	34,228	10	112,000	5	44,531	5	44,126	20	78,015	9	30,716	1	3,828
*Launched, building, and projected in 1900.		8	112,000	2	29,254	7	145,954	18	202,400	13	127,339	8	53,115	2	7,800	..	..	1	3,000
Nations.	Great Britain	61	760,960					43	445,150					105	374,810				
	France			38	375,118					19	173,174					36	129,626		
	Russia					24	323,017					16	123,373					10	47,004
	Italy					16	182,423					6	41,365					16	45,477
	Germany					21	200,455					4	34,162					25	76,071
	United States					18	219,190					13	149,765					23	81,532
	Japan					7	92,090					6	58,286					18	63,551
	†Minor navies					50	247,335					8	54,197					99	250,886
Class.	Nos. of Ships.	235						115						332					
Totals.	Tons displ.	2,400,588						1,084,472						1,063,457					

		Coastguard and Harbour Defence Vessels.						Torpedo Gunboats.					
		Great Britain.		France.		Russia.		Great Britain.		France.		Russia.	
		Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.
Dates of Launches.	Before 1881	20	111,670	5	26,068	8	26,406	..	..	..	..	..	..
	1881–1885	1	6,200	4	8,866	..	..	1	2,640	7	3,719	..	..
	1886–1890	..	..	3	3,368	1	1,492	16	10,945	5	4,504	3	1,856
	1891–1895	..	..	4	16,508	5	13,942	17	14,995	7	6,405	5	2,110
	1896–1899	..	..	..	..	1	4,126	..	..	2	1,763	1	535
*Launched, building, and projected in 1900.		..	..	..	..	1	4,126	..	..	..	..	..	..
Nations.	Great Britain	21	117,870					34	28,580				
	France			16	55,310					21	16,390		
	Russia					16	50,092					9	4,501
	Italy					3	12,396					17	13,916
	Germany					19	39,753					4	4,322
	United States					11	41,214					..	..
	Japan					1	2,000					2	1,750
	†Minor navies					66	154,401					54	39,464
Class.	Nos. of Ships.	153						141					
Totals.	Tons displ.	473,036						108,923					

		Torpedo-Boat Destroyers.						Torpedo-Boats.						National Totals.	
		Great Britain.		France.		Russia.		Great Britain.		France.		Russia.			
		Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.	Nos.	Displ. Tons.
Dates of Launches.	Before 1881														
	1881–1885														
	1886–1890	44	11,795	..	..	1	240	103	7,014	215	14,282	163	9,402		
	1891–1895														
	1896–1899	40	12,186	2	590	20	6,042	..	..	30	2,786	19	2,188		
*Launched, building, and projected in 1900.		24	7,846	20	5,996	22	6,252	4	712	72	6,805	6	752		
Nations.	Great Britain	108	31,827					107	7,726					479	1,766,423
	France			22	6,586					317	23,933			460	785,137
	Russia					43	12,534					188	12,402	306	572,923
	Italy					13	4,249					151	10,607	222	310,523
	Germany					17	5,580					121	11,777	211	372,120
	United States					16	6,695					36	5,437	117	503,838
	Japan					16	5,550					62	5,435	112	228,662
	†Minor navies					21	6,531					364	25,104	662	777,018
Class.	Nos. of Ships.	256						1,346							
Totals.	Tons displ.	79,552						102,511							

* Displacement in some cases is approximate only.

† Including Argentine Republic, Austria-Hungary, Brazil, Bulgaria, Chile, China, Denmark, Greece, Holland, Mexico, Morocco, Norway, Peru, Portugal, Rumania, Siam, Spain, Sweden, and Turkey.

International totals { 2,578 ships. 5,317,530 tons displacement.

It will be seen that the above table does not include training ships, storeships, troopships, sloops, yachts, gunboats, vedette boats, submarine boats, and a variety of other classes. Regarding submarine boats, it may be interesting to mention that in 1902 France had 68 (built, building, and projected), Spain 2, Turkey 2, Italy 1, United States 18, and Portugal 1.

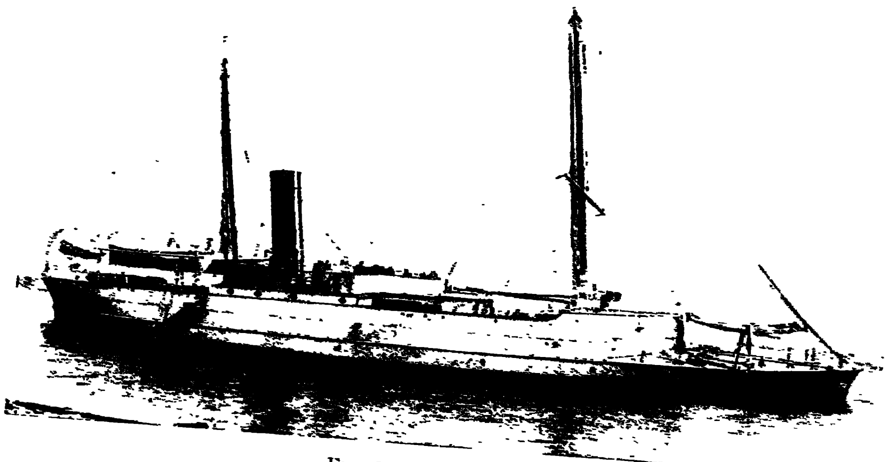


FIG. 80.—Chinese *Jota*.

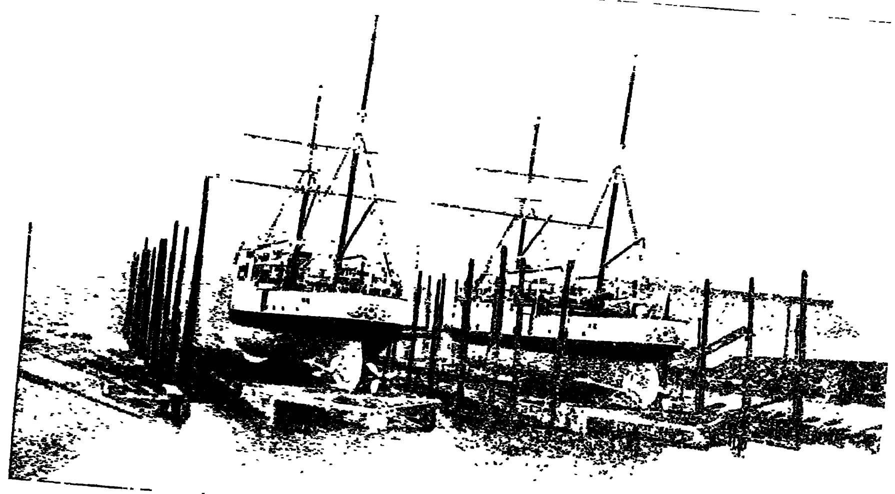


FIG. 81.—Queensland *Palumah* and *Gayundah*.

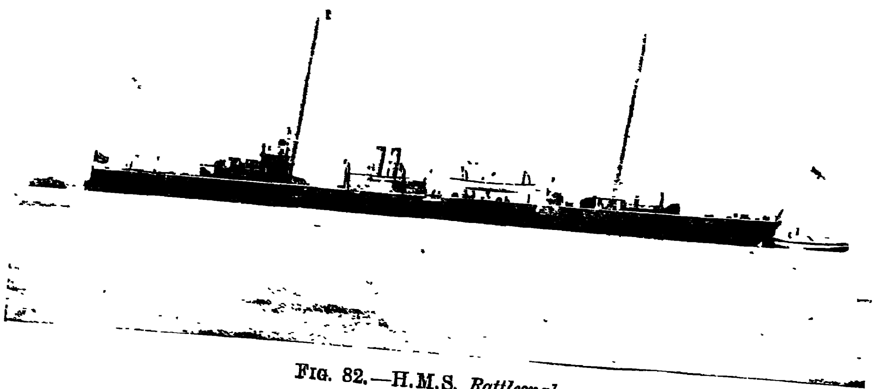


FIG. 82.—H.M.S. *Rattlesnake*.

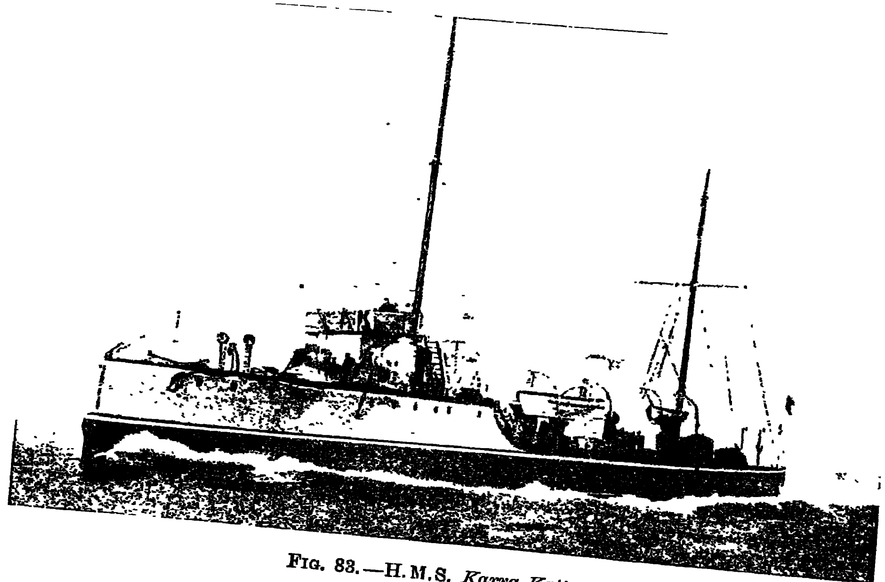


FIG. 83.—H.M.S. *Karra Katta*.

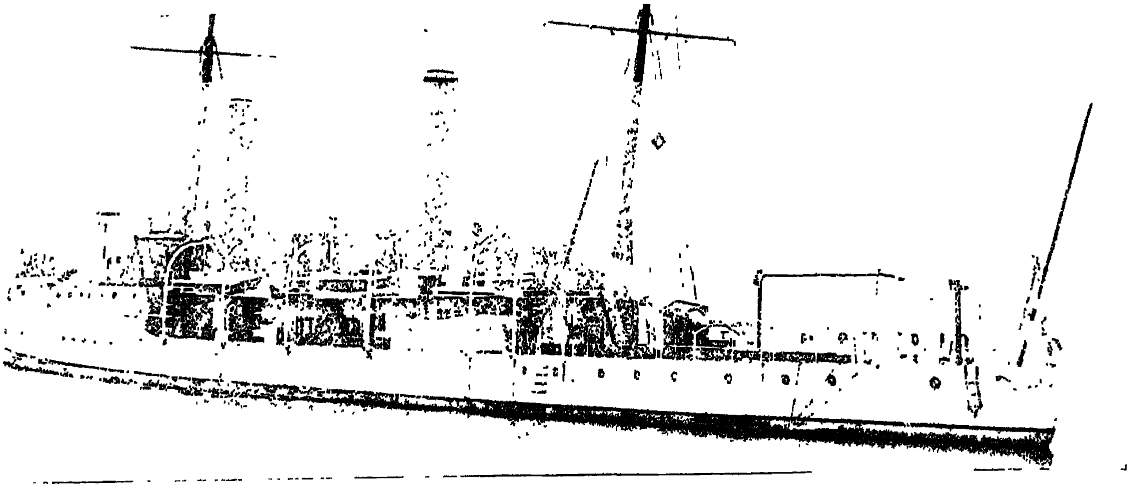


Fig. 84.—H.M.S. *Niger*.

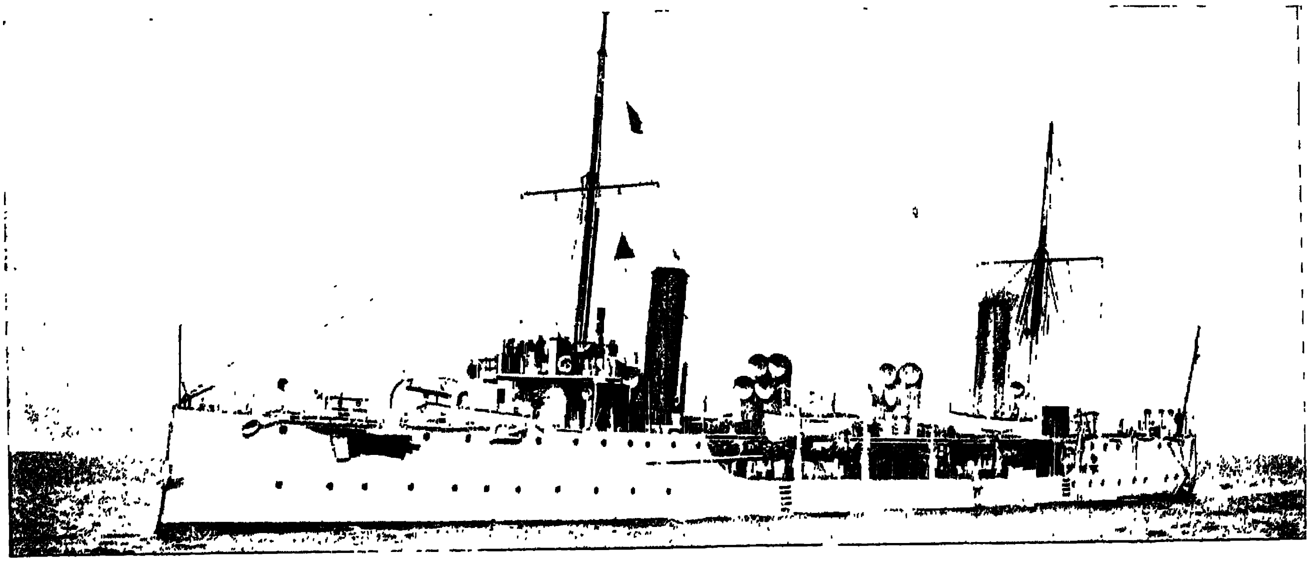


Fig. 85.—H.M.S. *Hazard*.

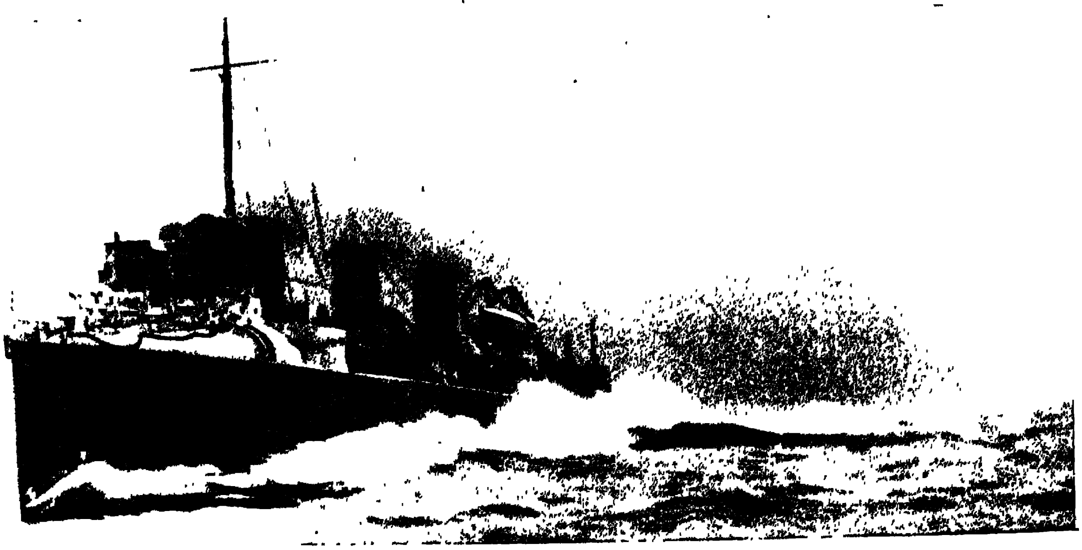


Fig. 86.—H.M.S. *Albatross*.

was achieved by Bushnell in America in 1775. His boat was manœuvred to the full extent contemplated in her design, and the one attempt made, as described below, to put her to practical use and sink the enemy's ship would have brought about this result if the operator had had more thought or more daring. It was worked by one man, for whom it provided just sufficient room; its general appearance, according to Bushnell's own description, bore some resemblance to two upper tortoise shells of equal size joined together, the entrance to the vessel being represented by the openings in the swellings of the shells at the animal's head; the body of the vessel was constructed of wood. The operations on board were entirely manual. By an oar in form of a screw with its spindle passing through the top the boat was sunk or raised, by another oar at the after end it was propelled; a rudder was used for guidance, and in some cases for propulsion, valves admitted water when submergence was required; and hand pumps discharged this water when it was desired to come to the surface, and a detachable weight of 200 ℔ was also supplied for emergency use. The air in the boat was capable of supporting the operator for thirty minutes; and as soon as he brought the boat to the surface, two air pipes, for discharge of foul and supply of fresh air, opened automatically. A compass, a pressure-gauge, and a sounding-line and lead were among the fittings. Behind the vessel was a large magazine containing 150 ℔ of powder, and a time-control for exploding it. From the magazine was led a rope to a wood screw at the fore part of the crown of the boat, and this screw, being worked from within, could be driven into the object to be destroyed in such a manner as to keep the magazine required for the explosion in position after it had been detached from the boat. During the War of Independence the boat was submerged beneath the British warship *Eagle*, and the operator attempted to attach the wood screw to her bottom planking: in this he failed, apparently simply because he did not let go his detachable weight and so get enough upward pressure to drive the screw into the plank. The magazine was released and exploded an hour afterwards, but at some distance from its intended position.

The problem of submarine navigation received the practical attention of Fulton during the time that he was making his experiments upon steam propulsion, and even at an earlier period. He constructed two submarine boats in France, and one in America. One of the former, the *Nautilus*, was built with the direct encouragement of Napoleon in 1801. It was supplied with compressed air for respiration, and with it Fulton conducted a series of experiments under the direction of a commission of naval officers. He descended to a depth of 25 ft., and remained under water for fully four hours, placing below a vessel provided for the purpose a torpedo by which it was blown into fragments. As with his steam engine, so too with his submarine boats, the report of the commission charged with investigation was so unfavourable that Fulton was much discouraged, and though he afterwards continued his labours in this direction, the results achieved by him were practically lost. Fulton's boat, like Bushnell's, was propelled by manual power, two horizontal screws being employed for propulsion, and two vertical screws for descending and ascending: it was built of wood with iron ribs, and was sheathed with copper.

The substitution of mechanical for hand power came later, and one of the first mechanically driven boats was the *Plongeur*, built in France in 1863 from the designs of Charles Brun. This boat had a length of 146 ft. and a diameter of 12 ft., and was propelled by an 80-horse-power compressed air engine. During the American Civil War in 1864, however, a hand-worked submarine boat 50 ft. long was employed by the Confederates. Manned by a crew of nine men, she successfully attacked the Federal ship *Housatonic*, and sank her by means of a spar torpedo, but in so doing was herself sunk. It is claimed that the loss of the boat was due to faulty handling, and not to inherent defect. Against the protest of her builder, she was immersed only to the hatch coaming; and the cover being left open, she was swamped and sunk by the wave thrown up by the explosion. It is said that this is the only submarine boat in connexion with which there is authentic record of loss of life; with her no less than three crews were drowned, in addition to the crew engaged on her last fatal expedition, so that she was the cause of the loss of thirty-six lives.

About the same time another hand-worked submarine, called the *Intelligent Whale*, 26 ft. in length and 9 ft. in diameter, attracted some attention in America. An officer, with two other persons, dived with her in water about 16 ft. deep; the officer, in diver's dress, left the boat through a manhole in the bottom, placed a torpedo under a scow, and blew the latter to pieces.

Holland's boat.

In 1875 Mr J. P. Holland produced his first plan for a submarine vessel, and in 1877 he constructed a small experimental boat, which embodied features now accepted as essentials in American design. His plan ensured that when, for the purpose of diving, water was admitted into compartments of limited size, the total weight of the boat and its contents should still be a little less than the total buoyancy. Immersion was maintained by the action of horizontal rudders, which gave a downward tendency so long as the boat had any forward motion, and there always remained enough surplus buoyancy to bring the boat to the surface on the stoppage of her propelling machinery. Any weight consumed on board was automatically compensated for by admission of water, so that the total weight remained fixed and constant; while the confinement of the water to small compartments further secured a fixed centre of gravity. The securing of these qualities of fixed weight and fixed centre of gravity is essential, and the want of them has been the cause of failure in many other designs. With the necessarily slight longitudinal stability possessed by a submarine boat, any change of centre of gravity in the fore-and-aft direction has a notable effect on the angle of trim; and such a change may readily occur, for instance, from the surging of water in a large ballast-tank not completely full. An unintentional alteration of trim when the submarine boat is being propelled involves several possible dangers: in extreme cases the crew or some of the fittings may be thrown out of position, but in any case the path of the submarine is altered, and may tend either to too great immersion on the one hand, or to breaking the surface of the water on the other. From the risk of these dangers it is claimed by Mr Holland that his design is free. The first of his boats now under discussion was steered down and up inclines by her horizontal rudders, and motive-power was obtained from a petroleum engine. The tests to which she was subjected showed that inefficiency of the engine, difficulty of vision, and trouble with the compass tended to destroy the boat's usefulness.

Nordenfelt's boat.

In 1883 Mr Nordenfelt, famous as an inventor in many directions, and especially associated with the gun which bears his name, built a submarine boat at Stockholm. She had a length of 64 ft., a main diameter of 9 ft., and a displacement of 60 tons; she was propelled by a compound surface-condensing engine indicating 100 H.P., and on a measured mile trial, not being submerged, attained a speed of 9 knots. Steam was supplied by an ordinary marine return-tube boiler, worked under forced draught, which could be fired

as long as the boat was at the surface. Storage of steam was effected at the surface, and the steam thus stored was used to drive the engine in the submerged condition. To store sufficient steam two large tank reservoirs or cisterns were connected with the boiler, and the contents of boiler and tanks (8 tons of water in all) were raised to a temperature corresponding to 150 ℔ pressure. In preparing for submergence the firing of the boiler was stopped, and the steam given off by the heated water in boiler and tanks sufficed to propel the boat for a period. The smoke was driven out through two channels, which passed round the hull and pointed astern. The material of the hull was mild steel, the frames being 3 in. by 3 in. by $\frac{3}{8}$ in., and the plating $\frac{5}{8}$ in. to $\frac{3}{8}$ in. in thickness; the depth to which she could safely descend was about 50 ft. When ballasted ready for a submerged trip, this boat showed only a very small dome for observation above the level of the water, the reserve buoyancy represented by this dome being but 1 cwt. To overcome this reserve two propellers working on vertical shafts were fitted in sponsons, one on each side of the boat, nearly amidships. These propellers were driven by a 6-horse-power engine, and drew the boat under water to the desired depth; an automatic contrivance, set in motion by the water pressure outside the boat, closing the throttle-valve when the safety limit of depth was approached. On coming to rest, the reserve buoyancy brought the boat again to the surface. When propelled by the main engines in the submerged condition, the boat was kept horizontal by means of two bow rudders operated by a plumb weight. The crew consisted of three men only, this small number rendering unnecessary the employment of artificial means of maintaining a pure atmosphere. The scheme of attack was to approach the hostile ship running at the surface until the danger of discovery was imminent, then to descend to the "awash" condition with only the dome above water, and finally to go below the surface and advance to striking distance entirely submerged, rising if necessary once or twice to allow the direction to be adjusted by observations made from the dome "awash." The weapon of offence employed was a Whitehead torpedo, carried outside on the bow and discharged mechanically. Two or three larger boats were subsequently built from Mr Nordenfelt's designs; they all involved the same principles, but were in some details made more efficient both for attack and defence.

The three main points insisted upon by the inventor were: (1) that his method of storing energy gave him a reservoir which was not liable to get out of order, could readily be repaired if necessary, and required for its manipulation no knowledge beyond that possessed by an ordinary engineer; (2) that for submergence he relied on mechanical means easily controlled, adding, as a criticism upon the alternative method of descending by steering downwards, "I need only point out the great risk of allowing an object 100 ft. long and of great weight to proceed in the downward direction even at a small angle, as the impetus gained would very easily carry it beyond a safe depth so quickly that they might not have time to check it"; (3) that the bow rudders always secured a horizontal position when the boat was running submerged, which position he had found to be a *sine quâ non* for a submarine boat.

In response to an invitation for proposals for submarines, made by the U.S. Government in 1887, designs by Holland and Nordenfelt were submitted. After much consideration the proposals of the former designer were accepted, and formed the basis of the eight boats that were built or building in the United States in 1902. From what has been already stated, the criticism of Admiral Hichborn (Chief Constructor of the U.S. Navy) will be understood when he characterizes Holland's method as a "steering-under" or "diving" device, and Nordenfelt's as a "down-haul" or "sinking" design. These two methods of obtaining submergence have each their sworn advocates, who approve of the one and disapprove of the other.

The largest boat of Mr Holland's design is the *Plunger*, which, although authorized in 1893, was not complete in 1902, a change in the surface motive-power from steam to gas having been found advisable. This boat has a length of 85 ft., diameter $11\frac{1}{2}$ ft., light displacement 154 tons, and load displacement 168 tons; she is of sufficient strength for a submergence of 75 ft., and when wholly submerged has a margin of buoyancy of $\frac{1}{4}$ ton. In addition to her horizontal rudders for diving, she has two down-haul screws, fitted in opposition to Mr Holland's recommendations; she may therefore be said to be a combination, for diving purposes, of both the Holland and the Nordenfelt designs. The *Plunger's* main engines are used for propulsion when she is navigated at the surface of the water. As originally designed, they were triple-expansion steam engines, driving triple screws, but have since been altered, as we have indicated above, to gasoline engines driving a single screw. These engines are also used for charging electric accumulators, from which alone motive-power can be obtained when the boat is submerged. The current for charging the accumulators is obtained from a dynamo of 70 H.P., which can always be run in the awash condition, and the accumulators thus kept fully charged. In the awash condition, when the boat is otherwise air and water tight, communication is kept up with the outer air by means of ducts and a smoke-pipe, the former bringing in air for combustion and respiration, and the latter carrying off deleterious products of all kinds. For submergence special fittings are used to close these ducts and pipes, and to stop the gasoline generator. The main engine is then no longer available, and for propulsion power is drawn from the accumulators, the dynamo thus becoming a motor which derives current from the accumulators, and itself drives the screw-shaft. As was the case with Mr Holland's earlier boats, great attention is given to automatic control of weights, and water-ballast is admitted to compensate for any change, such as would be produced by the discharge of a torpedo. With her original machinery the *Plunger* was to have had a surface speed of 15 knots; her anticipated speed awash or submerged is now 8 knots. To assist in determining the boat's direction a *camera lucida* is ordinarily provided, but for correcting this Mr Holland prefers trusting to observations made during occasional rises to the surface; for this purpose the boat is provided with a conning tower 4 ft. high, protected with 4-in. steel. The *Plunger* is armed with Whitehead torpedoes, and has two tubes for discharging them.

The *Holland*, a smaller boat, having a length of about 59 ft., though begun after the *Plunger*, has already been completed, and is now the property of the U.S. Government. The official report of this vessel is that "she has shown herself capable of such perfect control in the vertical plane that she may be kept whilst moving within a few inches of any desired depth, and that she may be brought to the surface and submerged again in a very short time." A good idea of the general form of the *Holland* may be obtained from Figs. 91, 92, 93, and 94 (Plate XXII.), the last three of which represent this vessel when undergoing trials to test her driving qualities.

The latest Holland design is shown in Fig. 95, which represents the design of the *Adder* and five other submarines, length 63 ft.

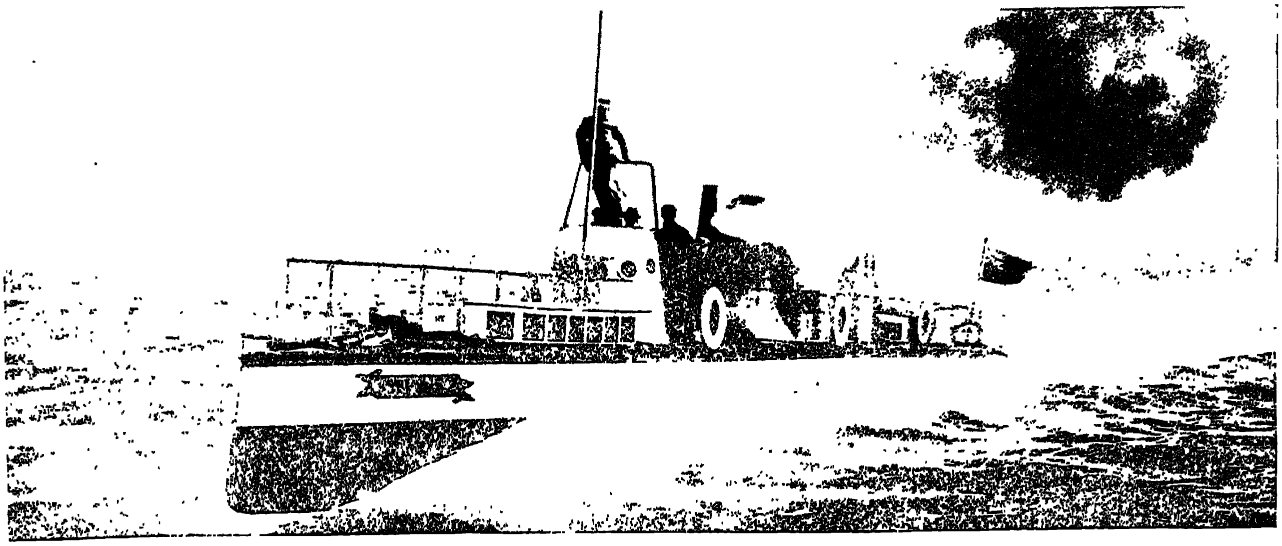


FIG. 87.—*Turbinia.*

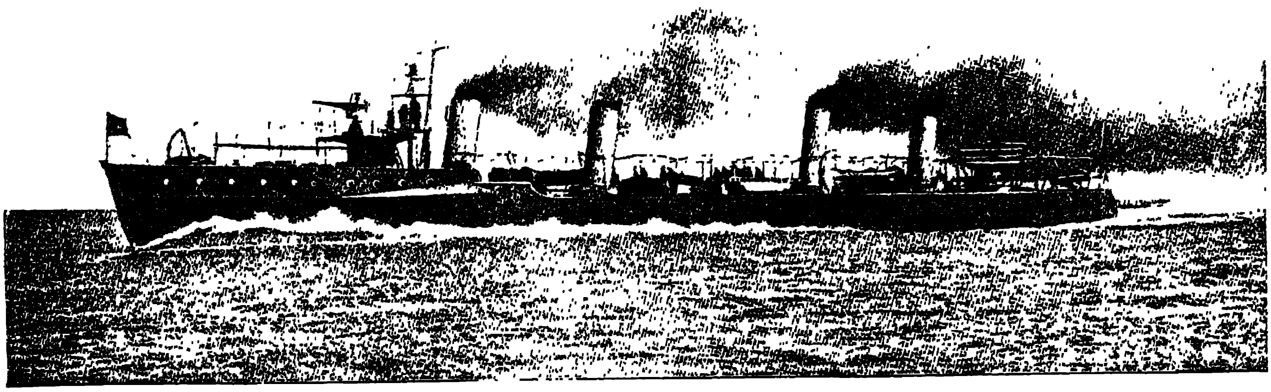


FIG. 89.—U.S.A. *Bainbridge.*

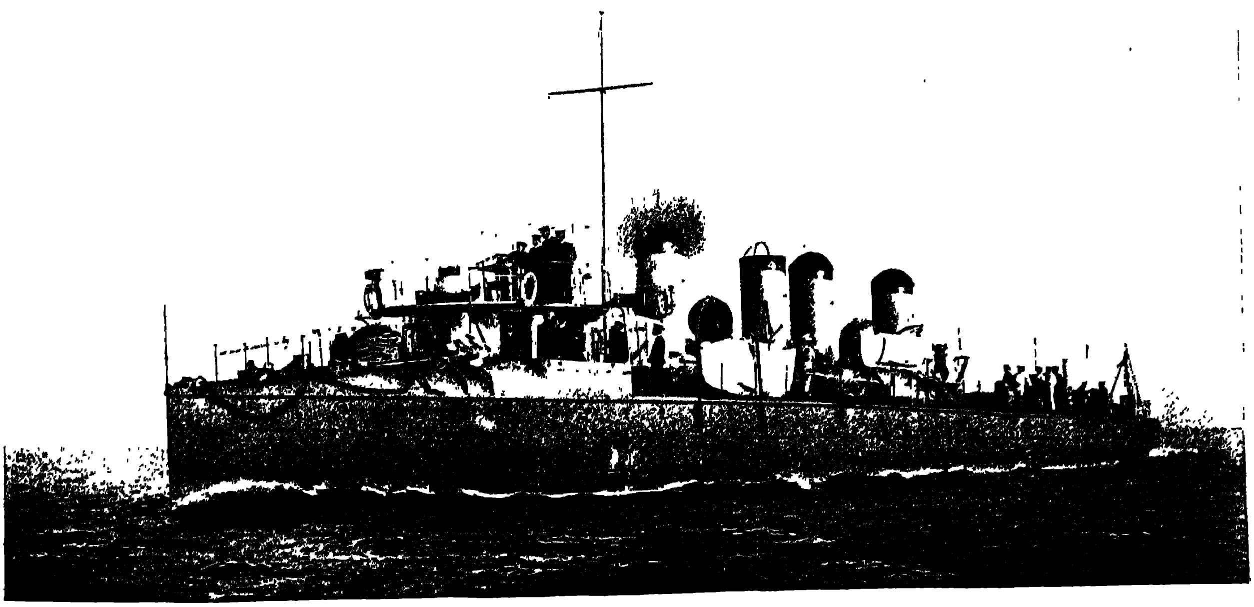


FIG. 90.—Japanese *Niji.*

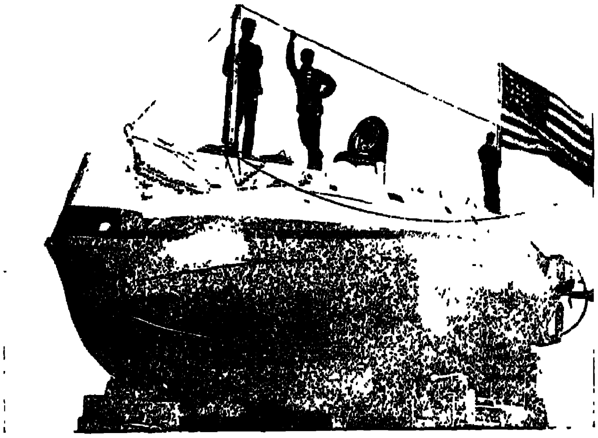


Fig. 91.—U.S.A. *Holland.*

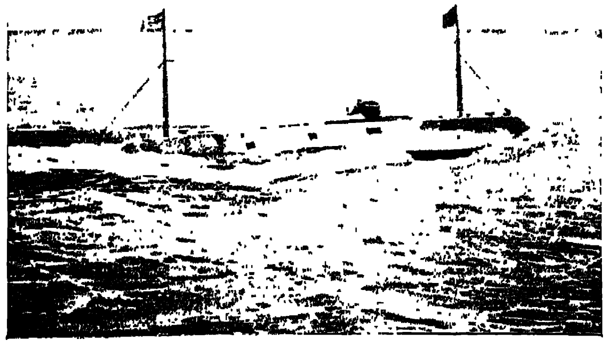


Fig. 92.—U.S.A. *Holland.*

Fig. 93.—U.S.A. *Holland.*

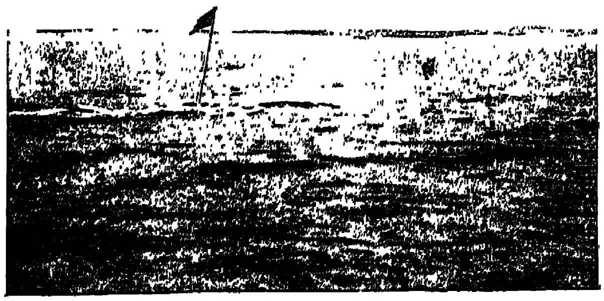


Fig. 94.—U.S.A. *Holland.*

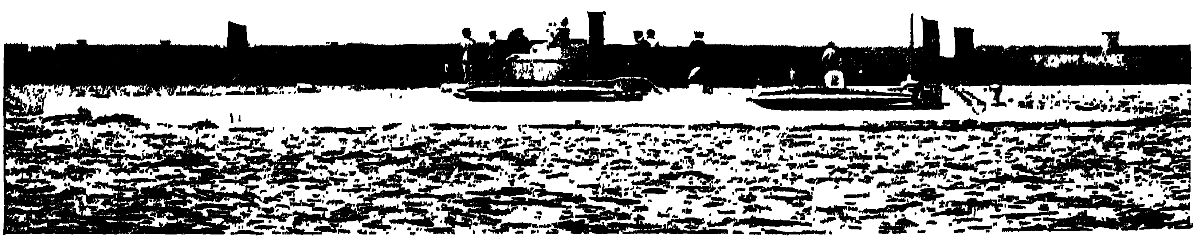


Fig. 97.—French *Narval.*

(By permission of "Page's Magazine.")

4 in., diameter 11 ft. 9 in.; displacement for surface running 104 tons; submerged displacement 120 tons. The main features of this class of boat are the same as have been described above for the *Plunger*, and are in essentials identical with the first five boats under construction for the British navy. The shell-plating is $\frac{7}{16}$ in. in thickness, and the frames $3\frac{1}{2}$ in. by 3 in., with a spacing of 18 in. The main machinery is a four-cylinder single-acting balanced Otto gasoline engine, which at 360 revolutions will develop 160 H.P. and give the boat a speed of about 8 knots. For propulsion in the submerged condition an electric motor is used, working at 800 revolutions, and giving a speed of 7 knots, a single left-handed propeller being employed. The current for the motor is provided by storage batteries capable of supplying 70 H.P. for 4 hours; and these batteries are charged by the main engine in a manner similar to that already described for the *Holland*. The requisite air supply is obtained when the vessel is at the surface, and is stored under a pressure of 2000 lb by a pump driven by gearing off the main engine or main motor. Air at a pressure of 50 lb is used for the expulsion of torpedoes, and the same agent, at various degrees of pressure, works the trimming and ballast tanks and some parts of the machinery; while the exhaust air from the latter subserves the purpose of ventilation. The vessel is fitted with steam and hand steering gear, and there are automatic devices for securing a constant depth during submergence. Five Whitehead torpedoes 45 cm. (about 18 in.) in diameter and 11 ft. 8 in. long are provided, and there is

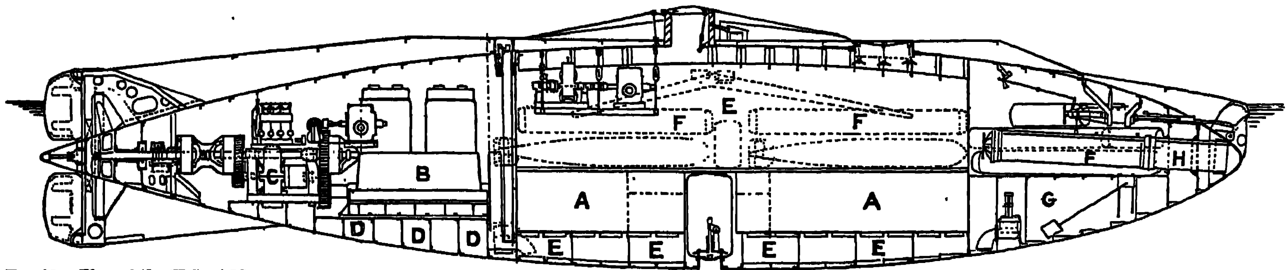


Fig. 95.—Plan of the U.S. *Adder* (reproduced by permission of Admiral Hichborn). A, storage batteries; B, gas-engine; C, dynamo and motor; D, water-tight compartments; E, main ballast tanks; F, air-flasks; G, gasoline tank; H, expulsion tube.

one expulsion tube placed forward about 2 ft. below the light water-line.

The French submarine boat *Plongeur* has already been described. A further advance in this direction was made in 1881, when a small submarine was completed by M. Goubet at Paris. An inspection of this vessel led to an order for the mechanism of a number of boats from this engineer for the Russian Government, and several sets were built and delivered early in 1883. The length of the boat constructed by M. Goubet in 1885 was 16 ft. 5 in.; it had an oval section 5 ft. 9 in. in depth and 3 ft. 3 in. in breadth, and tapered to a point at each end. A longitudinal section of the boat is represented by Fig. 96. The main portion of the hull was of bronze, cast in one piece, and at the centre of its length it was surmounted by a large dome having seven glazed openings. There was just sufficient room for an officer and a man seated back to back within it, their eyes in this position being level with the glass windows of the dome. All valves and other mechanism requiring regulation were brought within reach of these occupants, so that no movement on their part was required which might affect the trim; a reservoir of compressed air supplied the means of respiration, and an air-pump removed the vitiated atmosphere. The motive-power was furnished by accumulators, the electric energy stored therein driving a screw propeller by means of a motor. No means was provided on board of recharging these accumulators when exhausted. Submersion was effected by admitting water into tanks divided by transverse bulkheads at sufficient intervals to prevent the surging of the water in the fore and aft direction. A pump expelled this water again when desired, and a safety weight attached to the bottom of the boat was ready for detachment in the presence of danger. A pressure gauge indicated the depth of water reached, and the officer could regulate the opening of the inlet valves or the action of the pumps to maintain or vary this depth as desired. For controlling the boat in a horizontal direction a specially devised pendulum was employed, by means of which a clutch was moved, and a constantly running shaft was thrown into gear with a pump as soon as the boat departed appreciably from the horizontal plane. The action of the pump was reversible, and the clutch engaged it always in such a way that it drew water from a tank at the low end of the boat, and delivered it to a tank at the high end. Several other devices of great ingenuity were employed in the boat; notably a special form of universal joint introduced into the line of shafting. At the after end, close to the propeller, this universal joint was fitted in such a way that the screw could be set at an angle to the line of motion, and steering effected without the aid of a vertical rudder. A torpedo containing 100 lb of dynamite or other explosive was carried outside the hull, and secured by a catch joint. This torpedo, on the submarine boat being manœuvred into position, could be thrown off and allowed to rise and attach itself, by means of spikes, to some vulnerable part of the ship doomed to destruction. Retiring then to a safe distance, the submarine boat could explode the torpedo by the agency of an electric current.

Goubet system.

Working in the light of his now considerable experience, M. Goubet built several other boats. These were of larger dimensions, having a length of 27 ft.; their material was also bronze, and they were cast in three pieces, the centre one having a thickness of 1 in., while the others were reduced to a little more than $\frac{1}{2}$ in. at the ends. Possessing to a large extent the same contrivances as their predecessor, these improved boats were fitted also with an automatic apparatus for regulating the depth of submersion. In this regulator a piston is moved along a cylinder by the rotation of a rod with a screw thread cut in it, and so increases or diminishes the amount of water in the cylinder. The movement of the piston is effected by a small motor, and the direction of action of the motor is regulated by a commutator placed in juxtaposition to a pressure gauge. When the depth of submersion is too small, current is supplied to move the piston so as to admit more water; when the depth is too great, current is supplied in the opposite direction, and water is expelled. The speed attained by this boat was from 5 to 6 knots.

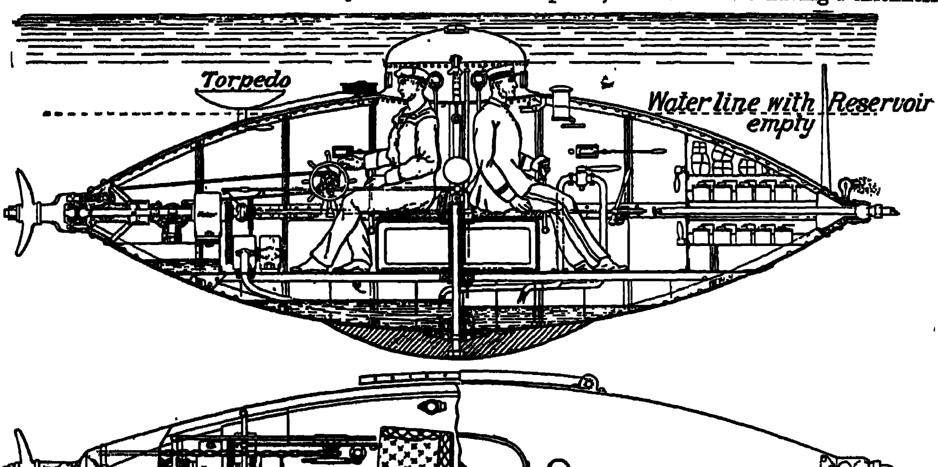


Fig. 96.—Section of Goubet submarine torpedo-boat.

The *Gymnote* was constructed at Toulon in 1888. She is a steel vessel, with a length of 59 ft. and a displacement of 30 tons;

being of an experimental character only, she has no weapon of attack. Her motive-power is obtained from accumulators, but she has within herself no means of recharging these. The maximum speed obtainable is 8 knots. For control in the vertical direction a rudder was placed aft, but this did not act satisfactorily, and was replaced by two plate rudders, movable about a horizontal axis in the middle of the boat. For the purpose of controlling the horizontal direction this boat is fitted, in addition to her vertical rudder, with a "gyrostat," the motion of which instrument is maintained by an electric motor. Previous to making a start the boat must be headed in the direction in which it is intended to move; when the gyrostat, once started, will, if not subjected to any accidental disturbance, continue to rotate about an axis invariable in direction, and any departure from this will be at once detected, whether the boat be above the surface or below it. The designs of the *Gustave Zédé* and of the *Morse* were both based on those of the *Gymnote*, the former having a length of 148 ft. and a displacement of 145 tons. In both of these the hull is of bronze; one great advantage of this metal being that, like the bronze of the Goubet boats, it is non-magnetic in character, and cannot therefore disturb the equilibrium of the compass. With their large dimensions they were intended to be formidable engines of war, and were furnished for attack with Whitehead torpedoes; of these latter they each carry three of 45 cm. (nearly 18 in.) diameter, discharging them by means of a torpedo tube. The *Morse* and the *Gustave Zédé*, like the *Gymnote*, possess only electric means of propulsion, the power being derived from batteries of accumulators. No power is provided in the vessel by which the accumulators can be recharged, so that the radius of action of these boats is necessarily very limited. A more recent boat, the *Narval* (Fig. 97, Plate XXII.), designed by M. Laubeuf, and the outcome of a general competition in 1897, has a length of 112 ft. and a total displacement of 200 tons. She was built at Cherbourg in 1898, and is furnished with a triple-expansion steam engine, obtaining its steam from a water-tube boiler of special form and heated by petroleum. As in the American submarines, this engine propels the boat when at the surface, and also drives a dynamo which recharges accumulators, the latter giving the reserve power for use in the submerged condition. A speed of 11 knots is obtained at the surface, and 8 knots when submerged. A new departure in the *Narval* is her double hull, the inner shell of which is of steel plate of sufficient thickness to resist any water-pressure to which the boat may be subjected, and the outer shell, placed at varying distances from the inner, forms a protection to the inner against attack. An armoured dome surmounts the boat, cutting through the external shell and carrying a short and narrow telescopic funnel, which, as in the case of the American boats, must be withdrawn preparatory to diving. Control in the vertical direction is obtained, when diving, by the use of two pairs of horizontal rudders, placed symmetrically—one pair forward, the other aft. By the above arrangement it is claimed that the horizontal direction of the boat is ensured, the American course of inclining the axis of the boat when diving being considered open to such grave objections that it is desirable to avoid it.

In all the more recent submarine boats of French construction much ingenuity has been directed towards obtaining instruments of vision for use when the vessel is in a steady position somewhat below the water surface. The optical tube is the instrument which has so far given the most satisfaction. A total reflection prism at the upper end of a telescopic tube is placed above the water surface, and a similar prism at the lower end of the same tube; this arrangement allows the officer in the boat to see, over a limited distance, the objects in his neighbourhood. Another instrument, the periscope, is now also employed, and has received much attention. In this an image is formed in the focus of a parabolic reflector, and can then be examined by means of an ingenious optical contrivance; but this instrument has scarcely given all the results expected of it, and in Mr Holland's boats is not used at all. American experts, indeed, place but little reliance even upon the optical tube.

Lake's "bottom-worker."

Quite a different class of submarine boats from the above is the "bottom-worker," which is represented in America by the *Argonaut*, built to the design of Mr Lake. This boat is intended for crawling over the surface of the bottom, and rather for the peaceful work of saving wrecks than for the purpose of attack, although the latter possibility has not been ignored in her conception. She consists of an underwater portion 56 ft. long, with a circular section of 9 ft. diameter; to this, for surface purposes, a superstructure has been added, with a total length of 66 ft. She is driven by a gasoline engine, and there is no storage. Ventilation is carried on from the surface, for the purposes of respiration and combustion, by two flexible tubes held up by a buoy; or, in shallow water, by pipes long enough to reach to the surface, there being also, in case of injury to these pipes, a sufficient supply of compressed air to last for some hours. For crawling purposes three wheels support the boat on the sea-bottom; two are forward and one aft, the steering being effected by the latter. Men can leave or enter the boat, by means of a door placed forward, either with or without a diving suit. The compartment to which this door belongs is kept under air-pressure sufficient to exclude the water, and is cut off from the rest of the boat by an air-lock chamber with double doors. Rising above the deck is a conning tower for observation, and at the forward end are a look-out compartment and searchlight.

Summarizing the tactical elements established by the *Holland*, Admiral Hichborn, amongst other criticisms, makes the following:—"*Control and direction in the vertical plane*—Perfectly satisfactory. *Control and direction in the horizontal plane*—Perfectly satisfactory when running on the surface; unsatisfactory when submerged, since the object to be steered for cannot be seen. Acceptable, because any predetermined direction can be held as well as can any vessel's course in a fog or on a dark night, and in the same way, *i.e.*, per compass; also acceptable because the quick rises and dives enable the helmsman readily to correct his course to intercept an off-shore enemy endeavouring to close with the shore. *Field of vision when submerged*—Nil, and therefore unsatisfactory as such; but acceptable because field of vision would carry with it the loss of the perfect invisibility which so largely adds to her effectiveness in attack, and because the quick rises and dives give perfect field of vision for a few seconds, with a minimum of chance of disablement from gun fire. *Sea-going qualities*—Perfect, since no sea, however heavy, can affect her when in the awash condition ready to dive, and when running light she can always be dropped to the awash condition in heavy weather. *Submerged motive-power*—Unsatisfactory, since its source is the heavy and cumbersome storage battery. Acceptable, since it is the most available motive-power for use when air cannot be freely used, and since the supply can always be renewed—as long as the fuel supply holds out."

In considering the possible future of the submarine boat, it appears that for such depths of submergence as were and are contemplated in any of the above-mentioned designs, there is no difficulty in employing scantlings ample for the pressures to be encountered, since the weight of hull necessitated by these scantlings introduces no abnormal difficulty into the design. The tendency at the present time is to increase the size of the boat, and what limit may be reached in this direction it is impossible to say. The greatest obstacles to progress are at present the want of satisfactory contrivances for artificial vision, and of durability in the electric storage arrangements for the requisite supply of motive-power or the substitution of a more perfect system of under water propulsion. Generally, however, it may be said that while such advances have been made in submarine construction as show that under certain conditions submergible boats may be of practical utility, they have not yet reached such a state of perfection as sensibly to modify the shipbuilding programme of great naval Powers. It is possible that for many years their value will remain moral rather than material; and their ultimate efficiency, like that of the torpedo itself, must remain in doubt until a naval war on a serious scale shall set the question at rest.

In the meantime experience seems to show that designs which provide a certain surplus buoyancy, and attain submersion by propellers or similar means, have advantages over other systems; that, under water, propulsion can be conveniently obtained by electrical motors and accumulators, and that the accumulators must be capable of being recharged by machinery in the boat, considerations of weight rendering it desirable that this machinery should be that which drives the boat in the "awash" condition. (P. WA.)

SHIPBUILDING.

THEORETICAL.

THEORETICAL shipbuilding embraces the consideration of all questions upon which the qualities and behaviour of a ship depend, and which thus determine the various features of the design. Among these are: the best size of ship to be adopted, having regard to the particular services which she will be required to perform; the requirements which must be fulfilled in order that she may make her various passages economically and with safety, in all conditions of wind and sea; the best form for the hull with regard to the resistance offered by the water at various speeds; the nature of waves and their action upon the ship; and the structural arrangements necessary in order that she may be sufficiently strong to withstand the various stresses to which she will be subjected. The determination of the best size of ship to fulfil certain conditions is one of the most difficult and at the same time one of the most important questions which have to be settled. It involves the consideration of a different set of circumstances for almost every service, and these are often so complicated that deductions from experience gained in vessels similarly employed are the only guide to be relied on, and the question is not therefore usually left wholly in the hands of the naval architect. The requirements of economical working, safety, &c., determine the length, breadth, depth, and form. The length has a most important bearing on the economy of power with which the speed is obtained; and on the breadth, depth, and height of side, or freeboard, depend to an important degree the stability and seaworthiness of the vessel. The best form for ships of high speed, their resistances at various speeds, and kindred matters of scientific interest, have been for many years the subject of experimental investigation with models—a mode of treatment which was devised and adopted by the late Mr William Froude, F.R.S., to whom the shipbuilder is indebted for very much of the trustworthy information at his disposal with regard to these matters. The stability of ships, their rolling among waves, their resistances at various speeds, and their strength, with the calculations to be made in estimating these elements, have been discussed in the ninth and previous editions of the *Encyclopædia Britannica*, and we do not propose to consider them in detail in the present article, but we add notes on the rolling and on the resistances of ships in which the results of recent investigation are given.

Rolling of Ships.

Unresisted rolling. The unresisted rolling of ships in *still* water is of no immediate practical importance, as a ship will not roll in still water unless made to do so; and even when thus set rolling, the motion cannot be unresisted, since the flat portions must experience resistance in passing through the water, and this and other causes of resistance bring about a degradation of the amplitude of rolling. The equation of motion of a ship rolling through moderate angles of inclination for which we can approximately say that the righting arm is proportional to the angle, *i.e.*, $GZ = m \times \theta$ is

$$\frac{d^2\theta}{dt^2} = -\frac{g}{\epsilon^2} m \cdot \theta \quad . \quad . \quad . \quad . \quad (1)$$

where ϵ = radius of gyration of the ship about the axis of rotation, m = metacentric height, θ = angle of inclination, and g = accelerating force of gravity. From this equation the time deduced for a single oscillation, *i.e.*, from port to starboard, or *vice versâ*, is

$$T = \pi\sqrt{\frac{\epsilon^2}{m \cdot g}} \quad . \quad . \quad . \quad . \quad (2)$$

showing that the time of oscillation varies directly as ϵ, the radius of gyration, and inversely as the square root of the metacentric height. This period, as found by calculation, is very nearly the same as the actual period observed on the ship herself when set rolling. The resistances to rolling do not sensibly affect the *period* of oscillation, but they do affect the *amplitude*. When the period is constant, *i.e.*, the time occupied in making a complete roll from starboard to port, or *vice versâ*, is the same, whatever the angle of roll, the rolling is said to be *isochronous*.

For the unresisted rolling of ships among *waves* the theory generally accepted is due to the late Mr W. Froude (see *Trans. Inst. Nav. Arch.*, 1861 and 1862). Before his work many eminent mathematicians had attempted to arrive at a solution of this most difficult problem, but for the most part their attempts met with scanty success, because wave-motion and wave-structure were imperfectly understood, and consequently the forces impressed on a ship by water in motion could not be correctly estimated. Mr Froude's theory is based on the proposition that when a ship is among waves the impressed forces on her tend to place her normal to the wave-surface. As in water at rest she is in equilibrium when her masts are normal to the surface of the water, so in waves she is in equilibrium when her masts are normal, instant by instant, to the surface of the wave that is passing her. When she at any instant deviates from this position, the effort by which she endeavours to conform herself to it depends on the momentary angle of deviation, in the same manner as the effort to assume an upright position, when forcibly inclined in still water, depends on the angle of inclination. Hence her stability, *i.e.*, her effort to become vertical in still water, measures her effort to become normal to the wave in undulating water. Mr Froude made the assumptions that the profile of the wave was a curve of sines, and that the ship was rolling broadside on in a regular series of similar waves of given dimensions and given period of recurrence. He was aware that the profile of the wave would be better represented by a trochoid, but he gave in his first paper several reasons why he preferred to retain the sine curve as the profile of the wave passing the ship. He also assumed that the ship's rolling in still water was isochronous, and that the period from one side to the other was given by $T = \pi\sqrt{\frac{\epsilon^2}{m \cdot g}}$, as above. On these assumptions, by substituting, in the equation of motion in still water, the instantaneous angle between the ship and the normal to the wave-slope for the ordinary angle of inclination, the following equation of motion is obtained:—

$$\frac{d^2\theta}{dt^2} = -\frac{\pi^2}{T^2}(\theta - \theta_1), \quad . \quad . \quad . \quad (3)$$

where θ = angle of ship's masts to the vertical, and θ_1 = angle of normal to wave-slope to the vertical at the instant considered. θ_1 has to be expressed in terms of time, and we have $\theta_1 = \Theta_1 \cdot \sin\frac{\pi}{T_1} \cdot t$, where Θ_1 = the maximum wave-slope, and T_1 half period of the wave, *i.e.*, half the time the wave takes to travel from crest to crest or from trough to trough. Equation (3) can therefore be written—

$$\frac{d^2\theta}{dt^2} = -\frac{\pi^2}{T^2}\left(\theta - \Theta_1 \cdot \sin\frac{\pi}{T_1} \cdot t\right) \quad . \quad . \quad (4)$$

which is the general differential equation of the motion of an unresisted ship in regular waves of constant period. The solution of this equation is as follows:—

$$\theta = \Theta_1 \cdot \frac{1}{1 - \frac{T^2}{T_1^2}}\left[\sin\frac{\pi}{T_1} \cdot t - \frac{T}{T_1} \cdot \sin\frac{\pi}{T} \cdot t\right] + C_1 \cdot \sin\frac{\pi}{T} \cdot t + C_2 \cdot \cos\frac{\pi}{T} \cdot t \cdot \quad (5)$$

where t dates from the mid-trough of the wave, and C_1 and C_2 are constants depending on the movement and attitude of the ship at that moment. The first term of this expression,

$$\Theta_1 \cdot \frac{1}{1 - \frac{T^2}{T_1^2}}\left(\sin\frac{\pi}{T_1} \cdot t - \frac{T}{T_1} \cdot \sin\frac{\pi}{T} \cdot t\right),$$

represents the forced oscillations imposed on the ship by the passage of the series of waves during the time t; and the second term,

$$C_1 \cdot \sin\frac{\pi}{T} \cdot t + C_2 \cdot \cos\frac{\pi}{T} \cdot t,$$

the continuance of the oscillations of the ship in still water which she had initially.

Equation (5) indicates, therefore, that the ship performs oscillations as in still water, but has superposed on these a series of oscillations governed by the wave-slope and the relation

existing between the period of the ship and that of the wave. This equation shows that there will be innumerable phases; of these, three are worthy of notice. If the initial conditions are suitably chosen (viz., ship stationary and upright at $t=0$), the second part of equation (5) will disappear, and therefore we shall first consider the forced oscillations imposed on the ship by the waves, given by the equation

$$\theta=\Theta_1 \frac{1}{1-\frac{T^2}{T_1^2}}\left(\sin\frac{\pi}{T_1}t-\frac{T}{T_1}\sin\frac{\pi}{T}t\right). \quad (6)$$

(*a*) In the case in which the ship's period in still water (T) is equal to the half period of the wave (T_1), we arrive ultimately at the equation

$$\theta=\frac{\Theta_1}{2}\left(\sin\frac{\pi}{T_1}t-\frac{\pi.t}{T_1}\cos\frac{\pi}{T_1}t\right),$$

from which we deduce (α) that at the middle height of the wave the ship's masts will have an inclination to the vertical equal to one-half the maximum wave-slope, and (β) that at each successive wave crest and hollow the range of the ship's oscillation will be augmented by $\pi/2$ times the maximum slope, so that the ship under these conditions would inevitably capsize but for the effect of the resistances and the want of synchronism.

(*b*) When $T/T_1=0$, *i.e.*, the case in which the ship is assumed to be quick in her movements, or when the period of the wave is infinitely long as compared with that of the ship, the equation (6) becomes

$$\theta=\Theta_1\sin\frac{\pi}{T_1}t;$$

that is to say, the ship will behave very much as a flat board in a seaway, so that her masts are always perpendicular to the surface.

(*c*) If we choose the initial conditions in equation (5) so that the coefficients of $\sin\frac{\pi}{T}t$ and $\cos\frac{\pi}{T}t$ are zero, then the equation will become $\theta=\Theta_1\frac{1}{1-\frac{T^2}{T_1^2}}\sin\frac{\pi}{T_1}t$; and since the slope of the wave $\theta_1=\Theta_1\sin\frac{\pi}{T_1}t$, we have the ratio of the ship's angle to the vertical to that of the normal to wave-slope to the vertical, or θ/θ_1, equal to

$$\frac{1}{1-\frac{T^2}{T_1^2}}=\text{constant}.$$

That is to say, the ship forsakes her own period and takes up that of the wave. This is termed *steady* or *permanent* rolling. Under these conditions, also, the ship's masts will lean towards the wave-crest if T is greater than T_1, and from the wave-crest if T is less than T_1. The above expression for θ is ordinarily termed the "forced oscillation," and represents the only element in rolling which strictly depends on the waves; if it be deducted from the first term of question (5) the remainder of that term with the two following terms represents a superposed "free oscillation" in the ship's natural period, which depends on accidental circumstances.

Mr Froude in his first paper further showed how the successive angles of a ship's rolling may be exhibited graphically, and he touched on the influence of resistance in reducing rolling. The following is the summary he gave of the conclusions he reached:—

"(i.) All ships having the same 'periodic time,' or period of natural roll, when artificially put in motion in still water, will go through the same series of movements when subjected to the same series of waves, whether this stability in still water (one of the conditions which governs the periodic time) be due to breadth of beam, or to deeply stowed-ballast, or to any such peculiarity of form as is in practical use.

"This statement would be almost rigorously true if the oscillations were performed in a non-resisting medium, or if the surface-friction and keel-resistance, by which the medium operates to destroy motion, were of the same equivalent value for all the ships thus compared. It requires, however, to be modified in reference to the circumstance that of two ships having the same periodic time in still water, the comparative forms may be such that the one shall experience such resistance in a higher proportionate degree than the other, and the necessary modification may be expressed in terms of their relative behaviour when set in motion in still water. The vessel which is the more rapidly brought to rest by resistance in still water will in the greater degree resist the accumulations of angle imposed on her by consecutive wave-impulses, and will the more fall short of the maximum angle which both would alike attain if oscillating in a non-resisting medium.

"(ii.) The condition which develops the largest angles of rolling is equality in the periodic times of the ship and of the waves; and this is true alike for all ships, whether their scale of resistance, as above referred to, be large or small.

"(iii.) That ship will fare the best which, *cæteris paribus*, has the slowest periodic time.

"(*a*) The waves which have a periodic time as slow as hers will have a greater length from crest to crest than those of quicker period; and, on the whole, long waves are relatively less steep than short ones. Now it is the steepness of the waves in a wave-series, not their height simply, which governs the rate at which angles of rolling will accumulate in a given ship when exposed to it.

"(*b*) Of two ships one of which has periodic time rather slower than the waves in a given ratio, the quicker ship will accumulate the larger angles.

"(*c*) It will require a heavier or a more continued gale to rear waves which have the lengthened period.

"(*d*) When the gale has continued so long that the largest waves have outgrown the period of the ship, she will not thereby have been released from the operation of waves having her own period, since the larger waves carry on their surface smaller waves of every intermediate period (this, at least, I believe to be the case).

"(*e*) When the gale has ceased and the sea is going down, the slower the period of the ship the sooner she will be released from waves of as slow a period.

"(iv.) There are two, and only two, methods of giving a slow period to a ship.

"(*a*) By increasing her 'moment of inertia,' as by removing her weights as far as possible from her centre of gravity; an arrangement which for the most part can only be accomplished to a limited extent.

"(*b*) By diminishing her stability under canvas. This can always be accomplished in the construction of a ship, and generally in her stowage, to any degree consistent with her performance of her regular duties, by simply raising her weights. Were we to raise these so high as to render her incapable of standing up against the action of the wind on her sails, the steepest waves would pass under her without putting her in motion.

"Thus the enormous weights carried by the armour-plated ships, extended laterally to the greatest possible distance from the centre of gravity, and raised high above it, serve in both respects to moderate, not to enhance, this tendency to roll; and when it is said that with the weights thus placed, and once put in motion, a ship 'must roll deep (deep, though easy),' it should be remembered that those very relations of force and momentum, which show how difficult it must be to check her motion when once it has been impressed on her, show also that it must be equally difficult to impart that motion to her in the first instance. The difficulty of starting her has a priority in point of time over the difficulty of stopping her, and prevents it from being felt by limiting the motion which would have called it into play.

"(v.) The conditions which govern pitching may be noticed here, though they have not been discussed in the paper.

"Were it possible, by concentrating her weights or by extending her plane of flotation, to give to the ship a period indefinitely quick for both longitudinal and transverse oscillations, as compared with that of such waves as are large enough to put her in motion, she would acquire no cumulative oscillation, but would float always conformably to the mean surface of the wave which passes under her.

"But this condition, which is so unapproachable in practice in reference to transverse oscillations that the attempt to approach it will but develop the evils pointed out in (iii.), is of necessity so closely approached in practice in reference to longitudinal oscillations, that those evils can only be escaped by approaching it as closely as is possible. The plunging of a ship whose weights are extended far fore and aft is but an incipient development of those phases of oscillation which have their proper development in transverse motion only. The best that can be desired in reference to longitudinal motion is that the ship's period, for longitudinal oscillation, shall be as quick as possible, and her position always as conformable as possible to the mean surface of the passing waves.

"I have insisted here, more prominently than in the body of the paper, on the circumstance that a total loss of stability, using that word in the ordinary sense of power of carrying sail, implies the possession of absolute stability, as regards rolling motion due to wave-impulse, because it has been pointed out to me that the attention of readers should be more strongly directed to it, not indeed as representing a practically available possibility, but as serving best to force the mind, by contact with an extreme conclusion immediately deducible from the theory, to appreciate its fundamental principles. And the proposition thus certainly furnishes a crucial test of whether the principles have been appreciated or not, and it supplies also a ready means of testing the theory by a crucial experiment. I must, in addition, express my own confident belief that any one who will try the experiment fairly will find the proposition so fully verified that he will feel obliged to admit that the theory which leads to so paradoxical yet true a conclusion deserves at least a careful study. But the more practically useful aspect of the theory is that which presents to view the varying phases of cumulative oscillation which a ship tends to undergo when exposed to various types of wave-series; the phases depending on the relation which her natural period of

rolling, when set in motion in still water, bears to the period of wave-recurrence, and on the maximum steepness of each individual wave of the series—phases, in fact, which she would actually undergo but for the effect of surface-friction and keel-resistance; the nature and value of which conditions, as well as the nature and necessity of experiments for their determination, have been pretty fully dealt with in the body of the paper.

"I will here only add a synoptical statement of the principal features of those phases, given in a rather more complete form than in that part of the paper which referred to them, though they are pretty fully exhibited by the diagrams.

"By a 'complete phase' is meant that series of oscillations which the ship undergoes counting from the time when, for a moment, she is stationary and upright in a similar position, and is about to recommence an identical repetition of the movements she has just completed.

"For the benefit of those who may glance at the appendix before they read the paper, I will mention that T is the number of seconds occupied by the ship in performing a single oscillation in still water, starboard to port, or *vice versâ*. T_1 is the number of seconds occupied by the wave in passing from hollow to crest, or crest to hollow. Θ_1 is the number of degrees in slope of the steepest part of the wave; and p/q is the ratio T/T_1, with the numerator and denominator converted into the lowest whole numbers that will express the ratio, where, however, it must be noticed that for $T/T_1 = 1$, p/q must be taken as the limit of such a form as $\frac{999999}{1000000}$. Then—

"(i.) The ship will complete the phase in the time $= 2qT$.

"(ii.) In completing the phase the ship will pass through the vertical position $2p$ times, or $2q$ times, according as p or q is the smaller number.

"(iii.) The ship will pass through the vertical position at the middle of the phase.

"(iv.) On either side of the middle of the phase there must occur, as equal maximum oscillation, the maximum in the phase, say Θ, which will approximately (but never in excess) $= \pm \Theta_1 \frac{q}{q-p}$.

"(v.) From these propositions it appears that if we compare two cases, in one of which the value of T/T_1 is the reciprocal of its value in the other, the phase will in each case consist of the same number of oscillations similarly placed; but in that one in which the period of the wave is slower than the period of the ship, the angles of oscillation will be the larger in the ratio p/q or q/p, whichever is the greater. The following table expresses the results of the above propositions, as exhibited in the diagrams, based on the assumption that the period of the ship is in every case $T = 5''$, and that the maximum slope of the wave $\Theta_1 = 9$ degrees:—

Ship's Period, or T.	Wave's Period, or T_1.	T/T_1.	T/T_1, reduced to Lowest Whole Numbers $= p/q$.	Time of Complete Phase $= 2qT$.	No. of Times Ship passes Vertical Position during Phase.	Approx. Outside Value of Θ, the Maximum Angle reached during Phase.
5″	5″	1	$\frac{999999}{1000000}$	Infinite.	Infinite.	Infinite.
5″	6·25″	0·8	$\frac{4}{5}$	50″	8	45 deg.
5″	4″	1·25	$\frac{5}{4}$	40″	8	36 ,,
5″	10″	0·5	$\frac{1}{2}$	20″	2	18 ,,
5″	2·5″	2	$\frac{2}{1}$	10″	2	9 ,,
5″	9″	0·55	$\frac{5}{9}$	90″	10	20 ,,
5″	2·77″	1·8	$\frac{9}{5}$	50″	10	11 ,,

It should be noted that the "wave-slope," spoken of as regulating the rolling, is not precisely the surface-slope, but a slope somewhat less (according to the depth of the ship), in virtue of the diminution of wave-motion with depth below the surface.

We have up to the present assumed that the rolling of ships in still water and among waves is *unresisted*, but this is not the case. A ship, if set rolling in still water, will experience resistance to the rolling motion, and a degradation of the amplitude will take place until the ship finally comes to a position of rest. Similar forces operate when a vessel is rolling among waves.

Resisted rolling.

The earliest investigators of resisted rolling in *still* water were Mr Froude in England and Messrs Bertin, Dubil de Benazé, Risbec, and Antoine in France. The method adopted was to roll a ship in still water and observe how the amplitude decreased roll by roll. As large an initial angle of roll as possible was obtained, generally by making men run from side to side of the ship, their runs being so timed as to add to the angle of roll swing by swing until the maximum angle was reached. This angle obtained, all movement on board was stopped, and the ship allowed to roll freely of herself until she came to rest. During this free movement a complete record of her angular motion against time was registered by means of a short-period pendulum and an electric timer. From this record a curve was constructed, in which abscissæ represented number of rolls and ordinates extreme angles of roll to one side of the vertical. Such a curve is termed a curve of "declining angles."

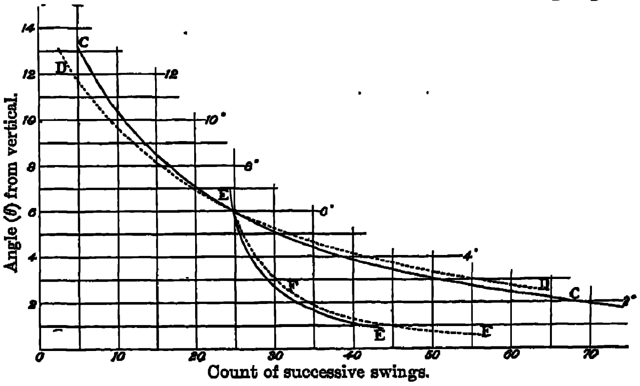


FIG. 1.—Curves of declining angles. C, light, and D, deep draught, no bilge keels; E, light, and F, deep draught, with bilge keels.

From this curve another curve is constructed, in which the abscissæ represent angles of roll and the ordinates the angle lost per swing. Such a curve is termed a "curve of extinction." Figs. 1 and 2 give these curves as obtained from experiments on H.M.S. *Revenge*; they are taken from a paper by Sir W. H. White, read before the Institution of Naval Architects in 1895.

Having obtained such curves, Mr Froude proceeded to investigate the relation between the degradation of the amplitude and the resistances which cause it. He assumed that the resistance to rolling varied (1) as the angular velocity, and (2) as the square of the angular velocity, and with these assumptions he obtained the following differential equation for the curve of extinction:—

$$-\frac{d\theta}{dn} = a \cdot \theta + b \cdot \theta^2,$$

where θ = extreme angle reached at any particular oscillation, n = count of the number of oscillations from the start of free rolling, and a and b are coefficients which bear a direct relation to the coefficients of resistance assumed to vary as the angular velocity and the angular velocity squared. Mr Froude assigned his reasons for expecting the resistance to vary partly as the first and partly as the second power of the angular velocity. The latter he considered due to surface-friction and the head-resistance of keels and deadwood, and the former to the resistance caused by the creation of a small wave each roll, which by travelling away from the ship becomes the cause of a dissipation of energy.

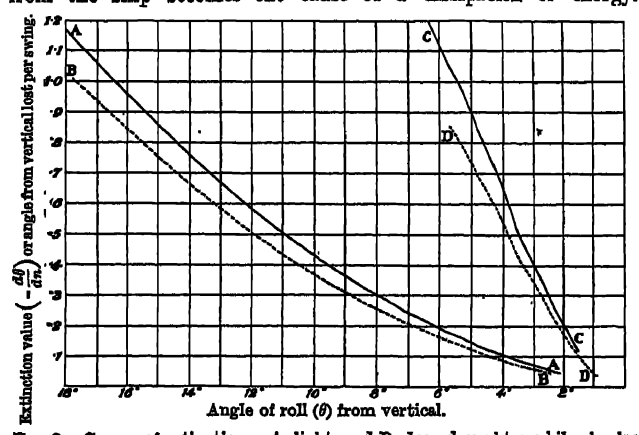


FIG. 2.—Curves of extinction. A, light, and B, deep draught, no bilge keels; C, light, and D, draught, with bilge keels.

Froude's views have been confirmed by the accuracy with which the expression $-\frac{d\theta}{dn} = a \cdot b + b \cdot \theta^2$ may be made to fit the curve of extinction of practically any ship by the judicious selection of the coefficients a and b. M. Bertin has, however, wished to substitute an expression equivalent to $-\frac{d\theta}{dn} = b \cdot \theta^2$, chiefly because he was not satisfied as to the mechanical conditions expressed by the other term. Other French investigators, again, have preferred an expression equivalent to $-\frac{d\theta}{dn} = a \cdot \theta$, but in Great Britain Mr Froude's expression has always been accepted as best representing all the facts.

For the *Revenge* the following equations represent the curves of extinction given in Fig. 2:—

For *deep draught*—

without bilge keels $-\frac{d\theta}{dn} = \cdot 0123\theta + \cdot 0025\theta^2$;

with ,, ,, $-\frac{d\theta}{dn} = \cdot 065\theta + \cdot 017\theta^2$.

For *light draught*—

without bilge keels $-\frac{d\theta}{dn} = \cdot 015\theta + \cdot 0028\theta^2$;

with ,, ,, $-\frac{d\theta}{dn} = \cdot 084\theta + \cdot 019\theta^2$

(θ in all cases being measured in degrees and not in circular measure).

The large increase in the b coefficient after bilge keels had been fitted has given rise to considerable discussion. Mr Froude had experimented with a deeply submerged plane oscillating in water, and he found that at a speed of 1 foot per second the resistance per square foot was 1·6 lb. Using this figure to calculate the work per swing (from an extreme angle of 6 degrees), the head-resistance of the bilge keels is found to be about one-fourth the energy lost in a single swing, due to the increased value of the b coefficient in the above formula. Thus the energy abstracted in this particular case is about four times what can be theoretically traced to the head-resistance of the bilge keels. This discrepancy has been observed in many previous cases, and it appears that when bilge keels are added to a ship they become effective, not merely as flat surfaces moving with the ship and experiencing direct resistance, but also by indirectly influencing the stream line motions which would exist about the oscillating ship if there were no bilge keels. In this connexion reference must be made to a paper by Professor Bryan, read before the Institution of Naval Architects in 1900, on the "Action of Bilge Keels."

The problem of resisted rolling among *waves* Mr Froude attacked in an inverse manner, to ascertain "what wave-series is required to keep the given ship at a given range of steady rolling with any assigned period, including the effect of resistance." Subsequently the problem was treated in a direct manner by the process of "graphic integration." This process is a most exact method of determining the motion of a ship, having given the elements of the ship's rolling in still water and the wave-series that is acting upon the ship, it enables the subsequent motion to be completely determined (see *Trans. Inst. Nav. Arch.* 1875). Some most valuable developments of the process were made by Sir William White in a paper read before the same society in 1881 on the "Rolling of Sailing Ships," in which the action of the wind on the sails, and the variation of the virtual weight of the ship on the wave are included. The effect of wind-pressure in heeling a ship is very much greater when she is at the crest of a wave than when she is at the trough, because her virtual weight is less. This must be taken account of in dealing with sailing vessels, the reduction of virtual weight, and therefore of righting moment, at the crest of a wave being very considerable, though the heeling moments due to the wind suffer no such reduction. We have seen above that when the half-period of the wave-series affecting a ship is equal to the period of the ship ($T_1 = T$), then at each successive wave crest and hollow the range of the ship's oscillation (unresisted) will be augmented by $\frac{\pi}{2}\cdot\Theta_1$, where Θ_1 is the maximum wave-slope. If, however, under these circumstances, the ship settles down to a steady roll of amplitude Θ, we can say that the increase of amplitude due to the wave is exactly balanced by the effect of the resistance to the rolling. The decrease of amplitude in still water per roll due to resistance is given by $-\Delta\theta = a\cdot\theta + b\cdot\theta^2$, and for the angle Θ will equal $a\cdot\Theta + b\cdot\Theta^2$. We can therefore equate these two quantities, and say $\frac{\pi}{2}\cdot\Theta_1 = a\cdot\Theta + b\cdot\Theta^2$, where Θ_1 = angle of maximum wave-slope and Θ = angle of steady rolling. With M. Bertin the equation would be

$$\frac{\pi}{2}\cdot\Theta_1 = N\cdot\Theta.$$

In 1894 and 1895 M. Bertin, at the Institution of Naval Architects, extended this relation to cases in which T_1 is not equal to T, obtaining at the same time not simply the angles of steady rolling for these cases, but the maximum angles passed through on the way to the steady condition; to these maximum angles he gave the name of "apogee" rolls. Mr R. E. Froude in 1896, at the I.N.A., investigated the probable maximum amplitude which she would attain under the influence of a non-synchronous swell if started with no roll. To arrive at the value of this "criterion amplitude," as he called it, Mr Froude superposed upon the steady resisted "forced oscillation" proper to the waves (which is easily calculated), a resisted "free oscillation" of equal initial amplitude, so that the two oscillations should at the start cancel one another and give no roll. For this supposition the mathematics readily give all the subsequent angles of roll. This treatment in effect assumes a curve of extinction such that the loss of roll per swing is proportional to the angle of roll; but provided the coefficient of extinction taken in the calculation was made to agree with the actual extinction at the angles mainly in question, little error was found to arise from the incorrectness of this assumption.

The following table shows the difference between the "criterion angle" and the angle of steady roll in the case of the *Revenge*, both without and with the bilge keels, and with the assumptions above mentioned:—

Maximum Wave-Slope, 3 Degrees.								
	$\frac{T}{T_1}$ = 1·3.		$\frac{T}{T_1}$ = 1·2.		$\frac{T}{T_1}$ = 1·1.		$\frac{T}{T_1}$ = 1·0.	
	Criterion Angle.	Angle of Steady Roll.	Criterion Angle.	Angle of Steady Roll.	Criterion Angle.	Angle of Steady Roll.	Criterion Angle.	Angle of Steady Roll.
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.
Revenge (deep draught), with no bilge keels	8·25	4·35	12·25	6·8	21·2	13·9	41·1	41·1
Revenge (deep draught), with bilge keels .	6·6	4·24	8·6	6·4	11·55	10·8	14·85	14·85

Mr Froude in his paper gives a number of instructive diagrams, from which he draws the conclusions that, however non-uniform initially, the rolling ultimately falls into the uniform forced oscillation; that it does so the sooner, *cæteris paribus*, the higher the resistance, and with the fewer "cycles" or alternations of amplitude of rolling, the more nearly synchronous the swell with the ship; that the amplitude of the ultimate uniform rolling is an approximate mean of the alternate maxima and minima of the precedent non-uniform rolling; that if the rolling starts from zero, the maximum amplitude falls short of twice the ultimate uniform amplitude, the more so the higher the resistance and the more synchronous the swell; and that in a synchronous swell the maximum amplitude cannot exceed the ultimate uniform amplitude, unless it does so initially. In two remarkable papers by Captain and Professor Kriloff of St Petersburg, read before the I.N.A. in 1896 and 1898, the whole motion of a ship, including pitching and rolling, is dealt with; these papers aim at taking account of every variation which can reasonably be conceived.

Bilge keels.

An extremely important practical matter very closely related to rolling is the effect of bilge keels. Some reference has already been made to these and the influence they exert on the rolling of a ship in still water, as illustrated by H.M.S. *Revenge*, in which there was one bilge keel on each side, 200 ft. in length and 3 ft. in depth, tapered at the extreme ends. The great value of bilge keels in diminishing rolling had been known as early as 1872, when Mr Froude experimented with the *Perseus* and the *Greyhound*, alike in every essential respect except that the former was not provided with bilge keels and the latter was. The general conclusion in this case was that the rolling of the *Greyhound* was only about one-half that of the *Perseus*.

Bilge keels were usual in warships until, in the design of the *Royal Sovereign* class, it was decided not to fit them, owing to the large dimensions of the vessels and the difficulties in certain circumstances of docking them if provided with bilge keels. Ultimately one of the class, the *Repulse*, had them fitted for purposes of comparison, and the result was so marked that it was resolved to fit similarly all the ships of the class. Before doing the work on the *Revenge* a careful programme was drawn up of experiments to be made before and after the bilge keels were fitted, and by carrying out this programme very valuable results were obtained. The experiments were made at Spithead in smooth water, and the general effect of the bilge keels was found to be the reduction of the rolling to one-third its former amount. When instead of having no motion in the line ahead the ship had a speed of 12 knots, the effect was even greater.

The experience of Great Britain with regard to bilge keels has been largely repeated in America. In the ships of the U.S. navy bilge keels were omitted for much the same reasons as in the *Royal Sovereign* class; then on the U.S.S. *Oregon* they were fitted, experimental investigation being made both without and with them, and the general conclusion arrived at was that the rolling was diminished to one-third by the bilge keels. The usual form of bilge keels fitted to warships to reduce rolling may be seen in Fig. 30.

As an alternative to bilge keels, water chambers at one time promised great results in the way of reduction of rolling. The effect of such chambers, with some numerical results, is described very fully in the ninth edition of this work. Exigencies of space

have, however, prevented them from becoming a permanent feature in the design of war or other ships; in addition, the conditions of warship design have changed, and now admit of more moderate values of the metacentric height, which is a most important factor in increasing the time of oscillations and thus reducing rolling.

Resistance and Propulsion.

The resistance and the propulsion of ships are dealt with at considerable length in the ninth edition of this work, and the account given should be read in connexion with the following notes.

By means of experiments with models of different sizes towed by a steam launch, Mr W. Froude established the truth of his "law of comparison" between vessels of different size, a law which he had conceived independently, but which had been previously worked out on mathematical lines by M. Reech in his *Cours de Mécanique*, published in 1852. He afterwards, in 1871, constructed a tank and apparatus at Torquay for dealing with these matters on behalf of the British Admiralty. When in 1885, six years after his death, the ground occupied by the Torquay tank was required for building purposes, a new tank was constructed at Haslar, near Portsmouth, from the designs and under the supervision of Mr R. E. Froude, F.R.S., such improvements being added as experience at Torquay had showed to be desirable. At both these tanks models of propellers as well as of ships were experimented upon, besides a variety of matters connected with the general subject. Similar Government establishments have since been established in Holland, Italy, France, Russia, and the United States, and by one private firm on the Clyde (William Denny and Brothers, Dumbarton). Others are in contemplation. The Admiralty experimental tank at Haslar is nearly 400 feet long, 20 feet wide, and 9 feet deep. The main experimental carriage spans the whole width of the tank, and carries a secondary railway on which the subsidiary carriages, which carry the experimental apparatus of different kinds, are adjusted in position. The main carriage runs on rails on the side walls, and can travel the whole length of the tank; it is driven at various speeds by a wire rope from a stationary engine of ample power. Ordinary speeds range from 100 to 800 feet per minute, while an extreme speed of 1200 feet per minute can be obtained; the speeds are regulated by a highly sensitive governor. The models are made of hard paraffin-wax, generally about 14 feet long and somewhat over one inch in thickness; they are cast in a mould, with an allowance of about $\frac{1}{8}$ inch for finishing. To shape a model accurately, it is placed bottom up on the bed of a machine in which a pair of revolving cutters, one on each side of the model, cut out on its surface a series of level lines, whose contours are precisely similar to those on the drawing of the ship whose model is under treatment. When all the level lines have been cut in, the model presents the appearance of a series of steps, the bottom angles of which correctly represent the true form the model should possess. The paraffin ridges between these level lines are trimmed off by the use of suitable tools, and the outside surface made quite smooth with flexible steel scrapers. When ballasted to its required displacement and saddled with a frame, which carries the guiding attachment and also the towing-rod, the model is placed below the dynamometer carriage, and the dynamometer is lowered into place. The towing-rod at its forward end is then in a position to impart horizontal forces by a hard steel surface to a knife-edge on the dynamometer lever within the model at about the level of the water-surface. There are various delicate arrangements with knife-edge adjustments, which result in the horizontal forces being transmitted through a spiral spring, the extensions of which are multiplied by a lever and recorded by a pen on a paper-covered cylinder, distances and time being simultaneously recorded. From these elements, the speed and resistance corresponding to each experiment are deduced, a most necessary condition being that the speed shall be uniform throughout each experiment. By somewhat similar arrangements on another subsidiary carriage, the action of model screw propellers is tested, either in undisturbed water or behind a model, the rate of rotation, rotary resistance, and thrust being measured.

Experimental tanks.

One of the most recent experimental tanks is that constructed by the United States Government at the Washington Navy Yard. The building is 500 feet long and 50 feet wide inside; the breadth of the water-surface is 43 feet, the length 470 feet, 370 feet of which has a depth of about 14 feet. The models are constructed of wood and not of paraffin, in consequence of the high temperatures reached at Washington in summer. The models are made by a copying machine adapted for the purpose; after removal from the machine a little finishing by hand is necessary, and over the finished surface a waterproof varnish is applied. The carriage to which the model is attached for the purpose of experiment runs upon four pairs of wheels and spans the entire breadth of the basin; it is driven electrically, one motor being applied to each pair of wheels; the speed is controlled by a delicate governor on the generator. The possible speeds obtainable range up to 20 knots. In the dynamometric apparatus electricity is also used, and multiplying levers, as used by Mr Froude, are entirely dispensed with, whenever it is desirable to avoid friction. Resistance is measured by the extension of a spring, as usual, and several ingenious arrangements have been devised to obtain the recorded results.

Mr W. Froude, basing his investigations partly on theory and partly on the results of experiments, found that in a body moving with uniform speed through water at, or near the surface, the resistance would consist of three parts: (1) surface friction; (2) eddy-making resistance, chiefly due to rapid changes of form, especially towards the after end; (3) wave-making resistance, due to the expenditure of energy in continually supplying the waste of the attendant system of waves. For some purposes it is convenient to group (2) and (3) together under the name of residuary resistance—that is, the resistance left after deducting surface friction.

Components of resistance.

Surface friction is of great importance, as it forms the chief cause of resistance at relatively low speeds, and a considerable proportion of the total even when the speed is high. It necessarily varies with the area and nature of surface exposed, and with the speed through the water; it also varies with the density, but not with the pressure, and is therefore practically independent of the depth below the surface. Formerly it was thought to vary directly as the area and the square of the speed. Mr W. Froude's experiments demonstrated that the resistance per square foot diminishes somewhat as the length of the surface is increased, and with varying speeds its variation is expressed in most cases by a less exponent than the second power. Thus for a surface covered with fresh clean paint 2 feet long in the direction of motion, at 600 feet per minute, the resistance is 0·41 ℔ per square foot, and it is varying as the second power of the speed. For the same surface 50 feet long in the direction of motion, the resistance is only 0·25 ℔ per square foot, varying as the 1·83 power of the speed.

With regard to the second form of resistance, that due to the formation of eddies, Mr W. Froude spoke of it as hindering the necessary stream-line motions, altering their nice adjustment of pressures and velocities, defeating the balance of forward and backward forces acting against the surface of the body, and thus inducing resistance. This view was extended by Mr R. E. Froude in 1894, in a paper read before the Greenock Philosophical Society. In speaking of the stream-line motion of a submerged body, he says: "Along the sides and at the shoulders of the body the particles in a frictionless fluid have a defective pressure and a corresponding excess of speed. In a frictional fluid the case will be the same so far as pressure is concerned. But in respect of speed the case will differ in this way, that near the surface of the body the particles will have their speed reduced in consequence of the skin friction, thus embodying what is called the frictional wake. Now, how are these particles of reduced speed to continue their flow against the rise of pressure between the low-pressure region at the shoulder and the high-pressure region at the stern? In the frictionless fluid the particles do so in virtue of their excess of speed, which they exchange for pressure; but what is to become of the particles near the side in the frictional fluid, which have already lost a great deal of their speed? They, in advancing into the high-pressure region, will render up what speed they have left, till they are bankrupt altogether in the matter of speed, and then tend to stop still." Pursuing this line of argument, he (1) shows that this disturbance of stream-line speed introduces quite other conditions of flow than pure stream-line conditions, and (2) explains why given abruptness of form is far more potent as a disturbing cause when it is situated near the stern than when near the bow.

With regard to the third form of resistance, namely, that due to the formation of waves, it is important to note that although it is of small importance at relatively low speeds, yet for high speeds it forms a considerable portion of the total. The rapid growth of resistance as the speed is increased, and consequently the large increase of horse-power for an increment of speed at high speeds, compared with that caused by a similar increment at low speeds, is due to the resistance caused by the formation of waves. In the motion of water past a body submerged deep enough below the surface to avoid wave-making, a portion at the forward end encounters increased pressure, due to the motion; a succeeding portion encounters decreased pressure; and the after portion, increased pressure again. In a frictionless fluid the sum of all these pressures resolved in the line of motion would be *nil*; there would be no resultant force on the body, due to the fluid being pushed aside at the front and closing in at the rear. With the body near the surface, and still more with the body only partially immersed, as a ship, the excesses of pressure at the ends, and the defects of pressure along the sides, due to the motion, have the immediate effect of causing the level of the water to be raised at the ends and lowered along the sides. In the case of a ship moving on the surface of water supposed to be still, these variations of pressure will still exist, and the imaginary statical wave, first mentioned by Mr R. E. Froude in his lecture before the Greenock Philosophical Society in 1894, would be their natural result. In this imaginary

wave "the elevations and depressions are the statical equivalent of the differences of pressure which there would be if the surface were forcibly kept smooth, as it might be conceived to be if the underwater hull were travelling beneath a rigid sheet of ice." This statical wave may be regarded as the cause of the actual wave-series we observe. Any disturbance of level in water tends to generate a series of waves, and so we have the bow series of waves, caused by the statical wave at the bow, and the stern series of waves, caused by the statical wave at the stern. The force required to maintain continually these waves is the measure of the wave-making resistance of the ship.

Each of these series of waves consists of a set having their crests nearly perpendicular to the line of motion, and a diverging set sloping aft. These latter pass at once away from the ship after being formed, but the transverse series initiated at the bow cause considerable interference with the corresponding series at the stern. The resulting total energy of the wave-field will vary according to the way in which the two series interfere with each other, so affecting the resistance of the ship. This is the cause of the series of humps and hollows which has been noticed as a characteristic feature of a curve of resistance on base of speed. This was investigated by Mr W. Froude in his 1877 paper before the I.N.A. on the effect produced on the wave-making resistance of ships by varying the length of the parallel middle body; the matter of this paper is given in considerable detail in the ninth edition of this work. It became apparent from his experiments that a hump on the resistance-curve was due to the incidence of a crest of the bow-wave series on the crest of the stern wave, while a hollow on the resistance-curve was due to the incidence of a trough of the bow-wave series at the same place.

The form taken by the waves generated in the motion of ship models has been carefully observed by both Mr W. and Mr R. E. Froude. To the peculiar arrangement of the crests of the diverging waves has been given the name *échelon*—the arrangement, namely, by which the most highly raised portions stand in ridges, each stepped back from the line of the crest of its preceding neighbour, the line again connecting the summits of these successive crests forming a definite angle with the line of motion of the body. The true meaning of this *échelon* series has been pointed out by Lord Kelvin; he has shown that it arises from the same cause as the transverse series, the two series being both parts of a complete whole.

Experimental results. Of the enormous number of experimental results that have now been obtained from the trials of ships models, in the tanks referred to above, remarkably few have been made public. In connexion with the Torquay and Haslar tanks some few of the reports by Mr W. and Mr R. E. Froude have been published by order or permission of the Board of Admiralty, chiefly through the I.N.A. and other societies. Amongst these may be mentioned the *Greyhound* experiments in 1873; the *Merkara* results, in an I.N.A. paper in 1876; experiments on the effect produced on the wave-making resistance of ships by varying the length of parallel middle body, in an I.N.A. paper in 1877; results obtained from models of three merchant liners in 1881; and a paper before the I.N.A. in 1888 on the "constant" system of notation of results of experiments on models used at the Admiralty experiment works. Of the Dutch results a number were published by the late Dr Tideman in the *Memorial van de Marine* in 1878. Of the Dumbarton experiments, results for three vessels were given by the late William Denny to the Institution of Engineers and Shipbuilders in Glasgow in 1884; and for two models at varying draughts by Mr A. Denny at the International Engineering Congress at Chicago in 1893. The results of some experiments at the Italian tank to ascertain the effect of depth of water on resistance were communicated to the I.N.A. in 1900 by Major Guiseppe Rota, and in the discussion Mr A. Denny gave the results of some similar experiments carried out at Dumbarton.

The experiments with the *Greyhound* were of special importance, as they helped materially to confirm the accuracy for practical purposes of the "law of comparison." In this case dynamometric experiments were made on the ship as well as on her model. Three different displacements were given to the ship, and for the least and greatest of these several different conditions of fore-and-aft trim were tried. Subsequently, also, the vessel was fitted with bilge keels. Resistances at various speeds were obtained for no less than eleven different conditions of the vessel. The model was on a scale one-sixteenth full size, and the resistances were obtained in the Torquay tank under each of the conditions of displacement and trim corresponding to those adopted in the ship herself. Very close agreement was found to exist between the resistances of the *Greyhound* and her model according to the "law of comparison." (This most important law is very fully dealt with in the ninth edition of this work.) The *Merkara* results are of special interest, because of Mr W. Froude's attempted

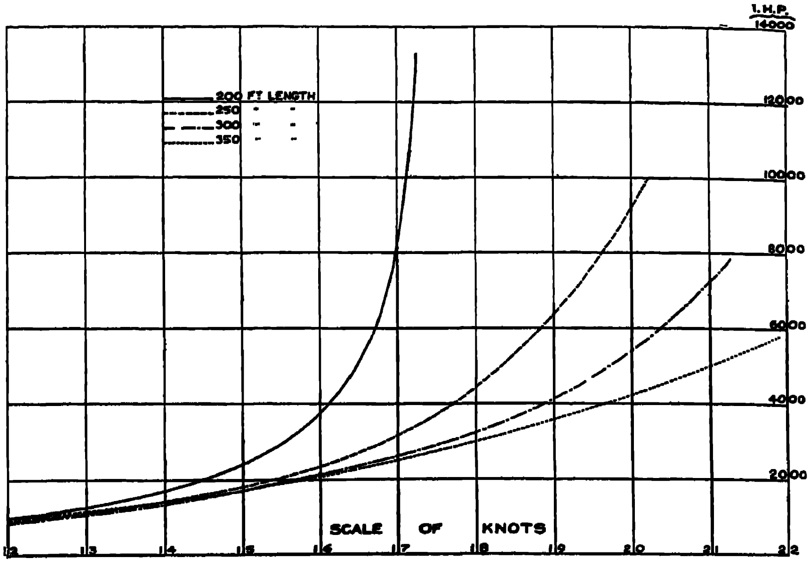


FIG. 3.—Curves of I.H.P. for a vessel of 2000 tons displacement.

analysis of the "indicated thrust" curve into its elements. Besides the curve of I.H.P. on base of speed, another curve was constructed showing "indicated thrust" on the speed base. This "indicated thrust" was obtained at any given speed by multiplying the I.H.P. by 33,000 and dividing by the product of pitch

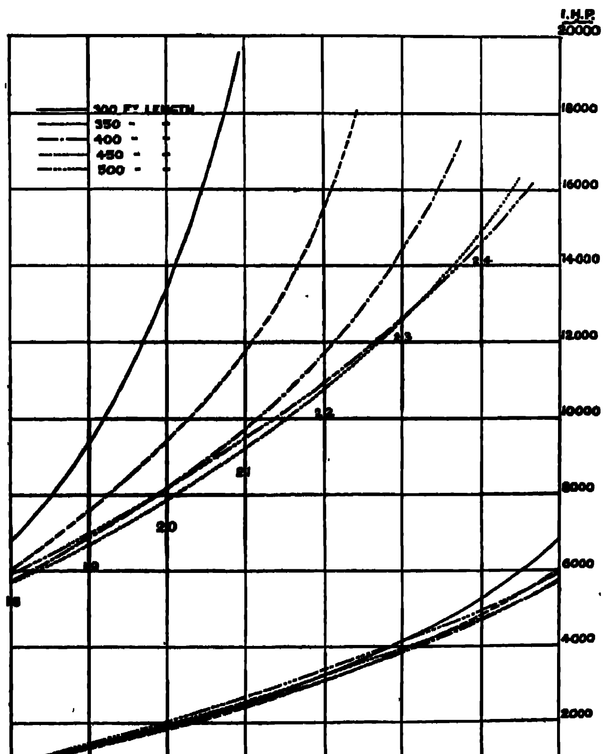


FIG. 4.—Curves of I.H.P. for a vessel of 5000 tons displacement.

and revolutions of the propeller. Mr Froude resolved this into its elements, namely: (1) useful thrust or ship's true resistance; (2) augmentation of resistance due to the action of the propeller (since called thrust deduction); (3) edgewise friction of propeller blades; (4) initial friction; (5) working friction; (6) air-pump and feed-pump duty. The results obtained from this analysis are of extreme interest as indicating the various sources of loss between

the actual I.H.P. and the H.P. due to the ship's net resistance (called Effective Horse-Power), but in the light of more recent experiments the values arrived at have been somewhat modified.

For estimating the indicated horse-power required to give a particular speed to a steamer there are two distinct courses open, according to the information available. One is the use of data obtained from tank experiments, the other the use of data obtained from actual ships. It is sometimes erroneously thought that the former of these courses excludes the latter; so far from this being the case, a good deal of the experimental work of a tank is directed to obtaining as full a knowledge as possible of the inconstancy affecting all comparative speed-results. Models are tried under conditions exactly similar to those of the ships they represent, the speeds and powers of which are known; from the models the effective horse-powers are deduced, and these are compared with the actual powers, the ratio of the former to the latter expressing what is known as the *propulsive coefficient*. In estimating for a new ship the designer has the propulsive coefficients of similar ships before him, together with such knowledge as is available of the cause of their want of constancy. Besides propulsive coefficients, other tank data are kept

Indicated horse-power.

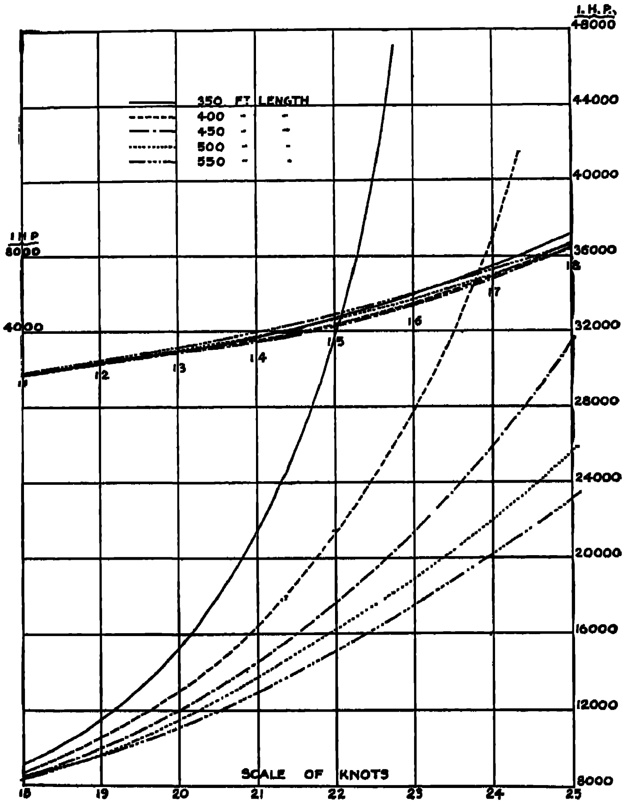


FIG. 5.—Curves of I.H.P. for a vessel of 9000 tons displacement.

in shape for ready application. From such particulars the curve of H.P. for the ship contemplated can be estimated.

With further reference to the propulsive coefficient, a very roughly approximate figure is 0·5; the difference between unity and this coefficient must be regarded as the combined loss of efficiency of all the different parts of the propulsive machinery, including the propeller. As already mentioned, these losses were analysed by Mr W. Froude in 1876 in his paper on the *Merkara*. The loss due to the propeller has since received great attention at the hands of Mr R. E. Froude, but there would seem to be room for more investigation and experiment regarding this and other losses.

The method of estimating speed and power which is probably most commonly used is one involving a relation between I.H.P., displacement, and speed, expressed by the formula—

$$\frac{(\text{Speed})^3 \times (\text{Displacement})^{2/3}}{\text{I.H.P.}} = C,$$

C being called the *Admiralty coefficient*. The value of C varies considerably for different speeds even of the same ship. For it to be constant, the I.H.P. would have to vary as the cube of the speed; if resistance varied as the square of the speed and I.H.P. as resistance and speed, the condition of constancy would be fulfilled. Resistance-variation, however, is not so simple. Again, in the dependence of I.H.P. on resistance and speed important terms are involved causing considerable variations. Those who use the Admiralty coefficient for estimating are very careful to choose their data from practice with which they are well acquainted, and to see that they do not press the application beyond the limits

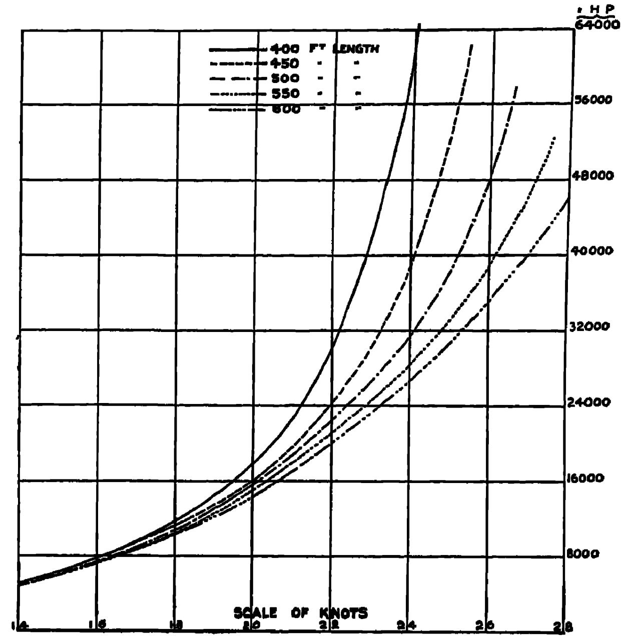


FIG. 6.—Curves of I.H.P. for a vessel of 14,000 tons displacement.

that the circumstances justify. In some cases great care is taken that the speed for the ship under estimate is the corresponding speed of the ship estimated from, or that the departure from the corresponding speed is not great. (Corresponding speeds are those varying as the square root of the lengths. These are the speeds

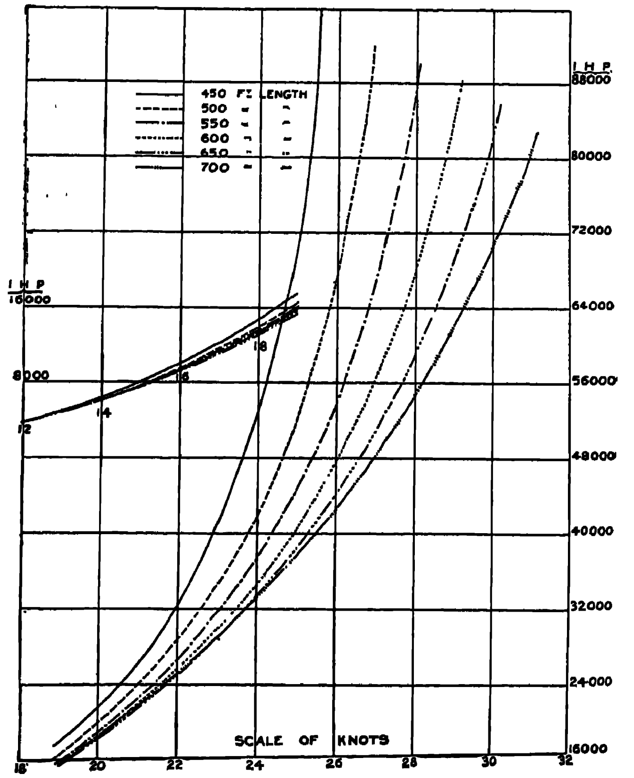


FIG. 7.—Curves of I.H.P. for a vessel of 20,000 tons displacement.

used in the law of comparison.) Again, between the ship under estimate and the ship estimated from, a general similarity as to form and as to proportions of length, breadth, and draught is sought.

A general indication only can here be given of the value of the

coefficient C. For good results it may be said to vary from 200 to 300 (speed in knots, displacement in tons), but many instances will be found of values both above and below this range; in steam launches (to take only one instance), where the speed is high in relation to the square root of the length, it may be as low as 80.

Use of law of comparison. As an illustration of the use of the law of comparison in estimating I.H.P. from the performance of a similar ship, the following example is given:—A vessel 300 feet long, $36\frac{1}{2}$ feet broad, $13\frac{1}{2}$ feet draught, and 2135 tons displacement requires 7000 I.H.P. for a speed of 20 knots. It is required to estimate the I.H.P. of a similar ship of 3000 tons displacement at the corresponding speed. The ratio of displacements being 3000/2135, the ratio of linear dimensions will be the cube root of this, or 1·12, and the ratio of corresponding speeds, the sixth root, or 1·06. The dimensions of the 3000-ton ship will therefore be 336 feet × 41 feet × 15·1 feet, and the corresponding speed 21·2 knots. At this speed the I.H.P. of the 3000-ton ship will be according to the law of comparison, $7000\times\left(\frac{3000}{2135}\right)^{7/6}=10{,}400$ I.H.P. about. Thus for a vessel similar to the above, 336 feet × 41 feet × 15·1 feet, with a displacement of 3000 tons, 10,400 I.H.P. is required for a speed of 21·2 knots. In this use of the law of comparison we make several assumptions:—(1) The machinery and propellers will work with the same efficiency in both cases; (2) the surfaces of the two vessels are in the same condition; and (3) the correction for surface friction in passing from one ship to the other of different length is unnecessary. (This correction is of great importance when passing from a model to a full-sized ship.)

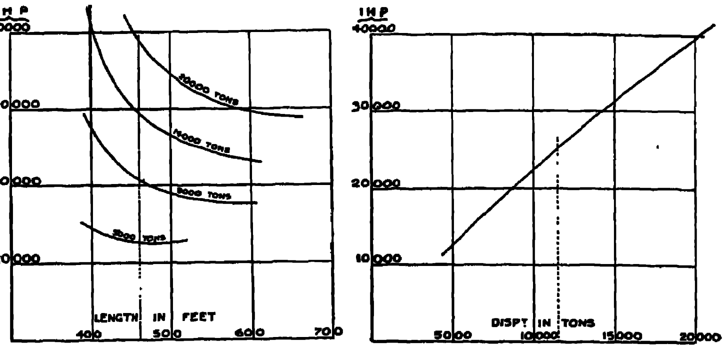
Power and speed. To illustrate what has gone before, and at the same time to afford useful data for estimating the I.H.P. of vessels of a particular type, a number of diagrams have been constructed (Figs. 3–7) showing for each of five displacements a series of curves of I.H.P. plotted to a base of speed for ships of various lengths. They are based on the steam-trial results of the Elswick cruisers and other data. The volume of displacement of the above vessels is approximately one-half that of the circumscribing parallelopipedon, or in other words the "coefficient of fineness" is about 50 per cent.—a very fair average value for modern cruisers. These results will only hold for vessels of about the same coefficient of fineness, for experience with models has shown this coefficient to have an important bearing on resistance. With this restriction the series of curves enables an approximate estimate to be made, by a process of interpolation, of the I.H.P. necessary to drive at any required speed a ship of given dimensions within a wide range of displacement and length. It must be borne in mind, however, that there are many possible features in the form of a vessel which militate against a good performance, principal among which we may mention the following:—sudden change of curvature in the curve of sectional areas, parallel middle body, too full a water-line, unduly large ratio of beam to draught; and to realize so good a performance as is represented by these curves we must suppose the lines of the ship designed to avoid, as far as possible, any of these features. Besides this, the engines and propellers must have been designed to minimize the waste of power in engine friction, churning of the water by the propellers, &c.; the ship must have a clean bottom, and be run in deep water under favourable conditions of wind and sea.

As a numerical example of the use of these curves, suppose we wish to estimate the I.H.P. necessary to drive a cruiser of 10,500 tons displacement and 460 feet length at a speed of 23 knots. We first plot a series of cross curves of I.H.P. on a base of length of ship (see Fig. 8) for each of the five displacements. By cutting this series at 460 feet length we again plot a cross curve of I.H.P. (Fig. 9), this time on a base of displacement. Lastly, we cut this curve at 10,500 tons displacement, which gives us 23,500 as the I.H.P. required. By repeating this process for a series of speeds, a complete curve of I.H.P. could be constructed.

The curves bring out very strikingly the great importance of giving a ship sufficient length if she is to run at high speeds. Take, for example, the curves on Fig. 3 for ships of 2000 tons displacement. The 350-feet ship here requires 2100 I.H.P. for 16 knots and 4200 for 20 knots, *i.e.*, the I.H.P. is doubled in passing from 16 to 20 knots. But $2=\left(\frac{20}{16}\right)^3$ approximately, indicating that for this ship the I.H.P. varies as the cube of the speed within these limits of speed, and therefore the resistance varies as the square of the speed. On the other hand, as the speed of the 200-feet ship passes from 16 to 17 knots the I.H.P. increases from 3800 to 8200, or approximately in the ratio 2·2. But $2{\cdot}2=\left(\frac{17}{16}\right)^{13}$ approximately, indicating that the resistance is actually varying as the 12th power of the speed for this ship between 16 and 17 knots. Practically so short a ship of this form could not be driven at a greater speed than 17 knots, for after this speed is reached any moderate increase of I.H.P. would not sensibly affect the speed.

This excessive rate of growth of I.H.P. does not continue indefinitely, for after a certain speed is reached the rate suddenly begins to fall off, and eventually will again bear a reasonable relation to the rate of growth of the speed. The phenomenon is a result of the harmonic nature of the wave system, and is not confined to abnormally short ships. In fact, it is most apparent in small fine vessels run through a wide range of speed, such as torpedo-boats and destroyers. Fig. 10 shows, for such a vessel, three curves plotted to a base of speed, the ordinates being respectively—I.H.P., $\frac{\text{I.H.P.}}{(\text{speed})}$, $\frac{\text{I.H.P.}}{(\text{speed})^3}$. The second of these is of course a curve of resistance, and the rapid rise and fall of the rate of growth of resistance manifests itself in this resistance-curve by a very marked hump between 15 and 25 knots speeds. The third curve, that of $\frac{\text{I.H.P.}}{(\text{speed})^3}$, is interesting as affording, by its slope at different points, a very good indication of this rate of growth.

Up to 13 knots speed this curve is not far from being horizontal, indicating that till then the resistance is varying about as the square of the speed. The rate of growth increases from this point till it reaches a maximum at 15 knots, and then falls off till at 19 knots the resistance once more varies as the square of the speed. From this point onward the resistance increases approximately according to the above law. It may be noted that



FIGS. 8 and 9.—Cross curves for determining the I.H.P. of a vessel of 460 feet length, 10,500 tons displacement, and 23 knots speed.

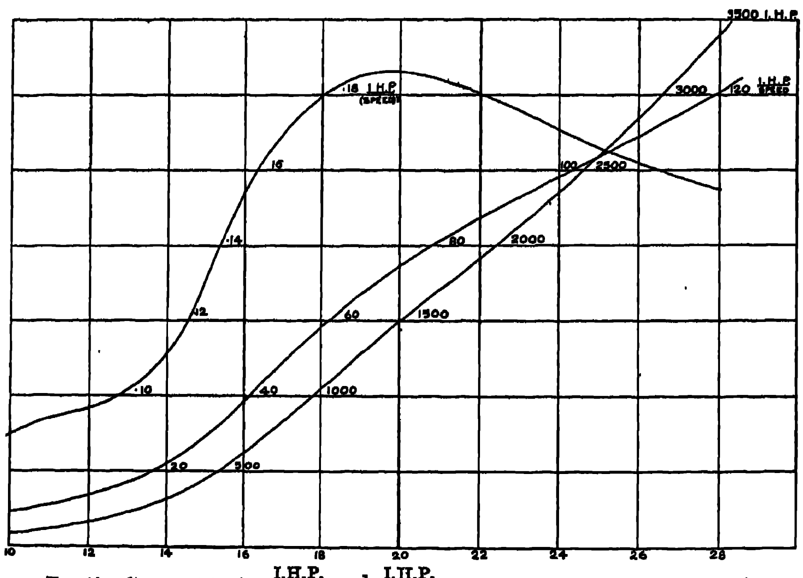


FIG. 10.—Curves of I.H.P., $\frac{\text{I.H.P.}}{(\text{speed})}$, and $\frac{\text{I.H.P.}}{(\text{speed})^3}$ for a vessel of 120 tons displacement.

at 19 knots the ship's statical wave has approximately the same length as the wave which would travel freely at the same speed as the ship, and this determines the position of the maximum value of $\frac{\text{I.H.P.}}{(\text{speed})^3}$. In this connexion a fact pointed out by Professor Biles in a paper read before the Institution of Naval Architects in 1881 is interesting. When the resistance of a form varies as the 6th power of the speed, an increase in the displacement by a proportionate enlargement of dimension will not cause an increase in the resistance for the same speed; and when the resistance varies as a higher power of the speed than the 6th, the resistance will actually be reduced by increasing the displacement.

As the speed is decreased, the advantage of the longer ship rapidly falls off, and at low speeds the longer ship actually requires more I.H.P. to drive it than the shorter one of the same displacement. For example, if we compare 5000-ton ships of 400 and 450 feet lengths (see Fig. 4) at 23 knots, the 400-feet ship requires 1800 more I.H.P. than the 450 feet, but at 17½ knots the I.H.P.'s required are almost equal (shown by the curves crossing); and if the speed is further reduced, the 450-feet ship becomes the worse of the two. The reason of this is not difficult to see. At high speeds the resistance is chiefly caused by surface disturbance or wave-making, and this is less in a fine long ship; but at low speeds the resistance consists almost entirely of surface friction, and consequently is proportional to the wetted surface of the ship. Now lengthening a ship of fixed displacement, with corresponding reduction of beam and draught, increases the wetted surface, just as increasing the eccentricity of an ellipse of fixed area increases the perimeter. Consequently the longer ship has the greater surface-friction resistance. In fact, for a given displacement and speed we can find a definite length of ship which will require the minimum expenditure of I.H.P., but structural and other reasons would generally make this length too great for practical purposes. This "best length" will, of course, increase both with speed and displacement. As a result of this reasoning we should expect the order of the curves at low speeds to be the reverse of that at high speeds on each sheet, *i.e.*, the ordinate for the longest ship should be highest instead of lowest, and so with the others. This would have been more apparent had the curves been plotted on a more open scale and continued to a lower speed than has been found convenient to do.

Before proceeding to discuss screw propellers, it will be desirable to define some of the terms employed. The product of revolutions and pitch is often called the speed of the propeller; it represents what the speed would be in the absence of slip. Speed of advance, on the other hand, is applied to the movement of the propeller in the line of its action without relation to its rotation. The difference between speed of propeller and speed of advance is the *slip*. Slip is often spoken of as either "apparent" or "real": if it is "apparent" for speed of advance is taken the speed of the ship, when it is not real, simply because it takes no account of the "wake" water carried with the ship. For analytical purposes this wake must be taken account of, and the speed of advance measured with respect to it; the resulting slip deduced is then the "real" slip. Since the wake moves with the ship, the speed of advance of propeller through the wake is, speaking generally, less than the speed of the ship, and the real slip is greater than the apparent slip. "Velocity of feed" is the term employed by Mr Barnaby for the speed of advance through the wake, and in some respects it expresses what is wanted better than any other term.

Screw propellers.

Previous to 1878 investigations into the action of the screw propeller were made on the following lines:—The velocity of water flowing past a propeller blade was resolved (1) normally and (2) tangentially to the blade; further, the normal velocity was resolved into (*a*) longitudinal and (*b*) rotational velocity. A fundamental error underlying this double resolution was that it did not correctly measure the forces involved, or take account of the effect of the obliquity of a plane moving at an angle to itself through the water. In Mr W. Froude's 1878 paper "on the elementary relation between pitch-slip and propulsive efficiency" this error was corrected. On the authority of Lord Rayleigh's investigations, supported by experiment, it was shown that the normal pressure acting on the face of a plane relatively narrow in the line of motion depends upon the sine of the angle of inclination rather than on the square of the sine, as had been previously assumed. Starting with this fact as a basis, and using figures for normal pressure and for surface friction obtained from his own experiments, Mr W. Froude constructed mathematical expressions for the forces acting on a plane area moving obliquely through the water at a given speed. Treating this plane area as an elementary portion of a propeller blade, and considering the forces in relation to resolved speeds, he obtained further expressions for (*a*) effective work done by the plane in the direction corresponding to the line of motion of the ship, and (*b*) total work required to be done in the circumferential direction to maintain the motion. The ratio of (*a*) to (*b*) in any case represented the efficiency for that case. He was led to the following conclusions regarding maximum efficiency:—(1) The slip angle (obliquity of surface to the line of its motion) ought always to have the same value (proportional to the square root of the coefficient of friction); and (2) when this is so, the pitch angle should be 45°. The maximum efficiency obtained from this investigation was 77 per cent. This theoretical investigation, though of importance and interest, does not exactly represent the actual conditions, inasmuch as the deductions from a small element are applied to the whole blade, and, further, the considerable disturbance of the water when a blade reaches it, owing to the passage of the preceding blade, is ignored.

The experiments on screw propellers which Mr W. Froude was carrying out in 1878 at the Torquay tank, and the nature of which he had in the previous year described in a paper read before the Institution of Civil Engineers, were after his death continued by Mr R. E. Froude, and some of the results were communicated to the I.N.A. in 1883, 1886, and 1892. A partial series on somewhat the same lines was also described by Mr Thornycroft to the I.N.A. in 1883. In the Torquay experiments four four-bladed propellers were used, with a uniform diameter of 0·68 feet, and having relation of pitch to diameter, or pitch-ratio, of 1·225, 1·4, 1·8, and 2·2 respectively. The pitch of each blade was uniform and the shape elliptical. The width in the middle of the developed blade was $0{\cdot}4 \times \frac{\text{diameter}}{2}$, so that the developed surface (making no deduction for the area of boss) was 0·4 × disc area. In the experiments a uniform speed of 206 feet per minute was obtained throughout; for the most part the propellers were tried in the open, no ship model being represented in connexion with them. In each case, while the speed of advance was uniform, the number of revolutions was varied throughout a sufficient range of experiments, the slip or slip-ratio was thus varied, by slip-ratio being meant $1 - \frac{\text{Speed of advance}}{\text{Pitch} \times \text{revolutions}}$. The thrust and also the turning couple were ascertained in each experiment, the relation of work done by thrust to work of turning moment expressing the efficiency. In combining the results from the four propellers great assistance was derived from the discovery that the curves expressing the variation of efficiency with slip-ratio had a close similarity, one curve being practically producible from another by an alteration of the scale used for the abscissæ of the curves, namely, the slip-ratio. Making the alteration in each case, a diagram was obtained in which one efficiency curve did duty for all the propellers. The ordinates of this curve represented efficiencies, the abscissæ represented slip-ratios, varying uniformly for any one propeller, but requiring a different scale of interpretation for each propeller in question according to its pitch-ratio. The data given by this diagram, although derived from propellers with four pitch-ratios only, were readily made applicable, by interpolation, to any other pitch ratios within the limits of those actually experimented upon. For practical application the next step needed was to make the results obtained from propellers of one diameter, moving at one speed of advance, available for any speed and any size. For this purpose the following assumptions were made, which, however, are well supported by experimental results:—(1) With given slip-ratio the thrust of a given screw varies as the square of the speed of advance. (2) With given slip-ratio and given speed of advance and given design of screw, with varying size, the thrust varies as the square of the dimensions. (3) With given slip-ratio and given design of screw the efficiency is unaffected by variations of speed or size of screw. The data from the small propellers were interpreted in accordance with the above by the introduction of the necessary multipliers and divisors into the scales of the diagram already referred to. This diagram is capable of very considerable modification, in accordance with the class of problem to the solution of which it is to be applied. Suppose it is desired to ascertain the best propeller for a certain speed of a given ship. Mr Froude assumes the effective horse-power to be known. There are then still four variables to be dealt with, namely, the diameter, the pitch or pitch-ratio, the revolutions, and the efficiency. If the revolutions, as is usually the case, are practically fixed by the size of the engines available and the horse-power to be developed, one other unknown is supplied, and Mr Froude's working diagrams (see *Trans. Inst. Nav. Arch.*, 1892) then give the means of expressing diameter in terms of efficiency and pitch-ratio, these last two variables being mutually involved. In ultimately deciding upon the diameter there is the question of space to be considered; and also, in fixing the pitch-ratio, a less efficiency than the maximum has often to be accepted, in order to avoid adopting a pitch-ratio either larger or smaller than seems justified by actual experience.

The results so far described were obtained from four-bladed propellers of the size already given. Some supplementary experiments were made upon other propellers having three blades and two blades. Other things being approximately the same, these gave thrusts differing from the thrusts of the four-bladed propellers in the ratios 0·865 to 1·0 and 0·65 to 1·0 respectively. The data for four-bladed propellers can therefore, with some qualification, be used

for the others, providing the thrusts, and consequently horse-powers, are reduced in the above ratios. A propeller with wider or narrower blades than used in these experiments would also require some corresponding modification of the thrust or horse-power readings of the data.

As already mentioned, the results just dealt with were obtained from propellers having no ship model in connexion with them. The effect of the presence of a ship model upon the screw has, however, received very careful attention, as has also the correlative effect of the screw upon the resistance of a ship model behind which it is working. The former is the effect of the wake, whereby the speed of advance of the propeller through the water is less than the speed of the ship. The latter is an enhancement of resistance due to the suction caused by the propeller, so that the thrust required to propel the model is greater than the net resistance; this difference is generally spoken of as "thrust deduction." Mr Froude in his curves assumes certain standard values for water and thrust deduction; the actual wake, expressed as a ratio of the speed of advance, is given by him for a number of ships, and a method of correction is pointed out for cases where the wake is known to be other than the normal.

Cavitation. The phenomenon of cavitation in connexion with the action of a propeller was encountered in a practical form in 1894. Experiments on the torpedo-boat destroyer *Daring*, made by Mr Barnaby in 1894, showed that in this vessel when the total thrust of the screw, divided by its projected blade area, amounted to 11¼ lb per square inch, a sudden change took place in the slip-curve, the slip being abnormally increased. The reason for the change was traced to the inability of the water at the back of the blade to follow the blade's motion, a partial rupture of the column of water occurring, and cavities forming in consequence. A thrust of 11·2 lb means approximately 5·6 lb push on the water leaving the screw-face and 5·6 lb drag on the water approaching the screw-back. The discrepancy between 15 lb and 5·6 lb shows "that rupture occurs at parts of the screw surface long before the mean thrust per square inch of the whole surface reaches the amount due to the external air-pressure."

Process of Design.

When a shipbuilder is approached for the production of a new ship, he must be informed of the requirements of the case; the kind of trade or service in which the vessel will be engaged; her speed; if she is to be a steam vessel, the distance she must run on ordinary voyages without re-coaling; the weight of cargo to be taken, or the number of passengers to be carried, and the kind of accommodation required for them. Very frequently these requirements will include certain limits of size, draught, cost, or tonnage, which must not be exceeded. In addition, it must be stated in what society, if any, she is to be classed, as this will determine the details of the scantlings to be employed. The shipbuilder will usually have, to guide him, the details of some successful ship or ships previously built to fulfil the same or similar conditions as in the vessel required, and he will probably know what measure of success or popularity the respective features of the vessel or vessels have earned on service. The dimensions can in this case be at once fixed to provide the necessary speed, strength, stability, and seaworthiness, and the cost of the vessel determined. If the departures from some similar ship of known and approved qualities are small, the details of the new ship can be inferred directly from those of the similar ship, and modified drawings, specifications, &c., can be rapidly prepared, and the building proceeded with. On the other hand, the departures from previous vessels or the usual practice may be very great, in which case much will depend on the shipbuilder's skill and judgment. Considerable investigation and calculation may be required to ascertain how the desired qualities and conditions can be best provided for. Outline drawings are first prepared to the dimensions which may be considered suitable, and the calculations are made on this assumed design. These will include estimate of the weights of the hull, of the machinery, equipment, &c.; and if it is not intended to class the vessel in some registration or classification society, questions of strength will have to be considered. If, however, the vessel is to be so classed, the determination of the structural strength may be omitted, as the scantlings required by the rules of such society are arranged to provide sufficient strength. If the calculations show that the dimensions assumed do not enable the required conditions to be fulfilled, the dimensions must be modified in the direction indicated by the calculations, and the calculations made over again. This process must be continued until a satisfactory result is obtained. As soon as the dimensions obtained for the vessel are found to be appropriate, more complete drawings are put in hand, and the final calculations pertaining to the displacement sheet, weights of hull and equipment, centre of gravity and trim, metacentric diagram and curves of stability and speed, are made.

There are many variations in the division of the work of designing and building a ship. In building large passenger ships the design often originates with the owner's or steamship company's staff, and in some cases naval architects are employed, completed drawings and specifications being handed over to the shipbuilder with the order for the vessel. In other cases shipbuilders work in close connexion with the steamship companies, and the business relations are of a very simple character, the company being content simply to send an order, with a note of the principal dimensions and type of ship required, leaving the determination of all details of the design in the hands of the builders. The general practice lies between these two extremes. In any case, complete design drawings and detailed specifications are necessary for the shipyard operations, and if not supplied must be prepared by the shipyard staff. Sometimes outline drawings of the vessel on a small scale—including an elevation or side view, one or two plans of the main deck and other parts, and a short description of the vessel—are first prepared, and are called an outline or sketch design; but usually the information which constitutes a design comprises a sheer plan, profile and plans of each deck on a ¼-inch scale, a midship section on a ½-inch scale, and a complete specification.

The sheer drawing gives the outside form of the ship. It consists of an *elevation* showing her longitudinal contour; the positions of the decks; the water-line or line at which she will float, and certain other lines parallel to this and equally spaced below it, which are also called water-lines; a series of vertical lines equally spaced from stem to stern, called "square stations"; and certain other details: of a *body plan* showing the sectional form of the ship at the square stations, supposing her to be cut by transverse planes at these stations: and of a *half-breadth plan* showing the form of the ship at the several water-lines, supposing her to be cut by horizontal planes at the levels of these lines. The profile and plans give all the internal arrangements of the vessel, the holds or spaces set apart for cargo, the passenger accommodation, the positions of the engines and boilers, the accommodation provided for the crew, and other principal fittings. In a warship there are no cargo holds or passenger accommodation, but the distribution of the armament and magazines, the armour, and other arrangements for the protection of the vessel against injury in action are carefully shown, and the appropriation of every portion of the internal capacity of the vessel is clearly indicated. The *midship section* shows the structural arrangements of the vessel, and usually the scantlings of the most important parts. The *specification* is a statement of all the particulars of the vessel, including what is shown on the drawings as well as what cannot be shown on them; the quality of the materials to be used is described, and the scantlings of the same carefully recorded; and it is clearly stated

how parts not manufactured by the shipbuilders are to be obtained.

Registration societies. As already intimated, the register societies, the object of which is to class ships with regard to their strength, durability, and general seaworthiness, mainly for purposes of insurance, fix the quality and strength of the material used, the scantlings of all the parts, and other details for ships built under their rules. But they also record all the important features of the ships so classed, and thus provide most of the information which the shipbuilder requires for the design and construction of ordinary vessels. In fact, the design for such ships, if design it can be called, consists in choosing from a large number of examples, differing very little from one another and all known to be good seagoing vessels, the exact dimensions and type of ship which the price named will admit of, and preparing outline drawings of the internal arrangements accordingly.

The principal registration and classification societies in operation in 1901, and the number of vessels (sailing and steam) classed at each, were as follows:—

Lloyds Register of British and Foreign Shipping, having its headquarters in London .	9290 vessels.
British Corporation for the Survey and Register of Shipping, in Glasgow	477 ,,
Bureau Veritas International Register of Shipping, at Paris	5122 ,,
Norske Veritas, at Christiania	2076 ,,
Germanischer Lloyd, at Berlin	1954 ,,
Record of American and Foreign Shipping, at New York	1530 ,,
Registro Italiano	1116 ,,
Veritas Austro-Ungarico	1107 ,,

Of these societies, *Lloyds Register*, as at present constituted, has existed since 1834; at that date it superseded two rival institutions having a similar object. The name Lloyds is traced back to Lloyds' Coffee-house, once situated in Lombard Street, in which underwriters met for business purposes, and from which in 1696 they issued their first publication. The first printed register was issued about 1726, a copy dated 1764 being still extant. The office of surveyors is referred to in a register book of the date 1781, but there are evidences that in 1768 repairs were superintended by officers of the society. In 1799 surveyors were stationed at twenty-four ports in the United Kingdom. In 1822 the register for the first time recorded a steamship. In 1824 appeared the first "Instructions to Surveyors" as to the carrying out the rules for classification; and in 1834, on the establishment of the present society, precise regulations were issued regarding the survey of steamers. An iron ship was built under survey and received a class in 1837, while the first rules for the construction of iron ships were issued in 1855. In 1851 a composite vessel was classed, but it was not until 1867 that rules for the construction of such vessels were issued. Steel was accepted in 1867, experimentally, steel being then made by the Bessemer process. Steel by the Siemens-Martin process was first used for two small steamers in 1877. Engineer surveyors were first appointed in 1874. The society is maintained by the shipping community; its affairs are managed by a committee of fifty-eight members — merchants, shipowners, and underwriters—elected to represent the important shipping centres of the country, and there are branch committees at Liverpool and Glasgow. The society has a staff of 170 ship and engineer surveyors in the United Kingdom, and 114 at the principal foreign ports.

In the case of a new vessel intended for classification, the plans for its construction are in the first place submitted to and approved by the committee; the building proceeds under the supervision of the local surveyor, and when completed, a *character* is assigned to the vessel by the committee upon that surveyor's report. The society issues annually to its subscribers a register containing particulars of the classification of vessels to which characters have been assigned, together with many other details. All other merchant vessels of the world, of 100 tons and upwards, except wood vessels on the Great Lakes of North America, are included in the work. This register contains particulars of the age, build, tonnage, dimensions, and ownership of some 28,000 vessels.

The *Bureau Veritas* was founded in Antwerp in 1828, one of its principal aims being to make known to underwriters the qualities and defects of ships frequenting Dutch and Belgian ports. In 1832 the headquarters were moved to Paris, and in due time its influence spread to all countries where shipowning or shipbuilding existed; it is now represented in over 200 districts comprising 1500 ports. In 1851 rules were drawn up for the construction of wood ships, and about 1867 for iron. Rules for steel came later, and also rules for the construction of machinery. A staff of surveyors formed part of the organization from the beginning; and in the earlier days the professional experience of the surveyors was the only guide as to what was necessary and sufficient. With the lapse of time, and with increased variety of construction and complication of interests, something more than individual judgment and experience became necessary, and with the Bureau Veritas, as with Lloyds and other similar societies, definite rules were introduced, and by their means a greater uniformity of practice was attempted and secured.

The *British Corporation* was founded in 1890, and obtained its charter under the Merchant Shipping Acts for the assignment of freeboards; its first rules were issued in 1893. Its inception was due to the enterprise and influence of a number of leading shipowners, shipbuilders, and engineers throughout the country, and more particularly in Glasgow and the West of Scotland, the first aim of the founders being to provide an independent society, thoroughly capable of dealing with the complicated questions which were likely to arise under the Load Line Act then coming into operation. The Liverpool Registry, which had once been independent, had been absorbed into Lloyds some years before, and it was felt that the enormous shipbuilding interests of the country demanded the existence of a society whose friendly rivalry with the great society of Lloyds would have a beneficial influence on the shipbuilding of the country.

The *Norske Veritas* was established in 1864 by the various marine insurance clubs of Norway. Previously each club had its own separate staff of surveyors, on whose report to their club depended the class of the vessel and the premium to be paid. As ships rose in value and reinsurance became the rule, something had to be done for mutual protection. By the establishment of the *Norske Veritas* one uniform system of classing and valuing was substituted for the older methods. In the matter of rules this society kept pace with the changes of the mercantile marine; it provided, as the occasion required, for the introduction of iron and steel in place of wood, and of steam in place of sails.

The *Germanischer Lloyd* was established in 1867, and reorganized as a joint-stock company in 1889. Its functions are carried out by officers at the central office in Berlin, assisted by a staff of 49 ship and engine surveyors in Germany and 138 at the principal foreign ports, the latter under control of agents, who are mostly consuls.

The *Record of American and Foreign Shipping* was established in 1867 by the American Shipmasters' Association (now called the *American Bureau of Shipping*), and is the standard American authority. Its rules for the construction and classification of vessels, as published in 1889 and amended in 1900, received the approval of the U.S. Navy Department and of the several boards of American underwriters. It has agents and surveyors in all the principal ports of the world.

The present rules of the above societies apply in every case to construction in steel and iron, and in most cases to construction in wood also. The tables accompanying the rules for steel and iron are in some cases quite distinct; in others they are so arranged that steel or iron scantlings may be read off the same tables, interpreted, when the material is steel, to give some 20 per cent. less sectional area than when it is iron. The Bureau Veritas and Germanischer Lloyd make a further distinction of materials by discriminating between common iron and superior iron.

The highest class assigned, upon the completion of a ship by the societies referred to, is as follows:—

Lloyds	✠	100A	1	✠ L.M.C.
Bureau Veritas . . .	⓵	3/3L	1 1	✚
British Corporation . .		B.S.✻	M.B.S.✻	
Norske Veritas . . .		A1	1	M. & K.V.
Germanischer Lloyd . .	✚	100	A_4.L.	
Record of Amer. Shipping	✚	A1	M.C.	

The star or cross in each case denotes special survey. In *Lloyds* 100A refers to conformity of scantlings with the tables; the figure 1, to the efficient state of the equipment, including anchors and cables; L.M.C. denotes Lloyds Machinery Certificate. In the *Bureau Veritas* the large 1 expresses first division of classification (out of three); the two rings around the 1 denote that the ship is divided into a sufficient number of water-tight compartments to enable her to float in still water with any two of them in free communication with the sea. Very few ships in the register have the double ring, but some have a single ring ①, denoting power to float in still water with any one compartment in free communication with the sea; 3/3 expresses completeness and efficiency of hull and machinery; the first 1, that the wood portions of the hull are entirely satisfactory; while the second 1 has the same significance in respect to the equipment of masts, spars, rigging, anchors, chains, and boats. In the *British Corporation Register*, B.S. signifies conformity with all requirements, these letters standing for British Standard; M.B.S. signifies that the machinery also conforms. In the *Norske Veritas*, A1 refers to quality and scantlings, mode of construction, and state of preservation; the second 1, to thickness of shell-plating; M. & K.V., to efficiency of engines and boilers.

The tests for steel material to be used in building the ships, as required by the same societies, may be tabulated as follows :—

	Ultimate Tensile Strength.	Elongation on Length of 8 Inches	Temper Test.
Lloyds . . .	Bet. 28 and 32 tons per sq. in.	Not less than 20 per cent.	Sample heated to a low cherry red and cooled in water at 82° F.
Bureau Veritas .	Bet. 27 and 32 tons per sq. in.	,,	
Brit. Corporation .	Bet. 28 and 32 tons per sq. in.	,,	
Norske Veritas .	Bet. 28 and 32 tons per sq. in.	,,	
Germanischer Lloyd	Bet. 26 and 31 tons per sq. in.	,,	None required.
Record of Amer., &c., Shipping	Bet. 58,000 and 68,000 ℔ per sq. in.	,,	Same as above.

For thin plates 16 per cent. elongation is allowed; for garboard strake plates *Lloyds* minimum strength is 26 tons, *British Corporation* 25 tons; for frames and beams (either angles or bulbs), strength may be as high as 33 tons. For rivet steel the *British Corporation* require a tensile strength between 25 and 30 tons per square inch, with elongation of 20 per cent. on a length of 8 inches. In view of the two varieties of iron accepted by the *Bureau Veritas*, the superior quality has also to be subjected to tests; the tensile strength of most parts must not be less than 22 tons per square inch with the fibre and 18½ tons across, the elongation on 8 inches, 7 per cent. with the fibre and 4 across; hot and cold bending and forge tests for angle bars are also prescribed.

Board of Trade supervision.

The regulation of certain matters connected with the design of merchant ships falls upon the Marine Department of the Board of Trade. The authority of the Board is the Merchant Shipping Act of 1894, which consolidated previous enactments. These matters include the measurement of tonnage, and provision for the safety and comfort of passengers and crew. The former is discussed in a separate article (see TONNAGE), but it may be mentioned here that the following countries have at various dates accepted the British rules for tonnage: United States, Denmark, Austria-Hungary, Germany, France, Italy, Spain, Sweden, Netherlands, Norway, Greece, Russia, Finland, Hayti, Belgium, and Japan. The amount of deduction for propelling power varies in Spain, Sweden, Netherlands, Greece, Russia, and Belgium, but option is granted to owners to have the engine-room remeasured under the rules of allowance for engine-room relating to British ships. Special certificates are at present also issued, on application, to vessels trading to Italian ports, as the Italian authorities do not at present recognize certain sections of the Act of 1894 in regard to deductions from tonnage and exemptions from measurement. Special tonnage certificates are also issued for the Suez Canal, where the measurements of ships and deductions from tonnage vary from British rules, and are detailed at length by the Board of Trade in their Instructions to Surveyors.

With regard to safety and comfort, the surveyors have to see, among other matters, that the crews are properly accommodated, and the passengers not too crowded; that the boats and life-saving appliances are sufficient; that the lights and signals are in order; that the freeboard is sufficient and ship otherwise seaworthy; that grain cargoes are properly stowed; and that coal cargoes are adequately ventilated. Any question of doubt as to the strength of passenger vessels has to be referred to the Board of Trade, and in future midship sections, with all particulars marked thereon, are to be submitted in the case of all new steamships building under survey for which passenger certificates are required. A passenger certificate is required whenever a steamer carries more than twelve passengers. In granting it, the Board of Trade recognizes five different services, ranging from foreign-going steamers to excursion steamers in smooth water. The Board of Trade rules for scantlings are not published officially.

Load line and freeboard.

A Bill, introduced into Parliament in 1869, dealing with the load line question, contained a clause requiring the draught of water to be recorded at which a vessel is floating when leaving port. This Bill did not pass; but in the following year the Merchant Shipping Code Bill was brought in, containing the same provision, and, in addition, requiring a scale showing the draught of water to be marked on stem and stern post of every British ship. This became law in 1871. The same Act empowered the Board of Trade to record the draught of water of all sea-going ships on leaving port by surveyors duly authorized. In March 1873 a Royal Commission on "Unseaworthy Ships" was appointed by the British Government, and one of the questions considered was that of the load line. In the final report in 1874 the conclusion was arrived at that a settlement of a load line should, in the main, be guided by reserve buoyancy as a first consideration. The Commissioners were, however, of opinion that an Act of Parliament, framed to enforce any scale of freeboard, would be mischievous, if not impossible, as would be any universal rule for the safe loading of merchant ships.

In 1874, in a paper read before the Institution of Naval Architects by Mr B. Martell, tables of freeboard were suggested from data collected at all the principal ports in the United Kingdom. These tables were based on the principle of reserve buoyancy, and were intended to apply to the loading of the various types of sea-going ships then to be dealt with. As an indication of the form of the vessel, it was suggested that a tonnage coefficient of fineness should be used, in order that the tables proposed might be readily adapted to all sea-going ships, whether at that time at sea or in port. In 1875 a short Act was passed, to remain in force only until October of the following year, which embodied as its chief feature the requirement of what was afterwards universally known as the "Plimsoll mark" (after the late Mr S. Plimsoll, M.P., the prime mover in securing legislation for the prevention of overloading in British ships). All British ships were to have the position of the deck shown on the side of the ship, and every foreign-going British ship was to have a circular disc marked below the deck line, indicating the maximum draught to which it was intended to load. The Act in no way fixed the amount of freeboard; this was left to the shipowner. The provisions of the 1875 Act were confirmed by a more comprehensive Act in 1876, which extended the compulsory marking of the deck line and disc to all British ships, except those under 80 tons engaged in fishing and the coasting trades, also excepting yachts or war vessels. Before this Act was passed, the Board of Trade took action, by appointing a committee to consider the possibility of framing rules for the regulation of freeboard. The committee was to be composed of representatives of the Board of Trade, Lloyds, and the Liverpool Underwriters' Registry. This attempt to establish an authorized scale of freeboard failed. Meanwhile the subject was not lost sight of; the collection of data was continued, investigations were carried out, and six years later (in 1882) the committee of Lloyds Register issued freeboard tables, and undertook to assign freeboard, on the basis of the tables issued, on owners making application for the same. In the course of three years 944 vessels had freeboards thus assigned to them, and in the case of 775 of this number the owners voluntarily accepted the freeboards assigned. In December 1883 the Load Line Committee was appointed by the Board of Trade; and after two years' careful deliberation and investigation, involving much labour, the committee presented its report. This report was accompanied by tables, which agreed closely with those previously issued by Lloyds; and they were accepted by the committee of that society in September 1885. Between 1885 and June 1890 (the latter being the date the Load Line Act was passed) 2850 steam and sailing vessels had freeboards fixed by Lloyds, and of these 2520 were taken from the tables. After the passing of the Act in 1890 appointments to assign freeboards were granted to Lloyds, Bureau Veritas, and the British Corporation.

In 1893 the original tables were modified with respect to some of the ports in the United States on the Atlantic, the sailing from or to which in the winter was to subject the ship to a few inches additional freeboard. In 1898 they were further modified (*a*) to exempt ships over 330 feet in length from the additional freeboard just mentioned, and to limit the additional freeboard in smaller ships; (*b*) to give some concession to turret-deck steamers; and (*c*) in some other minor matters.

Loading of grain and timber.

Ships laden with grain have to comply with rules of the Board of Trade, which provide that for single-decked ships there shall either be provision for feeding the hold, or there shall not be more than three-quarters of the hold occupied by grain in bulk, the remaining one-fourth being occupied by grain or other suitable cargo in bags, bales, or barrels, supported on platforms laid on the grain in bulk. For ships with two decks, grain in bulk in the 'tween decks is for the most part prohibited; but certain grains are allowed, provided there are separate feeders for hold and 'tween decks, or else sufficiently large feeders to the 'tween decks, and the hatches and other openings there made available for feeding the holds. In ships with two decks, longitudinal grain-tight shifting-boards must be fitted where grain is carried either in bags or bulk; these shifting-boards must extend from beam to deck and from beam to keelson, and in the case of bulk grain must also be fitted between the beams and carried up to the very top of the space. The regulations also impose a fine not exceeding five pounds for every hundred cubic feet of wood carried as deck cargo which arrives in a ship, British or foreign, in any port of the United Kingdom between the 31st October and 16th April, provided no unforeseen circumstances, as defined by the Act, intervene. By deck cargo in this section is meant any deals, battens, or other wood goods of any description to a height exceeding 3 feet above the deck.

In 1890 a committee was appointed by the Board of Trade to deal with the spacing and strength of transverse water-tight bulkheads, and to make recommendations. The first matter submitted to this committee related to subdivision which should enable a ship to float in moderate weather with any two compartments in free con-

nexion with the sea. The committee, while recommending the above as a standard for sea-going ships of not less than 425 feet in length, and for cross-Channel steamers irrespective of length, suggested less stringent conditions for sea-going ships of shorter length. There was no suggestion of enforcing such subdivision by law; but as a reward for complying, some concession was to be allowed, under the Life Saving Appliances Act of 1888, as to the boats or life-rafts to be carried. On the presentation of the report the matter was, however, allowed to drop, and the rules of Lloyds and the other classification societies are therefore the only rules with practical influence. The subdivision required by Lloyds for all steamers comprises a bulkhead at each end of the machinery spaces, and a bulkhead at a reasonable distance from each end of the ship, making four in all. In addition, for larger steamers other bulkheads have to be fitted, making the total as follows, namely:—

Transverse water-tight bulkheads.

Length of steamer,	280 feet to	330 feet	.	.	5 bulkheads.
,,	,, 330	,, 400 ,,	.	.	6 ,,
,,	,, 400	,, 470 ,,	.	.	7 ,,
,,	,, 470	,, 540 ,,	.	.	8 ,,
,,	,, 540	,, 600 ,,	.	.	9 ,,

The positions of these additional bulkheads, and the height to which they are to be carried, are clearly stated, and rules are given for their scantlings. These scantlings are suitable for purposes of safety in the event of accident; but it is understood that they have to be considerably increased when the bulkhead is also used to withstand frequently the pressure of oil or of water ballast; a deflection of the plating which would do no harm in an emergency once encountered, would certainly become serious if often repeated in the ordinary service of the ship. The foremost bulkhead of the ship receives the name of *collision* bulkhead, or sometimes *fore-peak* bulkhead; the aftermost, the *after-peak* bulkhead. In sailing ships the collision bulkhead alone requires to be fitted.

Practical.

Practical shipbuilding requires a knowledge of the properties of the materials used in the construction of ships, and of the processes by which they are produced or prepared for use, so that they may be suitably selected for the services for which they are intended; also a knowledge of the methods, means, and machinery by which, after delivery in the shipyard, the materials are brought to the requisite shape, erected in their proper relative positions, connected together, and completed so as to form a structure which shall fulfil the intentions of the design, whether large or small, merchant ship or warship. The varieties of ships are very great, and are constantly changing, and thus new problems continually present themselves to the shipbuilder. There is also an ever-increasing demand for rapid production, which necessitates a rigorous and constant search for simplification of methods of work, for labour-saving and time-saving machinery, for improved means of handling material in the shipyard, and for workshops and factories which will more completely prepare and finish their various products before despatch to the shipyard.

Whatever the size of the ship or the type to which she belongs, the general principles of construction remain very much the same in all cases. The following account applies to steel and iron shipbuilding; for particulars of wood and composite construction the reader is referred to the ninth and previous editions of this Encyclopædia. The exterior parts—the bottom, sides, and decks—supply the strength required for the structure as a whole. The bottom and sides are spoken of as the *shell* or *outside plating*, and are, with the decks, kept to the proper shape by means of frames running across the ship, like the rafters in a roof or the ribs in the body. These are called *transverse frames* or *ribs*, and *beams* where they run under the decks. The parts of the frames at the bottom of the ship, where they are made deep and strong to support her when she is docked or grounded, are known as *floors*, while the spaces between these floors are spoken of as the *bilges*. The transverse frames and floors are held upright in their proper relative positions by other frames which run lengthwise in the ship; one at the middle line being called the *centre keelson*, and others fitted at the sides, *keelsons*, *bilge keelsons*, and *side stringers*. All the fore-and-aft frames, taken together, are spoken of as the longitudinal framing. Where tanks for carrying water ballast are built into the bottom of the ship, the centre keelson is called the *centre girder*, and the keelsons or bilge keelsons, the *side girders*. In large merchant vessels, and in all war vessels, except the smallest classes, an *inner bottom* is provided for increasing the security against injury by grounding, and against ramming and torpedo attack in war vessels, in addition to forming tanks for carrying water, either as ballast or for use in the ship. In such cases the centre keelson is called the *vertical keel*, and the keelsons and girders are called *longitudinals*. When the deep vertical transverse plates forming the floors only extend between the keelsons, girders or longitudinals, and are attached to them by angle bars, the floors are called *intercostal* floors, and the keelsons, girders, and longitudinals are said to be *continuous;* on the other hand, when the keelsons, girders, or longitudinals extend only between the frames and floors, they are called *intercostal* keelsons, girders, and longitudinals, and the frames and floors are said to be *continuous*. In large merchant vessels and war vessels, except the smallest classes, much of the longitudinal framing is continuous; and the transverse framing, for the most part, is *built up* of angle bars upon the outer bottom and under the inner bottom, with short plates, called bracket plates, between them, attached to the longitudinals by short angle bars. Frames built up in this way are called *bracket frames*. In small vessels the transverse frames are usually continuous.

Structural parts.

Besides the transverse and longitudinal framing, there are partitions used for dividing up the internal spaces of the ship, which are called *bulkheads;* they are partial, complete, water-tight or non-water-tight, as the circumstances of the case require. In warships the transverse bulkheads are so numerous, in order to restrict as much as possible the entrance of water from damage in action, that they go a long way towards providing the necessary transverse strength, and the transverse frames are consequently made of thinner materials and fitted at greater distances apart than they otherwise would be. Transverse frames are from 36 to 48 inches apart in large warships, and from 24 to 27 inches in large merchant ships. At the extreme ends of the ship the shell plating on the two sides is attached to forgings or castings, which are known as the *stem* at the fore end, and the *stern frame* or *sternpost* at the after end. The stem of a warship is generally made very massive, and projects under the water so as to form the *ram*.

The longitudinal framing is carried right forward and aft when possible, and the ends of the several frames are connected together across the ship by strong plates and angles, which are called *knees* or *breasthooks*, forward; and knees or *crutches*, aft. Additional supports, introduced to enable the vessel to withstand the heavy blows of the sea in bad weather, are called *panting stringers*, *panting knees*, and *panting beams*, panting being the term applied to the movements which occur in the side plating if sufficient strength is not provided. Where the ends of the ship are very full, or *bluff*, the frames are sometimes inclined, or canted out of the transverse plane, so as to be more nearly at right angles to the plating; such are known as *cant* frames. At the stern a transverse frame, called a *transom*, is in some cases attached to the upper part of the sternpost to form a base for cant frames of the overhanging part of the stern which is known as the *counter*. To assist the beams and bulkheads in holding the decks in their proper positions, vertical *pillars* are introduced in large numbers; but to avoid the loss of space and inconvenience in handling cargo, ordinary pillars are often dispensed with, and special pillars and deep deck girders or carlings fitted instead.

The steel generally used in shipbuilding is known as *mild* steel. It is very tough and ductile, and differs from the *hard* steel, out of which tools are made, in that it will not take a *temper*, *i.e.*, if heated and plunged into oil or water, the sudden cooling has very little effect upon it, whereas with tool steels a great change takes place, the steel becoming very hard, and usually brittle. This quality of tempering depends chiefly on the amount of carbon in the steel, mild steel containing less than ·25 per cent. Steel of greater strength than mild steel is used occasionally in certain parts of warships. The extra strength is obtained generally by the addition of carbon, nickel, or chromium, coupled with special treatment. The quality of the plates and bars used is tested by cutting off strips about 2 inches wide, and bending them double by hammering, or in a press, until the bend is a semicircle whose diameter is three times the thickness of the strip. The strips are sometimes heated and plunged into water to cool them suddenly before bending, and they may be cut from either side or the end of the plate. Strips are taken occasionally and hammered into various other shapes while hot and while cold, so as to ascertain the general quality of the material. To ensure its tenacity, strips are taken and machined to give a parallel part 2 inches in width, of at least 8 inches in length. Two centre-punch marks are made 8 inches apart, and the strip is secured in a testing-machine constructed so that the ends can be gripped by strong jaws which do not injure the parallel part. The jaws are then gradually pulled apart, the amount of the pull required to break the strip being registered, and also the extent to which the strip stretches in the length of 8 inches before breaking. The tensile strength varies between 26 and 32 tons per square inch, calculated on the original sectional area of the parallel part before breaking, and the elongation in the 8 inches is about 20 per cent. The standard strength and elongation required by the principal registration societies have already been given. The steel used for making rivets is similarly tested; and samples of the finished rivets are also taken, and hammered into various shapes, hot and cold, to ensure that the metal is soft and ductile and suitable for the work.

Materials.

The stem, stern-frame, &c., are frequently made of forged iron; but if of steel, they are cast to the form required. These castings are tested by being let fall on hard ground and then slung in chains and hammered all over, when faults of casting are generally discovered by variations in the sounds produced. By this hammering the general soundness of the casting is ensured. To test the quality of the steel in the casting, small pieces, which are cast on for the purpose, are removed and tested in the same manner as just described for the strips cut off from the plates; they are required to give about the same tensile strength, but a little less ductility, say 10 per cent. instead of 20 per cent. elongation in 8 inches.

The sections of the iron and steel bars in common use are shown in Fig. 11, and are named as follows:—

A. Angle bar.
B. T (Tee) bar.
C. Channel bar.
D. Z (Zed) bar.
E. I bar.
F. Plain bulb bar.
G and H. Angle bulb.
I. T bulb bar.
J. Half-round moulding.
K. Hollow moulding.

The vertical, or central, portion in the I, T, and bulb sections is spoken of as the *web*, and varies from about 3 inches to 9 inches in depth; the horizontal parts are called *flanges*; in an angle bar, both parts of the section are called flanges. The flanges vary in width from about 2 inches to 7 inches in the angle bar, and from 3 inches to 6 inches in the others. The thickness varies from about ¼ inch to ¾ inch. These dimensions taken together are called the *scantlings* of such material. The thicknesses of the plates in common use generally lie between ¼ inch and 1 inch. Thicker or thinner plates are obtainable, but are not often used for merchant ships. These plates are of varying sizes as required, the tendency being to use very large plates where possible, and widths of 4 feet to 6 feet are used in lengths of from 40 to 20 feet. Angle bars are used in lengths of from 20 to 80 feet as required, or as may be limited by the means of transport between the steel works and the shipyard.

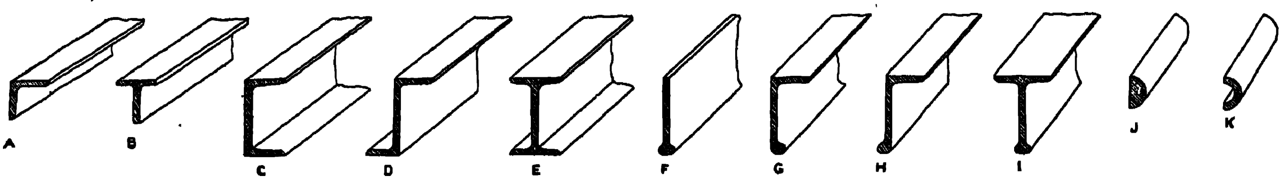


FIG. 11.

The various plates and bars are connected together by means of *rivets* of various forms. Specimens of the common kinds are shown in Fig. 12. The heads and points have distinctive names, as follows:—

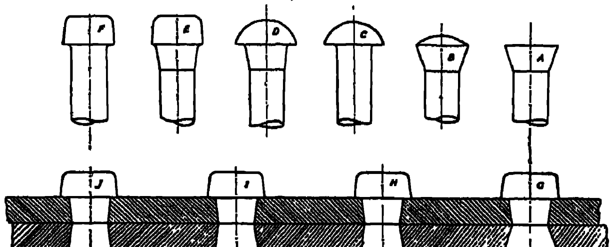


FIG. 12.

(A) Countersunk head, chipped flush.
(B) Ordinary countersunk head.
(C) Snap head.
(D) Snap head with conical or swelled neck.
(E) Pan head with conical or swelled neck.
(F) Pan head.
(G) Countersunk point.
(H) Rough hammered point.
(I) Snap point, hand work.
(J) Snap point, machine work.

The pan head rivet (E) with conical or swelled neck is the most commonly used, as it is convenient to handle and gives good sound work. The rough hammered point (H) is also very commonly used, is very effective, and is readily worked. The pan head (F) and snap head (C), without cones under the heads, are only used for small rivets; the heads (A), (B), (C), (D), are used where considered desirable for appearance sake, but (C) and (D) are also adopted when the riveting is done by hydraulic machinery. The countersunk point (G) is used on the outside of the shell, and in other places where flush work is required. The snap head (J) is used when the work is riveted up by hydraulic machinery, and the snap point (I) for internal hand riveting where desired for appearance, instead of the rough hammered point. The rivets vary in diameter from about ⅝ inch to 1¼ inch, and the lengths are as required to go through the holes and give enough material properly to form the points. The diameter of the rivet is settled according to the thickness of the plates to be connected, being generally about ¼ inch more than the thickness of the separate plates. The distance from centre to centre of the rivets is spoken of as the *spacing*, and is generally expressed in diameters. For connecting plates and bars in the framing, the spacing of the rivets runs generally to 7 diameters; for securing edges which must be water-tight, the spacing is from 4½ to 6 and, if they are to be oil-tight, 3 to 3½ diameters. In butts and edges of shell-plating the spacing varies from 2½ to 4½ diameters.

In some positions rivets like the above cannot be driven into place and properly hammered up; resort is then made to rivets which have screwed points, called *tap rivets*, shaped as shown in Fig. 13. That shown at (B) is used where it is necessary to make

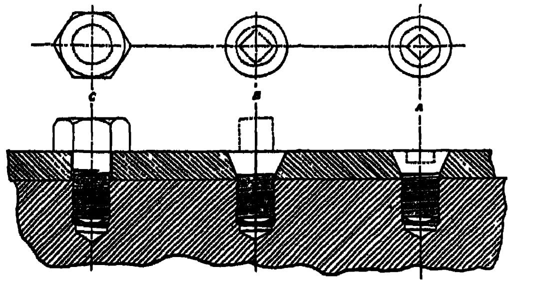


FIG. 13.

the surface flush, but not necessary to remove the rivet for examination of plating; and when hove right up, the square head is chipped off and the surface hammered smooth. In other positions patterns (*a*) or (*c*) are used as may be most suitable.

The machines used in the shipyard have been much improved of recent years. The one most used is the punching and shearing machine, on one side of which plates of all thicknesses up to

2 inches may be cut or sheared to any desired form, while on the other side rivet holes may be punched of any required size.

Machine tools. Special shears are provided with V-shaped cutters for shearing angle bars, but in some cases the cutters of ordinary shears may be replaced by V-shaped cutters for this purpose. When the plates and bars leave the shearing and punching machine their edges are rough and slightly distorted, to remove which it is necessary to plane them. This is usually done by special machines provided for the purpose. In the most modern types the cutters are duplicated and the machine arranged to cut both ways. When it is required to cut a square edge on the flange of an angle bar, which is often done by hand-chipping, a pneumatic chipping machine of recent introduction is frequently used. In shipbuilding a great deal of drilling must be done by hand, but, where it is possible, drilling machines are employed. The most modern forms can drill a number of holes at the same time. For countersunk work it is necessary to make the hole funnel shaped, as will be seen from Fig. 13. This shape is rapidly given to the holes already punched or drilled by means of a special drilling machine, which can be very easily and rapidly manipulated. The use of portable drills, to avoid hand labour, is rapidly increasing, and several types are in use, operated by electric motors, compressed air, or flexible shafting. They are carried to any position required. The hole made by a drill is cylindrical, but that made in the process of punching is conical. On one side of the plate its diameter is determined by the diameter of the punch, and on the other by the diameter of the die, which must be greater than that of the punch. This taper tends to produce close and sound riveting, as the joint is closed both by the knocking down of the rivet and by the contraction of the rivet on cooling. On the other hand, the operation of punching injures the steel in the neighbourhood of the hole, and for work subjected to great stress this deteriorated material must be removed by countersinking or by drilling the hole to a larger size, or the quality of the material must be restored, or partially restored, by annealing. The process of annealing consists in heating the steel to a good red, then allowing it to cool very slowly; during this process parts of the material which have been unduly distressed in working regain their strength by molecular rearrangements in the distressed parts. This process occurs to some extent when hot rivets are introduced into the holes and hammered up. The steel immediately adjacent to the rivet is heated, and afterwards cools gradually as the heat becomes distributed into the body of the plate. In some experiments carried out by the Admiralty in Pembroke Dockyard in 1884, it was found that the effect of punching holes close together, as for a butt-strap, was to diminish the tensile strength of the plates about 20 per cent.; that hot riveting restored about half of this; and that when holes were drilled and countersunk right through, also when holes were punched $\frac{5}{8}$ inch and countersunk right through, so as to enlarge hole to $\frac{7}{8}$ inch in diameter, there was no loss.

In addition to the machines mentioned above, many special appliances have recently been introduced into shipyards for the purpose of economically carrying out definite operations rendered possible by the use of mild steel. Ships built with a bar keel require the garboard strake plates on each side to be flanged on one edge, so as to fit against the bar keel. This flanging was formerly carried out by heating the plates and treating them hot, but now a very powerful machine, called a keel-plate bending machine, and usually worked by hydraulic power, is employed for the purpose with the plate cold. Flanging plates cold has also become general for a variety of purposes. In a bulkhead, stiffening is necessary, and for this purpose angle bars were commonly used; the horizontal stiffeners are now frequently formed by flanging the lower edges of the plates. Instead of fitting an angle bar to connect two plates at right angles to one another, the edge or end of one may be flanged, and half the weight of the angle bar and the rivet work saved. For all such work somewhat lighter flanging machines than the keel-plate bending machine are used; they are generally worked by hydraulic power, but there is no difficulty in driving them by any other means.

Another modern appliance is the scarfing machine, which is used chiefly in connexion with the lapped butts of shell and other plating. Before its introduction it was usual to bring the ends of the plates together and cover the joint with a short plate called a butt-strap, secured to both plates with a proper arrangement of rivets (see Fig. 14). It is now more usual in merchant ships to work overlap butts, some half of the weight of the butt-strap and riveting and other work being saved thereby, although the appearance may not be quite so sightly. The difficulty with this system is that the passing plates on each side have their edges lapped over the ends of the lap-butt, and in order that they may be brought close some machining is necessary; this is called scarfing, *i.e.*, slotting away the corner of the projecting butt so as to produce smooth surfaces for the side laps (see section at A B, Fig. 14). The machine used for this operation is a slotting machine with two heads, so as to slot both edges of the plate at the same time; it is provided with a table which can be adjusted to the necessary bevel, so that the slotting tools may reduce the thickness of the edges operated on in a gradual taper to a knife-edge. A more recent appliance for reducing weight is the joggling machine. As already described, the usual method of working the shell-plating is by alternate inside and outside strakes of plating, the outside plates overlapping the inside plates, and the space between them and the frames being filled in by slips or liners. These liners throughout the ship amount to a considerable weight, and the object of the joggling is to do away with the necessity for them. This is effected by shaping the outside plates as shown in section *b*, Fig. 15. Sometimes the frames are joggled instead of the plates, as shown in section *c*, Fig. 15; the inside plate lies in the recessed portion of the frame formed by the joggling process, and the outside plate on the unrecessed portion, its edge lapping over the edge of the inside plate the usual width. The angle bar in this case must be heated, and the hydraulic press is placed so as to be readily accessible for the handling of the part to be heated. The system of joggling the frames has not been adopted to nearly so large an extent as that of joggling the plates.

Frame-bevelling machines appear to be growing in favour. The machine is placed on rails, near to and across the mouth of the frame furnace, so that it can be readily placed in position for the frame bar to be drawn out of the furnace directly through it, and moved to one side when not required. In the machine a series of rollers, which can be inclined to suit the varying bevel required, operate on the bar. The inclination of the roller is varied as the bar passes along, a dial and pointer giving the angle of bevel at each instant. As the bar passes through, the workman, with his eye on the dial, manipulates the machine so as to give it the required bevel. It is afterwards completed on the slabs, the form being taken from the scrive-board in the usual way.

The shipyard should be supplied with modern machinery of the most approved type, in order to produce the best work at economical rates: rolls for straightening and bending plates, for fairing and bending beams and angle bars; shaping and slotting machines; lathes and milling machines; heavy planing machines. It should also have a blacksmith's shop, saw-mills, joiner's shops, &c., all fully equipped for completing, as far as possible, the work of the yard. The workshops and machines should be distributed so that, as far as possible, the material moves steadily along, as the various operations are performed upon it, to its place in the ship. Pneumatic tools are often preferred for light work, such as chipping, drilling, rimering, and caulking; they are also occasionally used for riveting, but they are not yet much in favour for this class of work. Hydraulic power is particularly well adapted for heavy presses, such as for keel-plate flanging, for punching and shearing, and especially for punching manholes and lightening holes in plates, and for heavy riveting. It is also very successfully applied for pressing to shape a great variety of small fittings made of steel or iron. For such machines as rolls, ordinary shears and punches, winches, &c., separate steam engines are still frequently fitted, but there is a very marked tendency to replace all these by electric motors. Electric power for driving all the machinery has been introduced into many shipyards. It has many advantages: all the power required in the yard may be generated in one building in any position, containing the boilers, steam engines, and electric generators, and the whole may be designed and worked so as to secure great economy. The current is supplied either to motors directly driving the heavier or outlying machines, or to motors driving a line of shafting where the machines are of a lighter character and are arranged in compact groups. Fixed machines can be placed where most convenient for the work, without any reference to the position of the boilers or other machinery, and a large number of machines can be very readily made portable for the lighter classes of work. The power may be transmitted with but little loss, whereas with steam-driven machines at a distance from the boilers, lines of steam piping must be introduced, and loss of power is entailed. The saving which the system of electric driving effects over that of steam driving in the consumption of coal in a large shipyard is considerable, and is claimed by those who have adopted it to be sufficient to justify the large capital expenditure required to convert a shipyard from the latter system to the former.

As the plates, beams, angle bars, Z bars, &c., are delivered, they must be stored in convenient racks, with marks showing for what purpose they are intended, so that they can be readily identified and removed without loss of time. When required, they are taken from the racks, and the edges, butts, and rivet holes carefully marked upon them before they are taken to the machines where the shearing, punching, drilling, shaping, &c., are carried out, after which they are taken to their proper position in the ship.

In many shipyards great attention has been given to the questions of the economical handling of the material, and very costly and novel appliances are to be found in these yards for the purpose. As an example mention may be made of the overhead cranes fitted at the Union Ironworks of San Francisco. A framework of

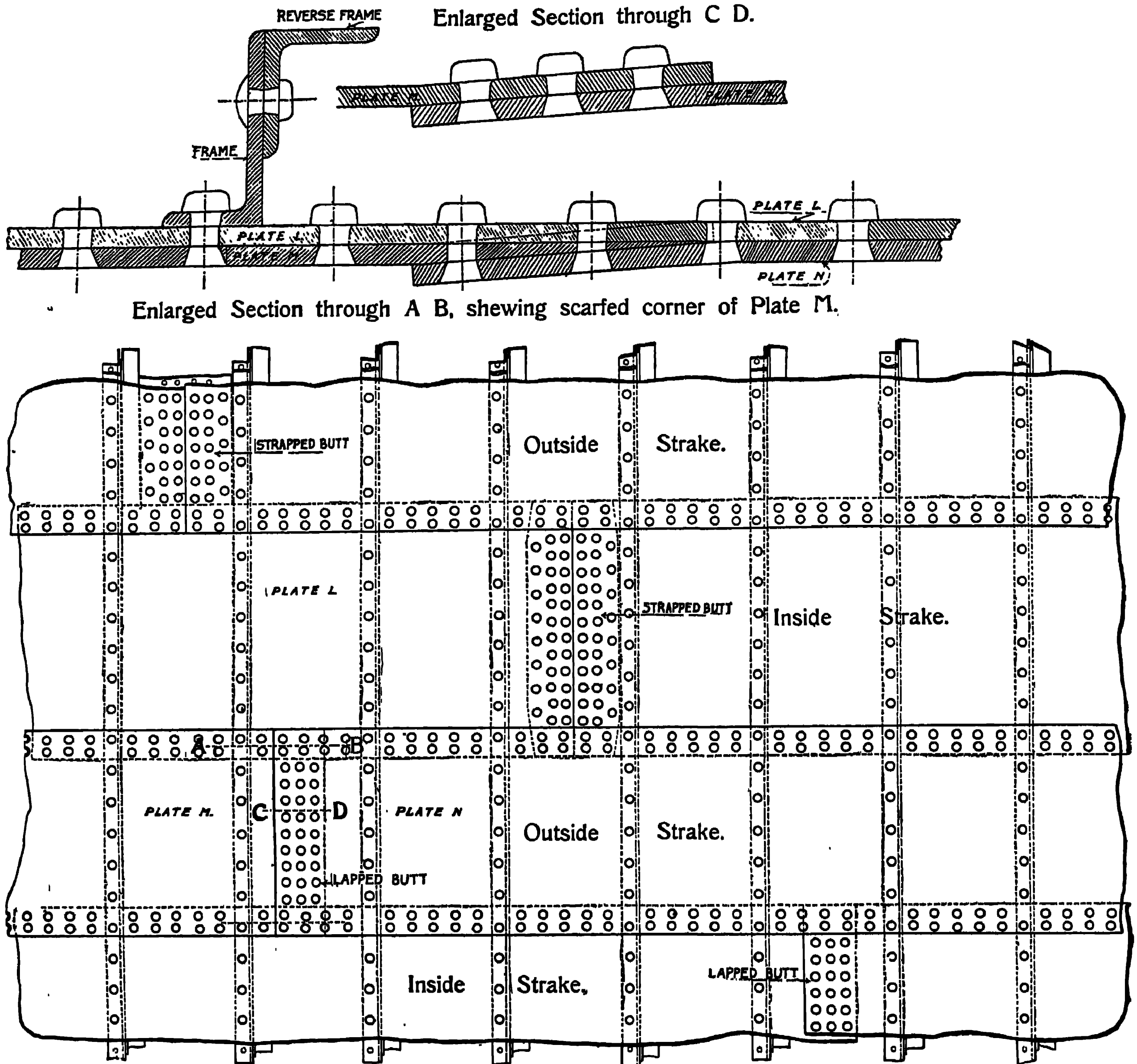


FIG. 14.—Details of shell-plating.

wood is built up over the entire building berth, the structure being well braced in all directions for carrying two travelling girder cranes. There are four building berths fitted in this manner, and the latest has a length of 408 feet, a clear breadth of 80 feet, and clear height of 72 feet. A swing crane of 50 feet spread at each end of the erection increases its effective length to 500 feet. Each of the travelling girders carries a trolley, with motion transverse to the ship; five tons can be so lifted, and parts of the ship's structure not exceeding this weight can be taken from the ground anywhere in the neighbourhood of the structure and conveyed to any desired spot in the ship. The driving power is electric. The longitudinal travel of the girders is 180 feet per minute; the transverse travel of the trolley and speed of lift, each 90 feet per minute. A manila rope is used for hoisting, except for plates under the bottom and counter, where a wire rope is used.

Cranes.

At Newport News, in Virginia, the structures are differently arranged, being on the cantilever travelling-crane principle. There are five such structures in the yard; three of them are wood, the last two of steel. The largest is 700 feet long. One trestle structure, or gantry, serves two building berths, and runs longitudinally between the two. On the gantry is mounted a double cantilever crane, having an effective reach of 95 feet on each side of the centre; this outreach is sufficient for a ship 70 feet broad on each side of the trestle. The height of the cantilever above the ground is some

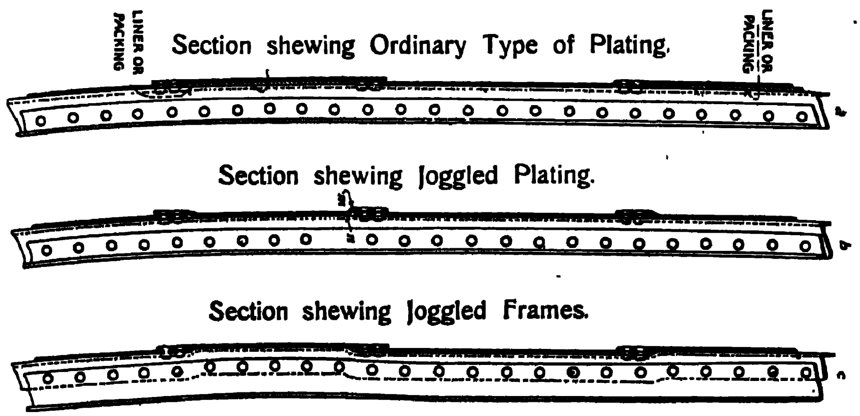


FIG. 15.—Methods of working shell-plating.

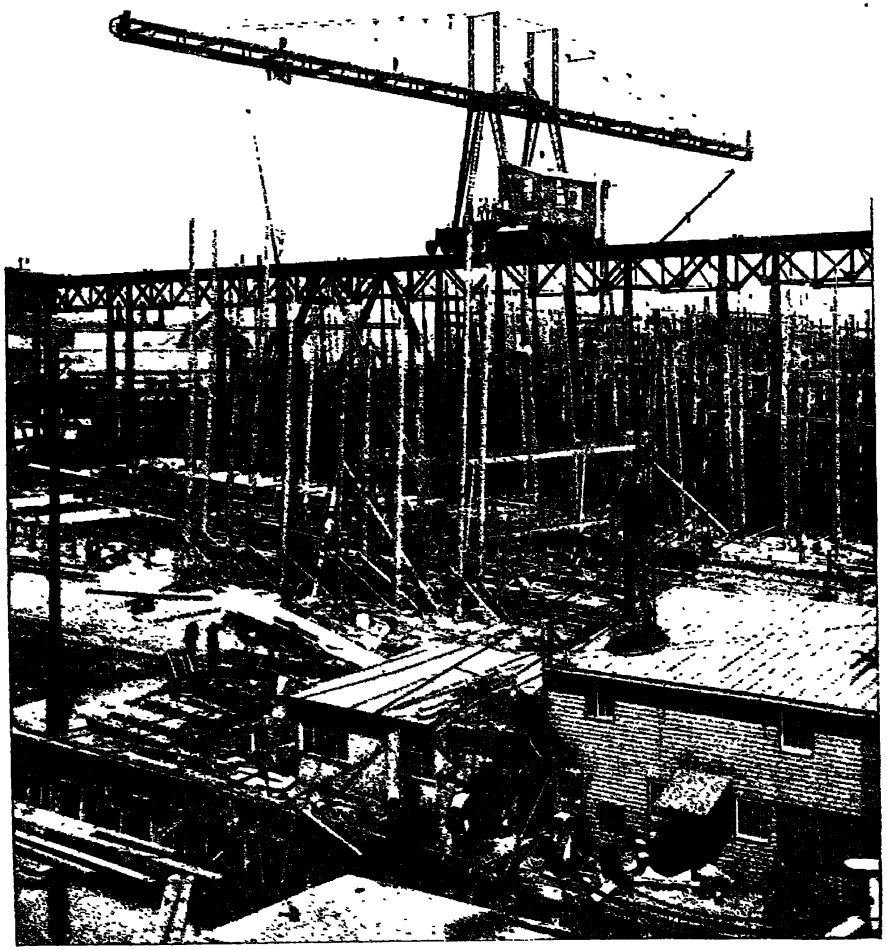


FIG. 16.—Gantry at Messrs Cramp's Shipbuilding Yard, Philadelphia.

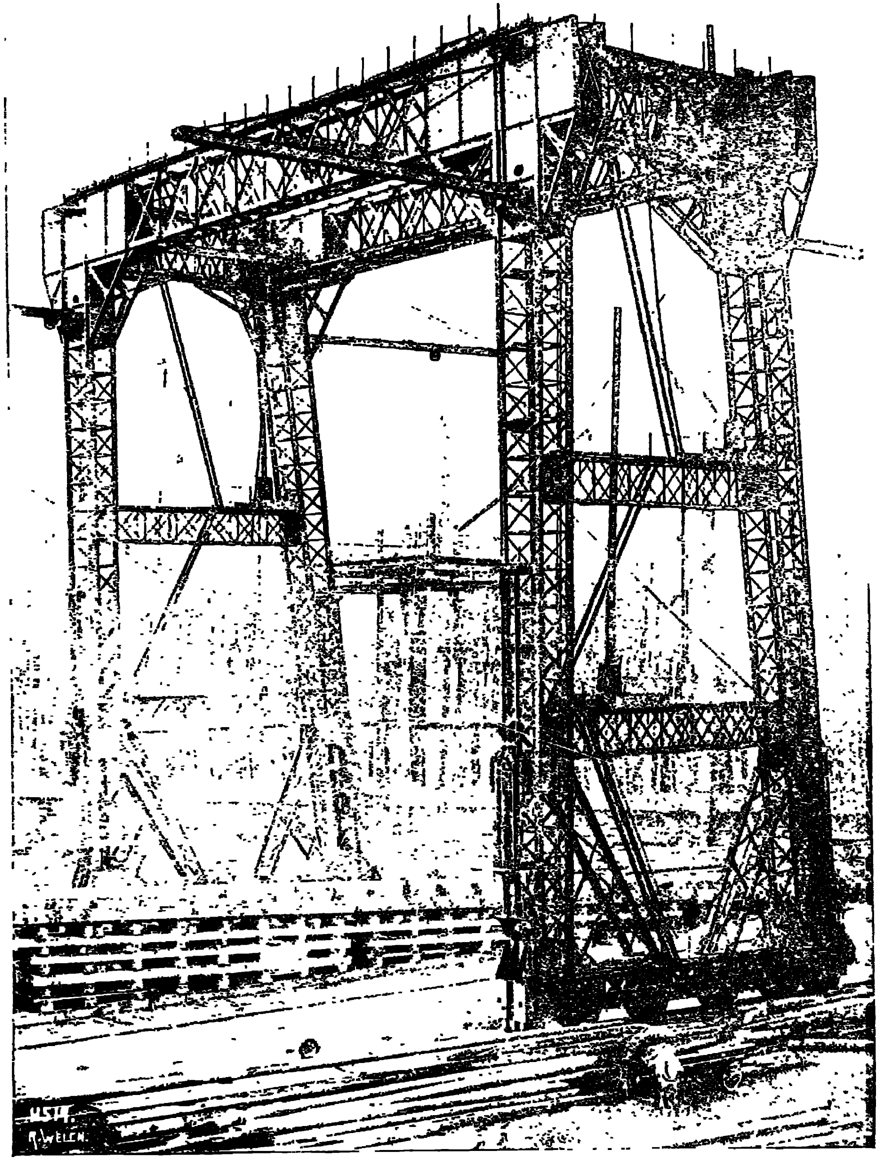


FIG. 17.—Gantry at Messrs Harland and Wolff's Shipbuilding Yard, Belfast.

90 feet, the load that can be raised is 15 tons, and if necessary a bulkhead up to that weight can be lifted bodily into place. The speed of lift for this weight is 100 feet per minute, and for lighter loads 700 feet per minute. The speed of the trolley along the cantilever is 400 to 800 feet per minute, and of the whole crane longitudinally is 400 to 700 feet per minute. All movements are made by electric power. Similar gantries and arrangements are used in other American shipyards. The view shown in Fig. 16 (Plate I.) represents one of these structures as fitted in Messrs Cramp's shipyard in Philadelphia.

At the yard of Messrs C. S. Swan and Hunter, on the Tyne, similar structures have been erected since 1894: besides carrying cranes, these have standards and stiffening girders, from which ships under construction are shored for fairing. Roofs and sides are fitted to protect the ship, and the workmen engaged in building her, from the weather. The side supports are three in number, and serve for two berths; they are formed of steel lattice-work, with standards mostly 20 feet apart. The clear height of roof is 83 feet, and clear breadth of berths 68 feet and 73 feet; a roadway on the ground level is left free on each side of the berths inside the standards. Two revolving 3-ton electric cranes travel along paths suspended from each roof; their jibs have sufficient radius to lift material from the roadways and deposit it at the centre of the ships building. The longitudinal speed of these cranes is 300 feet per minute; speed of lift, 100 feet per minute. A third berth is served by a travelling cantilever crane on top of the adjoining roof. At Messrs Harland and Wolff's yard at Belfast another modification was introduced in 1897 (see Fig. 17, Plate I.). In this case the structure takes the form of a travelling gantry or bridge over the building berth, the legs running on rails at the ground level. The gantry, which is driven by hydraulic power, has three traversing cranes and four 4-ton swing cranes. It was designed to facilitate the lifting of plates and portions of the structure into position, and also to support the hydraulic riveting machines and other appliances for the carrying out of the work. The success of the appliances, first used in the *Oceanic*, has led to a further extension for other ships in hand.

Course of construction. The first steps taken in the construction of a vessel, after the receipt of the design, drawings, and specifications, are with the view of obtaining the necessary particulars for ordering the material, making the moulds, and supplying other information for shaping the various parts of the framing. A half-block model is prepared of the exterior of the vessel, on a quarter-inch or other convenient scale. On this the positions of the frames, deck edges, the edges of the shell plating, and other details are carefully drawn in, and then the butts of all the keel and shell plating are arranged, the sizes of the plates are measured, some allowance is made for cutting to shape, and the plates and many portions of the framing are at once ordered. Another block model is generally made showing the form of the top of the ballast tanks, or in warships the shape of the inner bottom. In the case of a warship a block model will also be made of the protective deck, the plates arranged thereon, and ordered by measurements so obtained.

While the material is being ordered, the laying off the vessel, which consists of enlarging the sheer drawings to full size on the floor of the mould loft, and deducing from it the shapes of the various parts of the framing, is proceeded with. The mould loft is a large room floored with stout boards, planed smooth and carefully painted so as to produce a good hard surface; this is used as a large drawing-board, and on it nearly all parts of the vessel are drawn to full size before the work proceeds. The sheer drawing is transferred to the floor by measuring the ordinates or offsets from the ¼-inch or ½-inch scale, drawing and setting them off full size in their proper relative positions. Battens are bent to the curves passing through the spots thus obtained, and the lines are drawn and *rased* or *scratched* in, after being *faired*. The process of fairing is performed by laying off a series of vertical, horizontal, and oblique sections of the outside surface of the ship. These are modified as necessary to give fair curves, and the ordinates are adjusted accordingly. As soon as the form is faired, moulds or templates are made, to enable the patterns of the stem, stern frame, and shaft brackets (if for a twin-screw vessel) to be completed by the pattern-makers, which, to prevent delay in launching, must be completed and sent to the steel-makers at an early date. For very large vessels the sheer is in some cases partially faired on paper, to save work on the floor, by reproducing the drawing on a large scale, say ½ inch or ¾ inch to the foot, and fairing the lines as already described for the process on the floor. In some yards laying off on a large scale on paper is relied on almost entirely, and very little full-sized work on the floor is considered necessary. Before the lines are rased in, a displacement sheet must be fully worked out from the lines on the floor, to ensure that the correct displacement and position of CB and metacentre are obtained, otherwise the ship may not float at the waterline intended, or with the desired initial stability. Moulds for a great many of the plates and angle bars can now be made, such as the various flat and vertical keel plates and keelsons, intercostals, margin plates, the stringer plates of the decks, the frames, and bulkheads. They are often made separate in thin wood; but it is a common practice to make a copy of a large part of the body plan, showing the shapes of the frames, floors, reverse frames, &c., on a large wood platform prepared for the purpose, called a *scrive-board*, which is placed near the angle-bar furnaces for the use of the angle-smiths; and by its use the frames are set, instead of using separate wooden moulds for each frame. While the work on the scrive-board is proceeding, moulds for other parts are put in hand at the mould loft, such as the beams of each deck, the keelsons, girders, and stringers.

The practice in regard to laying-off and mould-making varies considerably in different places; some prefer making moulds at the ship when possible, some use the mould loft to the fullest extent, and others are content with the scrive board and little else. For instance, in the American Lake shipyards templates are very carefully and ingeniously made for the framing, one set sufficing to mark off all the frames over the greater portion of the ship's length. In a similar way, one template is made for each strake of plating, and used to mark off the whole of the plates of that strake, a slip mould being used when they begin to depart from the parallel midship body.

In the drawing office, arrangements of the plating and angle bars required in all parts of the vessel are worked out, with the view of ordering the materials at the earliest possible date. In many cases the sizes required can be obtained from the model, or, as already stated, from the floor, but in many others they have to be measured from these working drawings. All the drawings of the structure and of the fittings must be pushed on and issued to the shipyard in good time. Very much of the success achieved in actual building will depend upon the efficiency of the drawing office, and the rapidity with which the various detailed working plans can be supplied for guidance. These plans must be accurate and complete, and must be ready as soon as required. The drawing-office staff has the oversight of weights actually worked into the ship, a careful record of which should be kept. Each firm has its own system of work in these departments, but experience shows that the more thorough and systematic the work in the drawing office and its adjunct, the mould loft, the better the general result. Another important record is the cost of materials and labour. In all shipyards careful account is kept of workmen's time, whether employed on piece or by the day. Many different systems are in vogue; but whatever the system, the aim is to record the cost of the labour in each trade, and the detailed cost of various parts of the ship.

Laying keel blocks.

While the work connected with laying-off and obtaining materials, &c., is going on, the shipwrights, assisted by handy labourers, prepare the ground for the keel blocks, lay the *blocks* at the proper height and inclination, and secure them against being floated away by the tide or being accidentally tripped while the ship is building. The blocks consist of several pieces of tough rectangular timber, 4 to 6 feet in length, and laid on each other to the height required. The top block is called the *cap-piece*, and is of oak or other hard wood. The blocks are spaced about 4 feet apart for ships of medium size, and somewhat less for ships of large size. They are usually placed upon a longitudinal bed of timber, which remains embedded in the ground for successive ships: the ground should be hard, or very well piled, otherwise the blocks may sink when weight becomes concentrated over them during building, and difficulty arises from the keel, or the propelling shafts, drooping from a straight line. The upper surface of the blocks must be at such a height from the ground that men, especially riveters, can do their work with facility under the bottom of the vessel, that the launch can be fitted, and that when launched the vessel may move down into the water without striking the ground. The last named is a most important consideration; and thus it comes about that the first thing to be settled, before the blocks are laid, is how the vessel is to be launched. The tops of all the blocks are accurately adjusted to a plane surface sloping about ⅝ inch in a foot from bow to stern. The shipwrights at the same time prepare the uprights for the staging, and erect them around the building berth in suitable position with the first line of staging, which will be required at an early period in the ship's construction. The platers and angle-smiths begin to prepare the keel, framing, bulkheads, &c., as soon as the material is delivered and the laying-off and mould-making are sufficiently advanced for the purpose. The actual building generally dates from the first work of this character.

Keel and frames.

The keels of small vessels usually consist of a stout flat bar placed vertically and attached to the garboard strakes by through rivets. Occasionally the keel consists of a vertical centre through-plate, with side bars at its lower edge. In large merchant ships, and in war vessels, the keel usually consists of a wide horizontal plate running along the centre line of the bottom, the sides being turned up as necessary to follow the shape of the bottom (see Figs. 26 and 27, Plate II.). The framing varies very considerably with the size and type of the ship, as already described. In small vessels a frame usually consists of an angle bar, called a *frame bar*, extending from gunwale to gunwale, to which is riveted a bar, also continuous from gunwale to gunwale, called a *reverse bar*, in such a way as to form a built-up Z bar, and between these floor-plates are introduced across the bottom, to give the required strength when resting on the ground or on the blocks. Sometimes the frame consists of a Z bar, in which case the *reverse bar* is not required in the vicinity of the floor-plate. Sometimes angle bulbs are used for frames, as in the case of oil steamers, where internal ceilings are not required. The process of constructing a complete frame of angle bars and plate is as follows:—From the scrive-boards the shape of the section at the frame is transferred to the bending blocks or slabs, the outline being drawn in with chalk; the necessary preparation is made, and the frame bar is drawn from the furnace, and while hot bent to its shape and given the required bevel. The reverse bar is prepared in the same way, except that the inner edge of the frame and floor must be worked to. The floor-plate has to be cut to shape. In large ships the *frame bars, reverse bars,* and *floor-plates* will be in two, or even in three, pieces; in this case the butts are kept some distance from the middle line, and are *shifted* in alternate frames, so as not all to lie in the same fore-and-aft lines. The butts of both frame and reverse bars, as well as those of the floor-plate, are butt-strapped, to maintain as much as possible the strength of the structure. The frame bar, floor-plate, and reverse frame bar all being set, they are placed together in their respective positions over the outline of the frame on the slabs or scrive-boards, the final adjustments made and rivet holes marked and punched, and the work secured together and riveted up.

When the keel is in place, and as far as possible riveted, the frames, bulkheads, and beams, which have been made ready by the iron-workers, are brought to the building slip and got into position by the shipwrights. They are held in place and faired by means of shores and *ribbands*. The latter are made from straight-grained timber of considerable length, sawn out in long straight pieces of square transverse section. They hold the frames in position until the outside plating is riveted. Upon them are marked the lines at which they must be crossed by each frame, and they are bent round and attached to the frames in a fore-and-aft direction at certain heights, which are marked on the frames at the scrive-boards. Some four or more ribbands are used each side of the ship. As the work proceeds, the positions of the frames and ribbands are checked continuously, their positions being maintained by shores from the ground, or some structure prepared for the purpose. Except in small vessels, the beams are not attached to the frames before they are erected, but are hoisted into place as soon as possible afterwards.

The bulkheads are put together on some convenient flat surface, sometimes on the scrive-board or a similar platform constructed for the purpose. If of large size, they are transferred piece by piece and erected at their proper positions in the ship; but whenever possible, they are riveted up and hoisted into position complete. The stem and sternpost are obtained from the forge or foundry and erected at an early stage of the work. The part of the stern abaft the transom is sometimes framed separately on the ground before being erected in the ship. The centre keelson is generally worked intercostally between the floors, but it has continuous parts, usually angle bars, above the floors. Each intercostal plate is secured by angle bars or flanged edges to the floors and to the flat keel plate. Sometimes it is continuous, especially in large ships and in warships. The frames are then cut by it, and the floor-plates are attached to it by short angle bars. After the centre keelsons, the side keelsons and side and deck stringers are fitted. The steel pillars are substituted for the shores supporting the deck beams, being riveted at their heads to the beams and at their heels to the keelson, inner bottom, or tank top.

While the work is proceeding, the shipwrights make the stages, put up gangways and ladders for carrying on the work, fit extra blocks and shores, or remove and replace them as may be required. They line off all plate edges on the frames, the overlap being usually painted in with white paint, ready for the platers. They also erect the stem, sternpost, rudder, and shaft brackets, or struts in twin-screw vessels.

In a ship fitted with an inner bottom the procedure is somewhat more complicated, as the transverse frames cannot be lifted into place as a whole. There are many varieties in the arrangements in such cases; one frequently adopted is shown in Fig. 21, in which the inner bottom extends out to the turn of the bilge. This figure also shows the general construction of the vessel, including the framing at a bulkhead and elsewhere, the bulkhead itself with all its stiffening bars and attachments to the sides of the vessel, and the inner bottom. At the centre line, immediately over the flat keel plates, there is a vertical girder, the full depth of the double bottom, connected to the flat keel plate and to the centre plate of the inner bottom by continuous double-angle bars. This centre girder may or may not be water-tight, according to the desired tank arrangements. The transverse frames are in four parts: the two lower extending on either side from the centre girder to the margin plate of the double bottom, which is a continuous girder of special construction; and the two upper, from the margin plates to the topsides. The lower parts consist of a floor-plate with angle bars at its edges for attaching it to the outer and inner bottoms, the centre girder, and the margin plate. At the bulkheads these floor-plates are solid, and the angle bars are united and made water-tight; elsewhere they are lightened by holes, and the angle bars at their upper and lower edges and ends are separate pieces. The two upper parts of the transverse framing consist of a frame and a reverse bar, each having a deep and a shallow flange, and are riveted to one another along their deep flanges, with their shallow flanges standing the reverse way to one another. The shell-plating is attached to the shallow flange of the frame bar. Between the centre girder and the margin plate on each side of the ship there are two intercostal girders, the plates of which are connected by short angle bars to the floors and to the shell and inner bottom plating; and between the margin plates and the lower deck on each side there are three stringers, consisting of intercostal plates attached by short bars to the outer plating, and three continuous angle bars riveted to part of the intercostal plates which extend beyond the reverse bars.

In the course of erection, after the flat keel plate is laid upon the blocks, and the centre girder placed upon it, the two lower parts of the frames, which have been constructed alongside, are put into position, their outer ends being carried by ribbands shored from the ground. The intercostal girders and margin plates are then fitted. The lower edge of the margin plate is brought close to the outer edge of the frames, and is connected by a longitudinal angle bar to the shell-plating, while its upper edge is flanged for the purpose of being attached to the inner bottom plating. The ship at this stage gives the impression that a flat pontoon is being constructed.

When the margin plates are up and faired and, as far as desirable, riveted, the upper parts of the frames on each side are erected and the fairing proceeded with as before. The beams are now got into place, also the side and deck stringers. As will be seen, the margin plate cuts completely through the transverse frames, and special brackets are provided to maintain the transverse strength. The chief advantages derived from cutting the frames by the margin plate are the cheapness with which water-tight work is secured, and the rapidity with which this part of the work can be proceeded with.

As soon as the keelsons and stringers are riveted, and the ship by their means sufficiently stiffened, the outside or shell plating is

commenced. The plating squad is supplied with a drawing showing the disposition of the butts in each line of plates; light wooden moulds or templates are then made, giving the exact shape of the edges and butts, and the positions of all the rivet holes in the frames. From these moulds the edges and butts and the holes are marked off, the holes are punched, and the edges and butts sheared and planed. The plates are then rolled to shape, furnacing being resorted to only when the curvature is too extreme to be obtained with the plate cold. The usual arrangement of the plating is that of inside and outside strakes alternately (see *a*, Fig. 15). The inside strakes, which are worked first, are templated off the ship, and lie directly on the flanges of the frame bars. The outside or overlapping plates are then worked, and are templated from the place they are intended to occupy on the ship. They are kept at the proper distance from the frames by liners or slips of the same thickness as the adjacent inside plates. Towards the ends of the ship the number of strakes of plating must be reduced, as the girth along the frames is much less than over the midship portions. Stealers are introduced for this purpose; they are single plates, which at one end receive the butts of two plates, and at the other the butt of only one. By them two strakes are merged into one.

Shell or outside plating.

The number of plates requiring to be furnaced is small in comparison with the whole number, but there are always some at the after end of the ship, especially in the neighbourhood of the boss (for the stern tube) and the counter, and a few at the forward end of most ships. As each plate is got ready, it is taken to the ship, hoisted into position, and temporarily secured by the platers by means of bolts and nuts. As the work of plating proceeds, and the weight of the ship increases, extra shores are put into place, and bilge blocks erected by the shipwrights, to keep the structure to its shape and prevent local and general "unfairness." The shell-plating in way of the intended bilge blocks is completed at as early a period as possible, and painted, so that when once the bilge blocks are in place they need not be disturbed until immediately before launching. While the platers are at work on the shell-plating, other squads of riveters are engaged on the deck-plating and internal work, such as the bunkers, engine and boiler bearers, the shaft tunnel, casings, and, in the later stages, the hatches, houses on deck, &c., and as much as possible of the internal work is done before the shell shuts out the daylight. As the work is completed by the platers, it is ready for the riveters and caulkers; and these trades follow on without delay, except in some parts of the casings and decks in way of the machinery, which are left portable, and taken down after the launch, to allow the machinery to be put in place.

The platers usually work in squads, composed generally of three platers, a marker-boy, and a number of helpers or labourers, the number of whom depend on the size and weight of the plates, and the nature of the work to be done on them, and also on the facilities of the yard for handling such material. On the work of a large vessel many of these squads would be employed. The riveters also work in squads, a squad consisting of two riveters, one holder-up, and one heater-boy, with sometimes a catcher, *i.e.*, a boy to pass on the heated rivets when the distance from the rivet-hearth is great. Pneumatic riveting has not made great progress in Great Britain. Hydraulic riveting to a limited extent is adopted, especially in the case of work that can be taken to the machine, such as frames, beams, and other parts; but in shipbuilding the large proportion of the riveting is done by hand. In the Royal dockyards platers' work is done by shipwrights, and riveting is not considered a trade, though regarded as skilled labour. Shipwrights also lay the blocks, erect the ribbands, shore and fair the ship, but labourers construct the stages. Drillers' work consists in drilling by hand holes which it is not convenient or possible to punch or drill by machine; they also rimer out and countersink punched and drilled holes when this is necessary. Portable electric or pneumatic drills are used when possible in some shipyards, and three-cylinder hydraulic engine drills are employed for some purposes, such

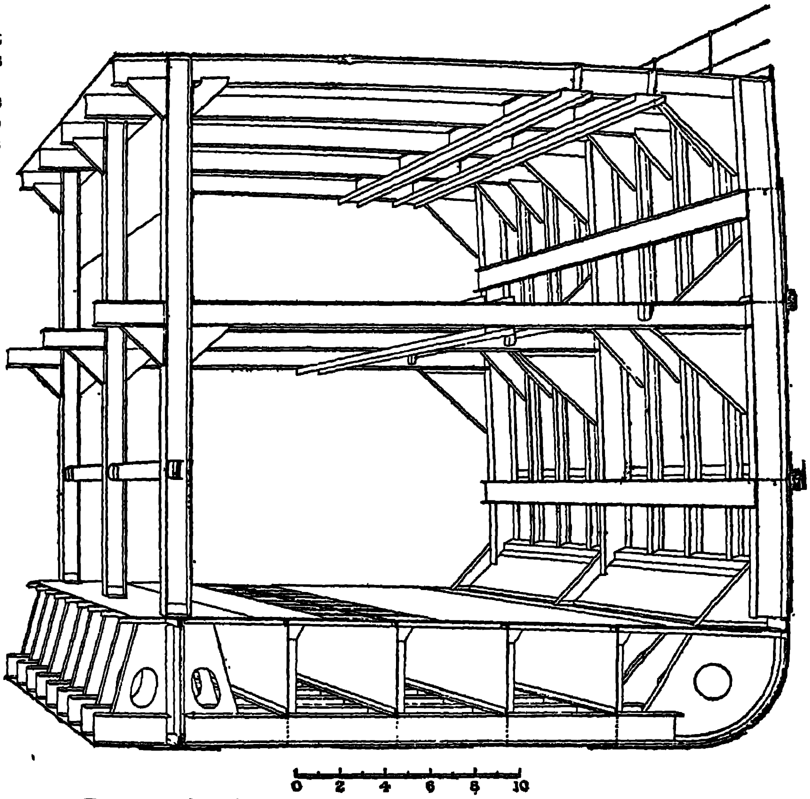


FIG. 18.—Modern Great Lake Cargo Steamer; midship portion, in perspective.

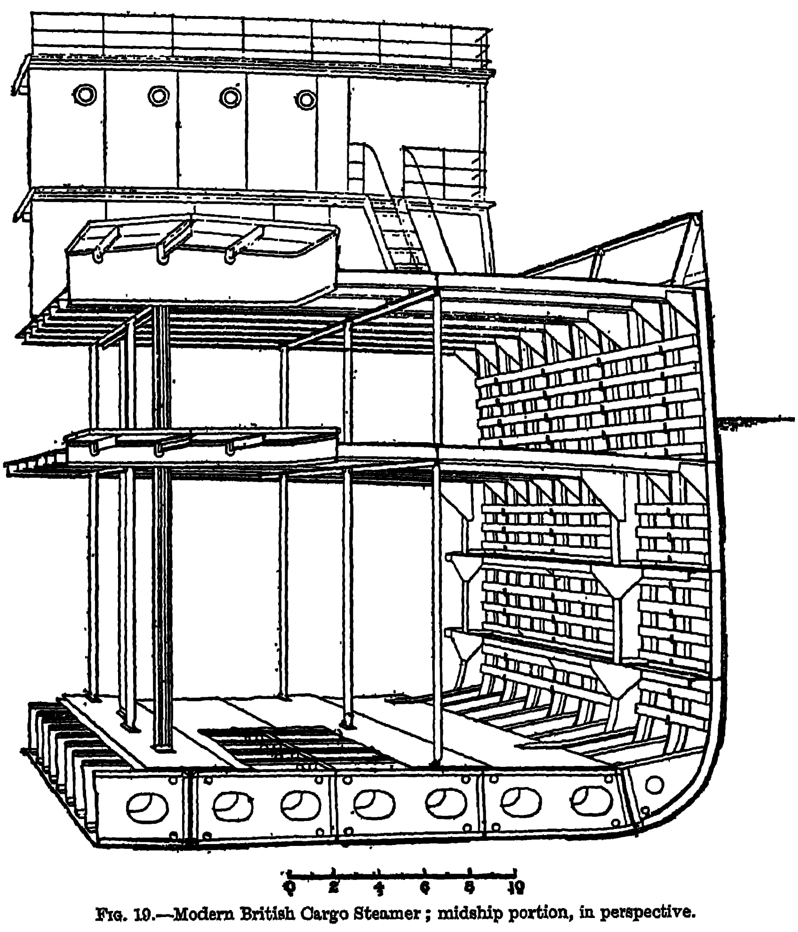


FIG. 19.—Modern British Cargo Steamer; midship portion, in perspective.

as in cutting armour bolt holes in thick plating behind armour. The caulkers follow closely upon the riveters, and generally work singly. A very important part of a caulker's duty is water-testing. In the large oil-tank steamers possibly 8000 tons of water are used for testing one ship alone, and about the same amount for a large war vessel. This water is pumped from the sea or river into the compartment to be tested. In the case of an oil vessel, each compartment is filled right up, and a pressure put on by means of a stand pipe, carried for a considerable height above the highest part of the tank; any leakage found must be made good by the caulker, and the tank re-tested until it is perfectly water-tight. The double bottoms of merchant ships, and the smaller compartments and double bottoms of war vessels, are filled up and tested by a head of water rising a few feet above the load water-line. It is not usual to fill all the larger compartments, such as boiler and engine rooms in war vessels, or the machinery compartments and cargo holds in merchant ships; but water at a high velocity is played on the bulkheads by hose, to test the water-tightness and the strength. An occasional test, however, is made by filling a typical large compartment with water to a height of some feet above the load water-line. Angle-smiths form beam knees where these are welded, and generally all angle bar work where heating in a smith's fire is required. It is usual to defer the painting of certain parts of the steel structure of a ship as long as possible, so that ordinary red rust may form and dislodge the black mill scale which is answerable for a great deal of corrosion in steel ships, as in certain circumstances it forms a galvanic couple with the steel plate. For warships the British Admiralty requires the removal of this scale from these parts by immersing the plates in a weak solution of hydrochloric acid. Red and white lead, oxide of iron, and oxide of zinc form the bases of most of the paints used on steel ships.

Structural Arrangements.

The following are particulars of ships in course of construction at New London (Conn., U.S.A.) on the *longitudinal* system:—"The great centre girder, which in all vessels prior to these has been in the form of an I girder, is formed of a double II or box; that is, these vessels have two vertical keels instead of one. The girder is of the same depth as the double bottom (6 feet). On each side of this girder there are several other vertical longitudinal members, having the plating on the top, forming the tank top, and the shell-plating below, forming the bottom of the tank. This tank or double bottom is 6 feet deep for the greater part of its length, and is increased at the extremities, where it merges into the fore-and-aft peaks at the collision bulkheads. The whole of this space can be filled with water when desired, to sink the ship to a suitable draught when making a voyage without a cargo or with a very light one, at the same time allowing the ship to keep afloat whenever the outer shell or skin has been pierced by rocks or by colliding with other vessels. This bottom girder or double bottom forms the 'backbone' of the ship, from which the great frames spring or extend up to the weather deck, about 60 feet above the keel. The frames are made of channel steel spaced 30 inches apart, but as they near the extreme ends they are spaced closer, and are composed of angle bars riveted together. At certain parts of the structure, where the heave of the sea will tend to strain the ship, the frames are double and made very strong. The outer surface of these frames is covered with a shell of steel plates averaging about 1 inch in thickness. These enormous plates are arranged to give a maximum of strength, and the riveting of them to the frames and to each other is receiving the utmost care.

"These ships have a continuous longitudinal bulkhead on the centre, extending from the inner bottom to the main deck. The side plating of the shell, with this longitudinal bulkhead, form three vertical members of the entire structure. The upper flanges of the girder are formed by the upper and main decks, which are laid with heavy steel plates. This great girder is designed to support a full cargo when suspended by long waves of the sea at either end. The side girders are kept in place by three intermediate decks between the tank and the main deck, making in all five complete decks, each covered with heavy steel plate. The beams supporting all these decks are of channel steel, and fitted to every frame by large bracket plates. One of the many notable features in the construction of these vessels is the distribution of the water ballast. Various conditions of trim and safety can be obtained. The double bottom is divided longitudinally into three water-tight divisions and transversely into about twelve, making in all thirty-six separate tanks. In addition to these there are the fore-and-after peak tanks, and side tanks between the main and 'tween decks, about one quarter of the vessel's length from either end. The latter tanks are really fitted for the purpose of controlling the ship's stability and seaworthiness.

"The vessels are divided transversely into thirteen water-tight compartments, while the longitudinal bulkhead is water-tight in the machinery space, which makes in all fifteen water-tight compartments. The engine-rooms are completely independent of each other; so are the boiler-rooms; but access is had from one to the other by water-tight doors. The coal can gravitate direct to the stokehold floor. The method of pillaring is somewhat novel, and has never been attempted before by any American shipbuilder. . . . Strong girders run under the transverse beams and are supported at wide intervals by built stanchions. By this means the least possible trouble is experienced in stowing the cargo. . . . The building-slips rest upon a solid granite ledge, which at a suitable declivity runs down to the bank of the Thames river. Opposite the yard there is over 60 feet of water, and it is proposed to run the launching-ways about 300 feet from the shore-line into the water. The vessels will be the heaviest ever launched."

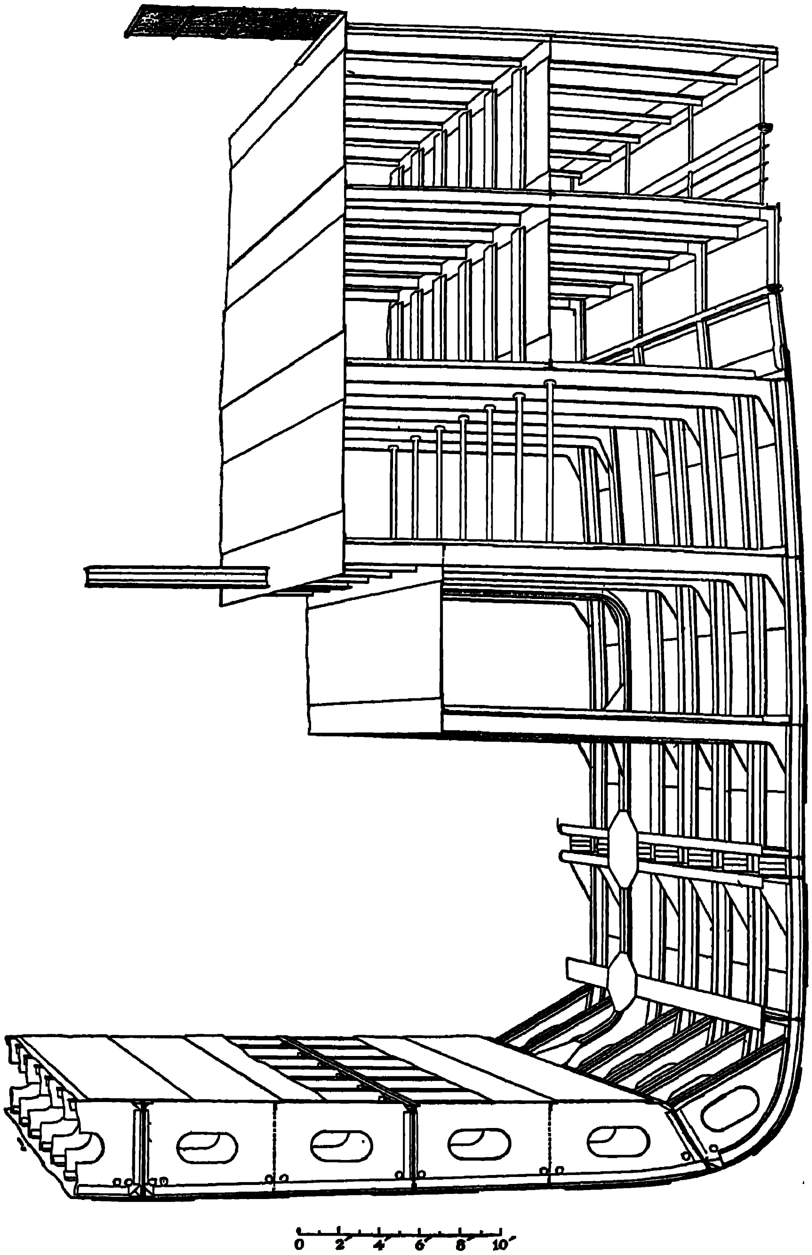


FIG. 20.—Cunard Liner *Campania*; midship portion, in perspective.

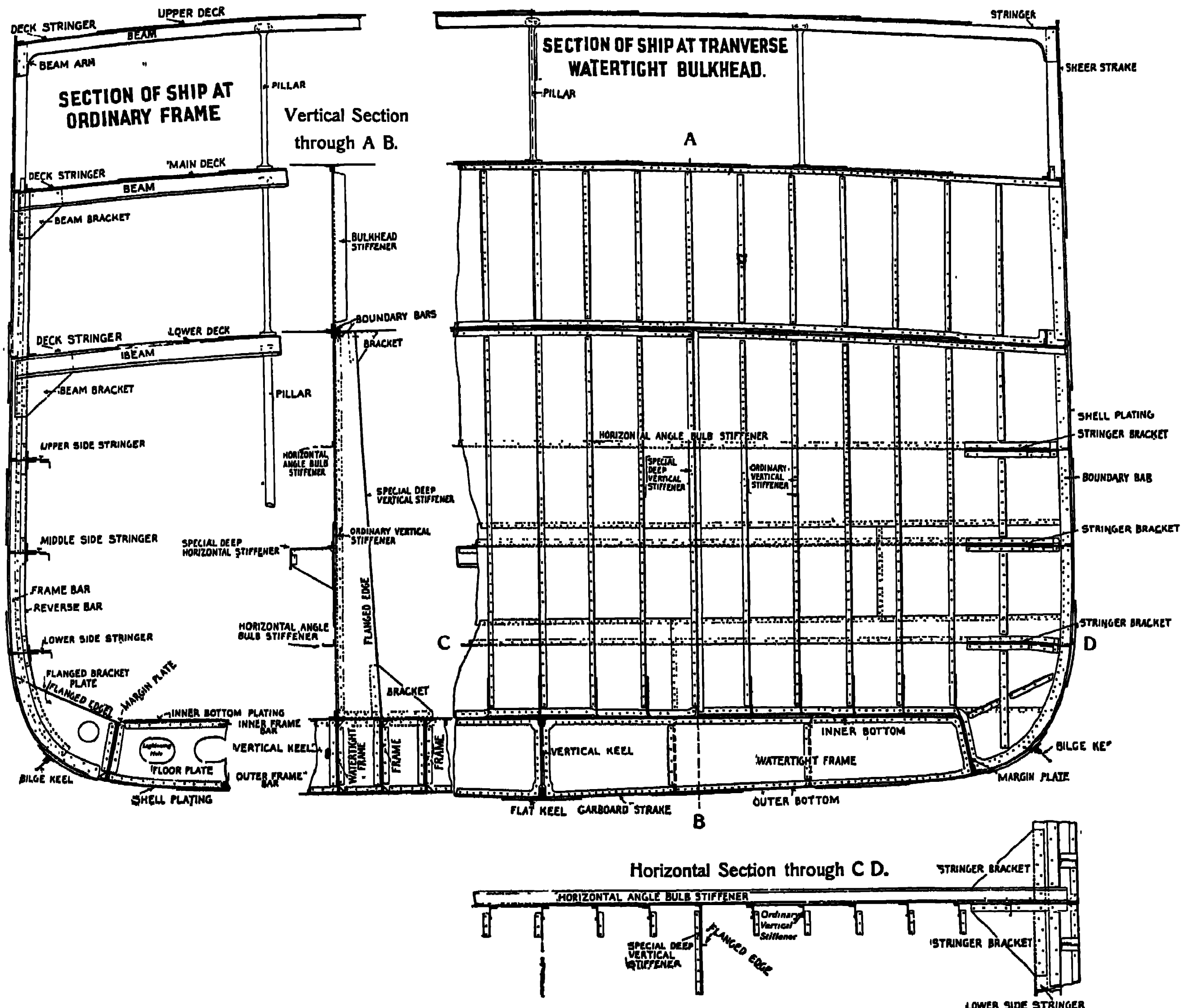


FIG. 21.—Details of framing and bulkheads.

Fig. 18 shows the construction of a typical American Lake steamer. a diagram of which is given in the article SHIP, Fig. 12.

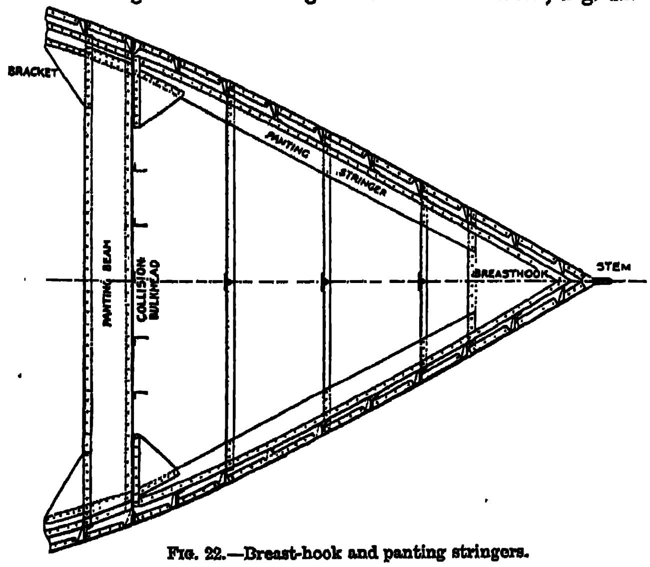


FIG. 22.—Breast-hook and panting stringers.

She is 450 feet over all, 50 feet beam, and 28 feet 6 inches moulded depth; and when loaded to a draught of 18 feet 3 inches can carry about 6000 tons weight of cargo on a total displacement of about 9000 tons. For half the length or more the ship is of the same transverse section, the frames being made identical in form. The outside plating is about $\frac{5}{8}$ inch thick generally, but it is thicker at the garboards, flat keel, and sheer strake, and becomes thinner generally towards the ends of the vessel. The frames are 24 inches apart, and consist of four separate pieces—two across the bottom and one up each side. Those across the bottom consist of a 15-inch channel bar, with deep flanged brackets of $17\frac{1}{2}$ ℔ plating connecting their inner ends to the centre keelson and their outer ends to the bilge and tank top. Extending up each side, the frames consist of 6-inch channel bars of 17 ℔ per foot, worked 24 inches apart in the case of ordinary frames; and 15-inch channel bars of 33 ℔ per foot, worked 8 feet apart, and called belt or special frames. The frames are all connected to the tank top and to the upper deck-plating by flanged bracket plates $17\frac{1}{2}$ ℔ per square foot; and the belt frames are stiffened by hold beams of I section, 12 inches deep and 35 ℔ per foot, attached to each by deep flanged brackets of $17\frac{1}{2}$ ℔ plating as indicated, and supported in the middle by stanchions or pillars of similar section. The stanchions are attached to the tank top by double clips of 6-inch angle bar, and to the upper deck beams by direct riveting and by flanged brackets of 15 ℔ plating. Each belt frame is thus complete in itself, and very readily erected after the tank top is completed. The tank top is of 20 ℔ plating amidships and under the loading hatches, and $17\frac{1}{2}$ ℔ elsewhere. The margin plate is a continuation of the tank top, is made of $17\frac{1}{2}$ ℔ plating, and flanged against the shell. The centre keelson is of about $22\frac{1}{2}$ ℔ plating and about $5\frac{1}{2}$ feet deep; the side keelsons are of $17\frac{1}{2}$ ℔ and slightly less depth, so that with a small rise of floor on the outside, say 3 inches in the half-breadth of the ship, there is a small fall of the tank top towards the bilges, say 6

American Great Lake steamer.

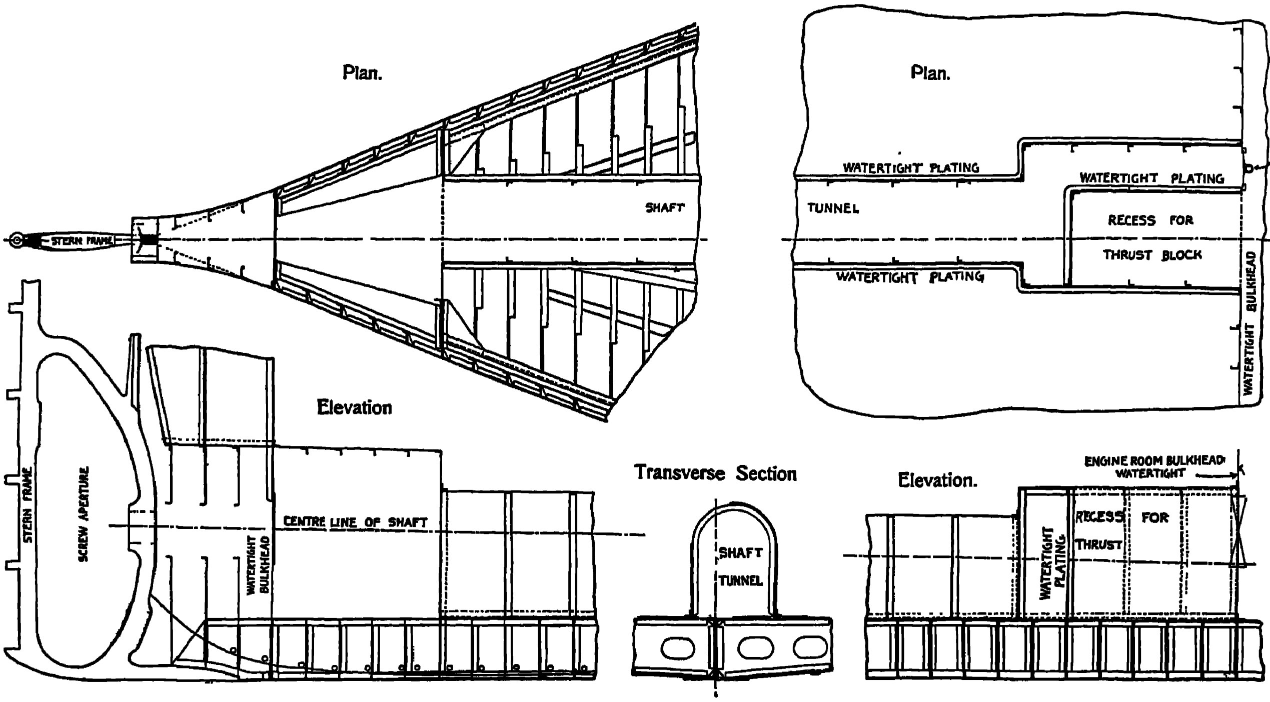


FIG. 23.—Stern framing, shaft tunnel, &c. of single-screw ship.

inches in the half-breadth, so as to drain the hold to the watercourses over the margin plates. The centre keelson extends from the inner to the outer bottom, being attached to the tank top and the flat keel by heavy double angle bars, and well stiffened by the flanged floor brackets, which are connected to it by heavy double angle bars. The side keelsons are connected to the tank top and the floors by fore-and-aft angle bars 3 inches by 3 inches of $7\frac{1}{2}$ lb per foot, and stiffened by vertical 6-inch angle bars at every frame. At the lower edge the keelson plates are connected to fore-and-aft intercostal channel bars 15 inches deep of 33 lb per foot, riveted to the shell-plating, which, with the channel floors, give very great local support to the bottom. This system of framing extends practically throughout the length of the vessel; thus the bottom is very strong, and very large ballast tanks are formed, having a capacity of nearly 3000 tons. The upper deck is plated, and the stringers are made specially heavy, to compensate for the strength lost by cutting wide hatchways.

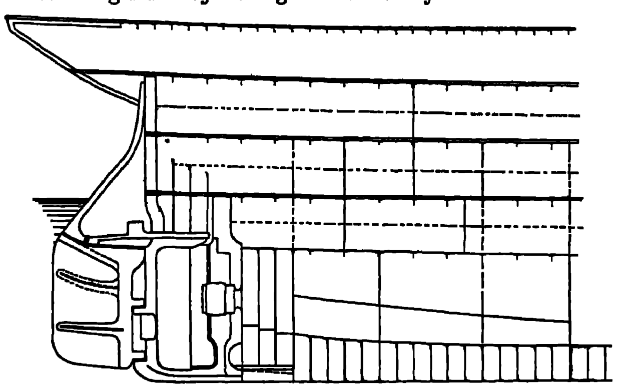


FIG. 24.—Stern framing of the *Campania*.

British cargo steamer.

Fig. 19 represents a modern British cargo steamer of ordinary construction, of about the same breadth and depth as the American Lake steamer just described, and it will be interesting to note the differences between the two vessels. These differences, so far as the outside form is concerned, are chiefly that the British cargo steamer has deck erections, topsides, and a main deck, whereas the Lake steamer has scarcely any deck erections and no topsides, while her hold extends from the top of the inner bottom to the upper deck; they are due to the fact that the latter ship is only required to traverse inland waters, where heavy weather is not met with, whereas the former is an ocean-going vessel, and must be prepared to meet all conditions of wind and sea. As to the differences in the details of construction, they are chiefly that in the American Lake steamer the bottom framing, which is of great depth, consists of deep channel-frame bars, above which the longitudinals are continuous, instead of the usual transverse framing in the British ship, extending between the outer bottom and tank top; and that the margin plate continues the surface of the tank top out to the side, instead of being nearly vertical, as in the British ship. The system adopted in the American steamer conduces to security in case of grounding in the shallow waters through which she has to pass.

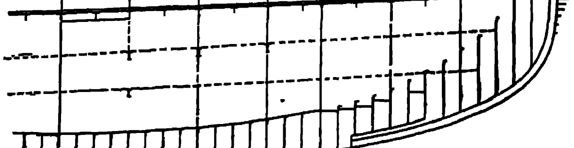


FIG. 25.—Bow framing of the *Campania*.

Atlantic liner.

The general construction of a large passenger vessel is shown by Fig. 20, which gives a perspective sectional view of the framing, &c., of the Cunard liner *Campania*. The transverse frames and the girders or longitudinals extend in depth from the outer bottom plating to the inner bottom plating. The centre keelson, the second longitudinal from the middle line, and the margin plate on each side, are continuous, the transverse frames being fitted between them and attached to them by angle bars. The first and third longitudinals from the middle line are intercostal, being fitted in short pieces between the frames and attached to the floor-plates by short angle bars. The floor-plates have large holes cut in them to lighten them, and to give access to the different spaces for inspection, painting, &c., and smaller holes for watercourses. From the margin plate the transverse frames consist of stout channel bars extending to the upper deck; each tier of beams is securely riveted to them, and their lower ends are connected to the margin plate by strong brackets. At intervals the channel-bar frames are replaced by deep built-up frames, the frequency of which depends on local requirements. Heavy side stringers of the same depth as the deep frames run fore and aft,

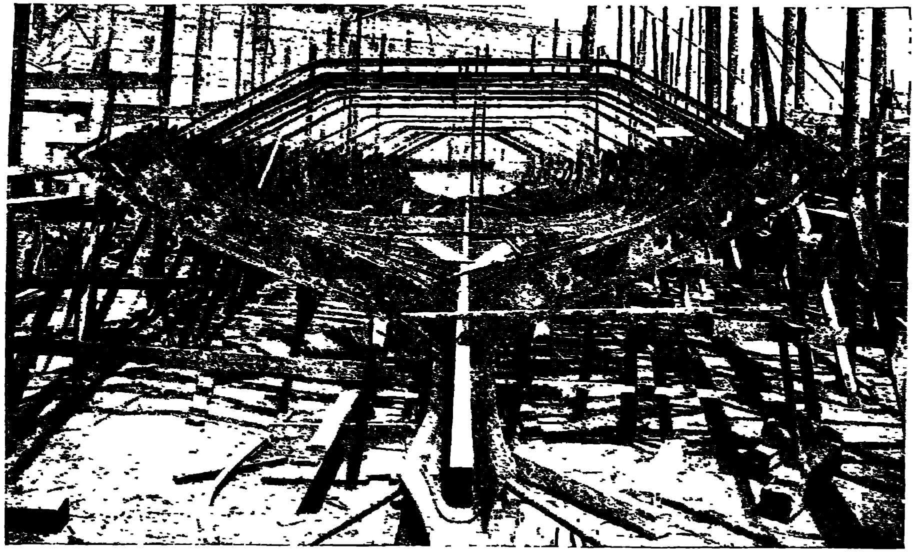


Fig. 26.

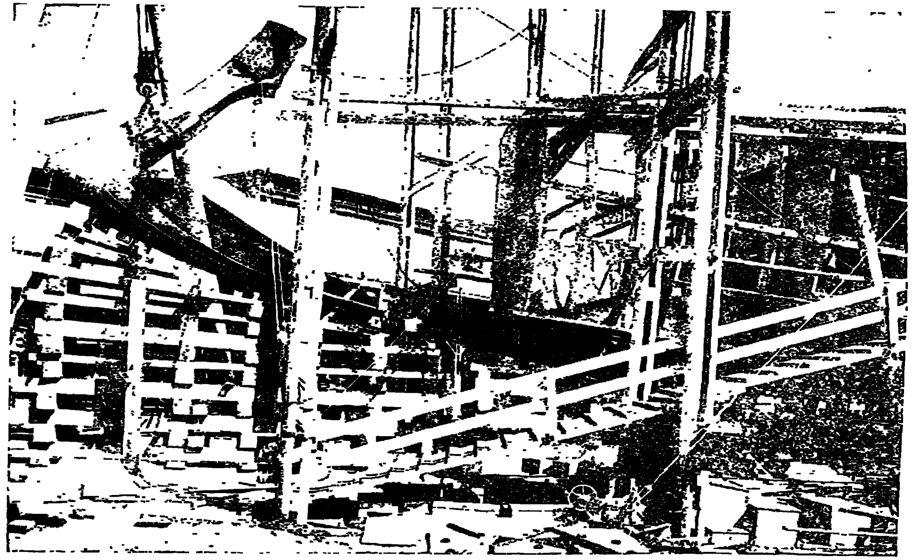


Fig. 27.

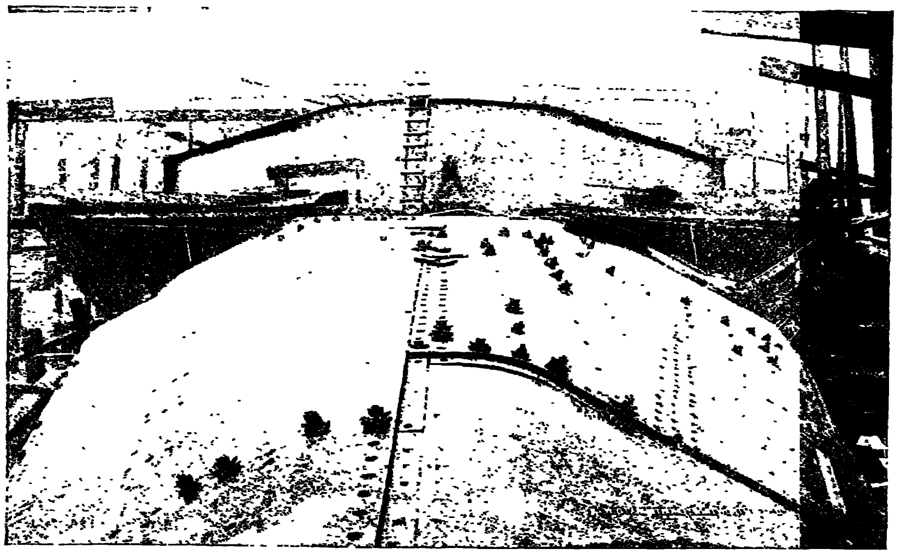


Fig. 28.

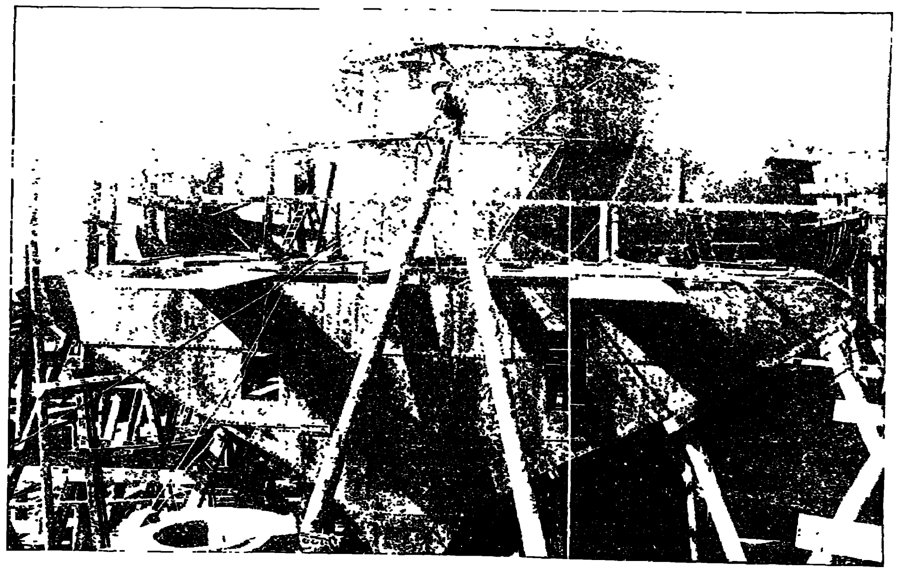


Fig. 29.

Stages in the Construction of a Warship

(*Japanese Cruiser "Idzumo."*)

to stiffen the side between the bilges and the first plated deck. Where the deep frames are cut by these stringers, the strength of the frames is continued by *gusset* plates, as shown.

Some further structural arrangements usually adopted in British ships are shown in Figs. 21 to 23. Fig. 21, to which reference has already been made, shows in detail the construction of a bulkhead, with the framing in wake of it, and the same details at an ordinary frame; also the stringers, beams, pillars, &c. The bulkhead itself stops at the tank top, being secured to it by double angle bars, and the floor immediately beneath it is made water-tight. It would involve very costly work to make the bulkhead water-tight if the side and bilge stringers were made continuous; these have therefore been cut, and the continuity of the longitudinal strength is maintained, as far as possible, by the large brackets shown in the plan. Besides bulb stiffeners, the bulkhead is provided with built-up vertical stiffeners at AB and a built-up horizontal stiffener at CD. Fig. 22 shows the arrangement for special strengthening at the extreme fore end of a vessel, between the collision bulkhead and the stem, and below the main deck, these consisting chiefly of panting stringers, panting beams, and breast hook. Fig. 23 shows the general arrangement of stern framing of a single-screw ship, including the shaft tunnel. A water-tight door, which can be closed when necessary from above the level of the outside water, shuts off communication between the engine-room and tunnel; the form of the stern post and aperture frame casting is shown, with its attachment to the centre keelson and other details.

Figs. 24 and 25 show the arrangements of the stern and bow framing of the *Campania*, which may be taken as those usually adopted in large passenger steamers of this class.[1] In both the transverse framing becomes deeper and stronger as the extremities are approached, while the decks and side stringers are all continued to the extremities, finishing in strong breast-hooks, and additional stringers, breast-hooks, and panting beams are introduced. It is worthy of note that the rudder and steering gear are in this vessel entirely under water, so that she may be used for war purposes without running the risk of disablement by the rudder or steering gear being struck by projectiles. Above the water the stern is finished off so as to have the appearance of being fitted with an ordinary rudder. This important departure from the usual practice was first introduced by Professor Biles in the *City of Paris*, and the *Campania* and her sister the *Lucania* were in 1902 the only British ships so fitted.

Fig. 30 gives in perspective the general structural arrangements of the Japanese cruiser *Idzumo*, and Figs. 26–29 (Plate II.) are from photographs of the vessel in course of construction. It will be seen that the departures from the structural arrangements of a merchant ship are very considerable. As already pointed out, lighter scantlings are used in warships than in ordinary merchant ships. This is effected by more carefully devised and more costly arrangements of framing and plating, and by making the structural features necessary in a warship for protection, &c., serve also for local and general strength. In warships, frames are placed at greater distances apart, 4 feet amidships and 3 feet at the extremities being the usual spacing, as compared with some 2 feet in a merchant ship. On the other hand, there are more continuous longitudinals in the framing of a warship, which extend in depth from the inner bottom to the shell-plating, and give local support to the bottom as well as general strength to the vessel. There are in a warship so many structural features, such as water-tight bulkheads and flats or platforms, required for the necessary subdivision, armour decks, plating and framing behind armour, &c., which are made to contribute to the strength of the structure as a whole, that the strength of the shell-plating and the transverse framing can be proportionately reduced.

Differences between war and merchant ships.

In a merchant ship there are many considerations which require the structure to be stronger and heavier than would be necessary to withstand the wind and waves which she may encounter. The continual change of cargo and of disposition of cargo necessitates special local strength throughout. The custom, often pursued, of grounding vessels to discharge cargo, and their liability to touch the ground in the ports they frequent, make the provision of great strength in the floors and the shell-plating essential. Other considerations affect the decks, and call for local strength in them with corresponding increase of weight.

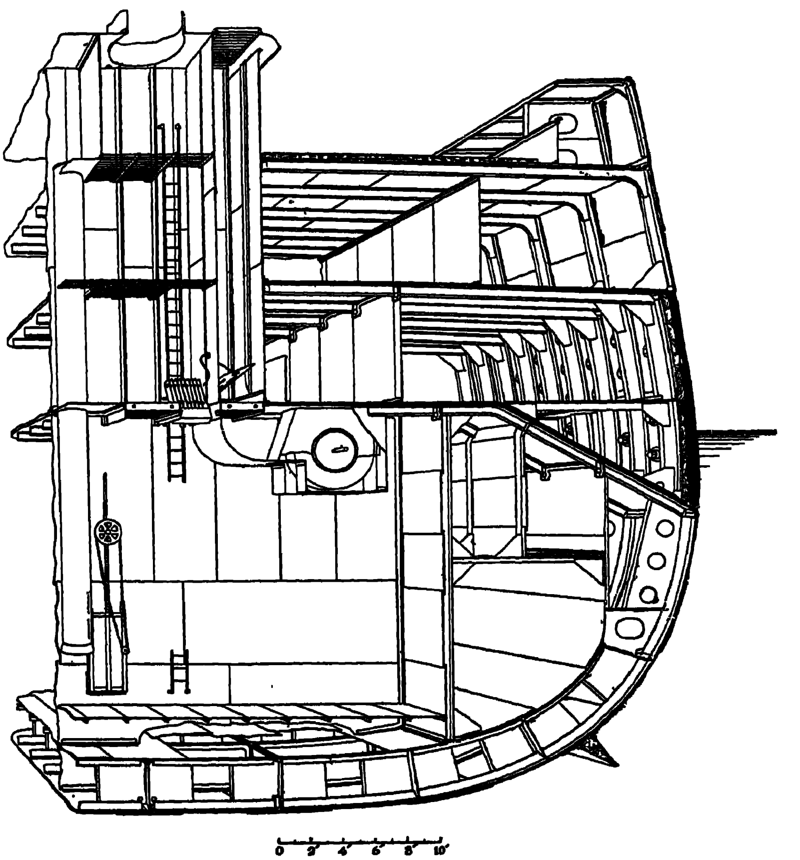


FIG. 30.—Japanese cruiser *Idzumo*; midship portion, in perspective.

Most warships, except gunboat, torpedo, and other small craft, have double bottoms, chiefly for protection against damage in action, but also against accidental grounding. The space between the bottoms is divided into a large number of compartments by making some of the frames and longitudinals water-tight. The inner bottom extends on each side to the turn of the bilge, and from that point is carried up vertically as a wing bulkhead, as shown in Fig. 28, the wing spaces thus formed being occasionally utilized for coal-bunkers. The framing, consisting of frame bars, reverse frame bars, and frame plates or brackets, is usually carried up in a fair curve to the armour shelf, supposing the vessel to be an armour-clad, as in Fig. 30. From the edge of the armour, which is generally about 5 feet below the load water-line, a change in structure is made, and the framing behind the armour is set back from the outside of the ship sufficiently to admit of an internal

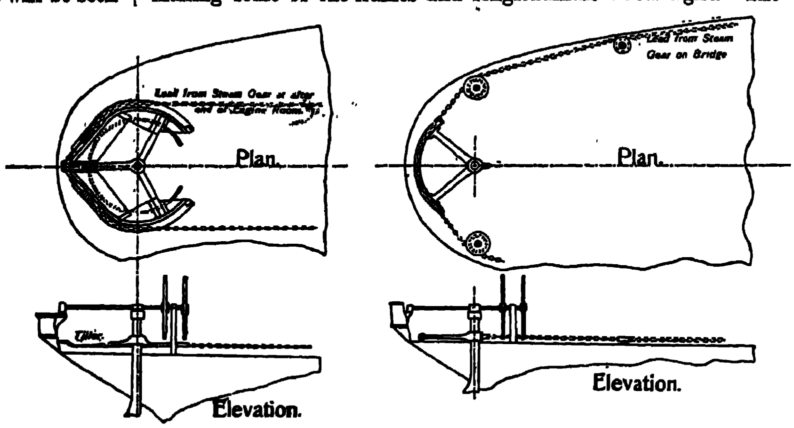


FIG. 31.—Steering-gear of merchant ship.

[1] We are indebted to Dr Elgar, F.R.S., for these and other plans of the *Campania*.

skin of steel plating (often worked in two thicknesses), teak backing, upon which the armour is embedded, and the armour itself, to be carried with the surface of the armour flush with the shell-plating. The vertical frames behind armour are spaced 2 feet apart, and the longitudinals are made intercostal, the whole having exceptional strength, to support the armour. Above the armour another change is made, the frames being brought again to the outside of the ship, and the topside plating directly attached to them becoming flush with the outside of the armour. There is generally a strong deck, called the protective deck, extending from stem to stern in the form of a turtle back, the lower edges being at the armour shelf on each side of the ship, and the top of the arch forming the first deck above water, as indicated in Fig. 28. With a view to maintaining its defensive power where it has to be perforated for funnels and air shafts, armour gratings, or armour bars as they are called, are fitted in the openings. As much water-tight subdivision as possible is introduced throughout the ship, but for communication between the various compartments openings are provided in the bulkheads, having water-tight doors which can be closed either from a position close to the door or from a deck above water, or from both. Below the protective deck are the engine and boiler spaces, magazines, shell-rooms, submerged torpedo rooms, and steering-gear. A passage is provided on each side of the ship just below the protective deck, for the supply of ammunition to the secondary armament.

Fig. 26 shows the *Idzumo* partially in frame, looking forward from the after extremity: the frames below the armour deck over a considerable length of the ship are complete, and a number of the beams which carry the armour deck are in place. Fig. 27 shows the ram stem, which has just been placed in position. The collision bulkhead and the framing below the armour deck are for the most part in place. Fig. 28 gives the top of the armour deck, which is nearly completed, as seen from the fore end, with the forward citadel bulkhead in course of construction. Fig. 29 shows the after part of the vessel, which is not so far advanced as the forward portion shown in Fig. 28. In Fig. 29 the framing has been carried to a bulkhead near the after extremity, the rudder post is in place, and the bearing for the rudder head can be seen in the foreground. The construction of the armour deck is proceeding, and the after citadel bulkhead is also well advanced, though no backing is yet upon it, as in the case of the forward bulkhead, but the base of the redoubt which carries the after turret is erected.

Internal fittings.

The whole of a ship's fittings are prepared during the building. The various plans are carefully worked out in the drawing-office, sketches being prepared to show the accommodation for passengers and crew, the rigging, bridges, and wheelhouse, the pumping and draining arrangements, steam piping and heating, details of steering-gear, anchor and cable gear and electric lighting, and of all blacksmiths', joiners', and shipwrights' work, upholstery, &c. Such drawings as are necessary are issued to all the various trades for guidance in performing their parts of the work; others are issued to manufacturers for the supply of completed fittings and special appliances, so that all may be ready at the proper moment for installation in place on board the vessel. In war vessels similar but more elaborate plans are required than in merchant ships, and, in addition, plans of magazine and shell room arrangements, gun foundations, torpedo installation, armour plates and bolts, transport of ammunition, and many others. The shares contributed by the various trades in completing the vessel are briefly as follows:—The shipwrights do all the heavier woodwork, such as laying decks, fitting ceilings, erecting and fitting storerooms, and completing all weather work. In the Royal dockyards their work embraces the fitting of the pumping, flooding, draining, and ventilating arrangements throughout the ship, part of the steering-gear, the greater part of the hydraulic mechanism, the supporting structures of the heavy guns, and much other work which is usually performed by fitters in private yards. The joiners do the more highly finished woodwork, such as cabin and saloon fittings and the lighter store-room fittings. Blacksmiths complete all the forged work, pillars, handrails, davits, mast fittings, awning stanchions, and a large variety of deck fittings. Fitters make and fit the water-tight doors, sluice, drain, and flood valves, gun-mountings and torpedo gear, and fit the steam windlass, winches, parts of the steering-gear, &c.

The fittings in a ship cannot be fully described in the present article, but we shall conclude with some account of the auxiliary machinery. Two ordinary arrangements of steering-gear fitted in merchant steamers are shown in Fig. 31. In the first example a three-quarter circular grooved rim, keyed to the rudder head, carries the steering-chains, which are led forward one on each side of the hatches to the steam engine, placed in this case in the engine-room casing, and controlled by shafting from the bridge. The usual steering-wheel is fitted on the bridge, and actuates the controlling valve of the steam engine by means of the shafting. The second example is very similar to the first: a quadrant is keyed on the rudder head, and worked by chains led over pulleys one on each side of the ship to the steam gear, which in this case is placed on the bridge, close to the wheel. In all such cases gear is also provided by which in an emergency the ship can be steered by hand, by steering-wheels placed close to the rudder head, as indicated in the figures.

Auxiliary machinery.

In a warship the arrangement is different, as it is necessary to keep the steering-gear below the water-line for protection. The breadth available at the rudder head is as a rule not sufficient for a tiller or quadrant to be fitted. Fig. 32 illustrates an arrangement frequently adopted. A crosshead of sufficient size is keyed on to the rudder head, and is worked by connecting rods from a similar crosshead placed a little farther forward, where the breadth of the ship is sufficient to allow a tiller to be worked. The tiller is worked

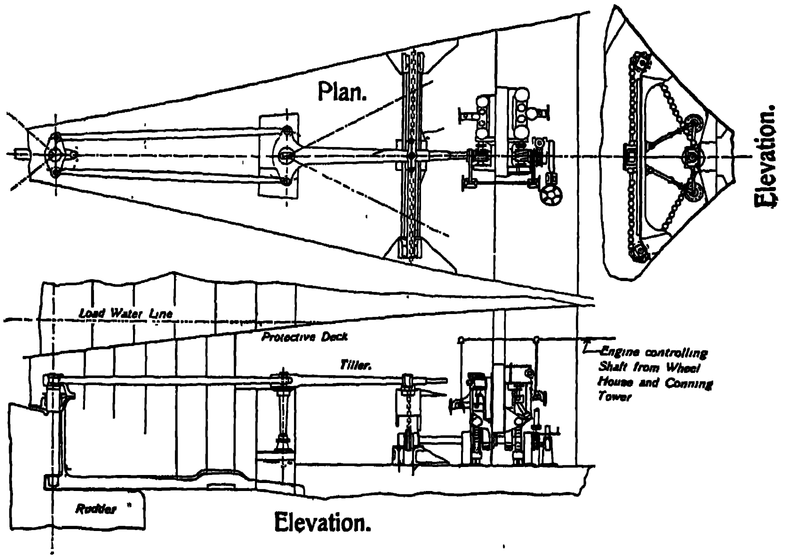


FIG. 32.—Steering-gear of warship.

by a block or carriage, which is drawn across the ship on a guide, at the same time sliding upon the tiller, which is machined for the purpose. The block-and-guide arrangement is known as Rapson's slide. The block is hauled to and fro across the ship by a chain which passes round a sprocket wheel upon a shaft, which is driven in either direction, as required, by the steering-engine. In many cases the steam steering-engine is placed in the engine-room, to avoid heating the after compartments by the steam pipes, and for the sake of easier control by the engineers.

Amongst the auxiliary machinery usually fitted in passenger and other well-found vessels may be mentioned the windlass for working the cables and weighing the anchors; a warping capstan forward in connexion with the windlass, and another aft with its own engine; steam winches for handling the cargo and baggage, and for hoisting coals on board; and occasionally steam cranes, fitted either in addition to or in place of the winches. Then there are the electric light, pumping, ventilating, and refrigerating installations. Hydraulic power is employed in many cases, especially for cranes, but here the source of the power is necessarily a steam engine, which is usually placed in the main engine-room. Electric power sometimes replaces steam for operating some of the machines enumerated above; for instance, ventilating fans are now generally driven by electric motors in passenger and war ships. A large number of comparatively small fans are used, each supplying air to a particular part of the ship. In warships the amount of auxiliary machinery has been very much increased in recent years. On each side of the deck amidships there is generally a steam winch for raising and lowering the boats, one of the principal functions of the mast in the modern warship being to carry the derrick used for this purpose. Electric motors are fitted for working the after-capstans, ash hoists, sometimes the winches, and the workshop machinery; also to traverse, elevate, and work the guns, and bring the powder and projectiles up from the magazines to the guns. But for the heavier guns, the steering-gear, and certain other purposes, hydraulic power or steam is still preferred. (P. WA.)

Ship Canals. See CANALS.

Shipley, a township in the Shipley parliamentary division of Yorkshire, England, on the Aire, 3 miles north by west of Bradford by rail. The parish includes the village of Saltaire, so named after its founder, Sir Titus Salt, who here established large alpaca manufactures. Area of urban district, 2179 acres. Population (1891), 23,387; (1901), 25,570.

Shippard, Sir Sidney Godolphin Alexander (1838–1902), British colonial administrator, was born in 1838, being the eldest son of Captain William Shippard, 29th Regiment. He was educated at King's College School, and went thence to Oxford, where he obtained an exhibition at Oriel College, and subsequently a scholarship at Hertford College. Taking his degree in 1863, he was called to the bar as a member of the Inner Temple in 1867. He then entered upon a long and honourable career in South Africa. In 1873 he was appointed Attorney-General of Griqualand West, a post which he continued to hold until 1877, when he was made Acting Recorder of the High Court of Griqualand. From 1880 to 1885 he sat as a judge of the Supreme Court of Cape Colony; and he was British Commissioner on the Anglo-German Commission in 1884–85 for settling the Angra Pequena and West Coast claims. It is, however, with Bechuanaland that his name is chiefly associated. He held the chief official position there from 1885 to 1895, being administrator, chief magistrate, and president of the Land Commission for British Bechuanaland, and resident commissioner for the Bechuanaland Protectorate and the Kalahari. In 1887 he was made K.C.M.G. In Bechuanaland the crucial problem of native administration was the liquor question. Khama, the great chief of the Bamangwato, addressed to Shippard in 1888 an appeal in which he said: "To fight against drink is to fight against demons, and not against men. I dread the white man's drink more than all the assegais of the Matabele, which kill men's bodies, and it is quickly over; but drink puts evil into men, and destroys both their souls and their bodies for ever. Its wounds never heal." Shippard took the same view, and the law prohibiting the supply of liquor to the natives was most strictly enforced by him, the result being that the natives became prosperous, happy, and peaceable. In 1896 Sir Sidney Shippard played a not inconsiderable, though unofficial, part in the negotiations between Sir Hercules Robinson, the High Commissioner, and the Johannesburg reformers after the Jameson Raid. On 7th January, in company with Sir Jacobus de Wet, the British Agent, Shippard made a most effective speech at the Johannesburg Club, which had considerable influence in inducing the Johannesburgers to lay down their arms. Sir Sidney Shippard was twice married, first to Maria, daughter of Sir Andries Stockenström, who died in 1870, secondly to Rosalind, daughter of Mr W. A. Sanford, of Nynehead Court, Wellington. He died on 29th March 1902.

Shipping Companies. See Steam-ship Lines.

Shirley. See Southampton.

Shirwa, Chirwa, or more properly Chilwa, a shallow lake in British East Africa, cut by 35° 20′ E. and lying between 15° and 15° 35′ S. The lake has greatly diminished in area within recent years, the open water filling less than half its former bed except in the rainy season, when the level plain round its margin is flooded. Formerly the water seems to have found an outlet northwards to the Lujenda branch of the Rovuma, but with the sinking of its level it is now separated from the latter by a wooded ridge some 30 to 40 feet above the surrounding plains. The permanent water, which is often almost unapproachable by reason of the swampy nature of its shores, measures only some 38 miles by 14, the width between the former elevated banks being about 20. There are four islands, the largest rising 500 feet above the water.

Shklov (Polish, *Szkłow*), a district town of Russia, in the government of Moghilev, on the highway to St Petersburg, and on the left bank of the Dnieper, 38 miles from Orsha railway station. It carries on an active trade in agricultural produce and manufactured goods imported from Austria. Population (1897), 10,630.

Shoa. See Abyssinia.

Sholapur, a city and district of British India, in the Deccan division of Bombay. The city is 164 miles south-east from Poona by rail. Municipal area, about 8 square miles; population (1881), 61,281; (1891), 61,915; (1901), 74,521. Since 1877 it has ceased to be a military cantonment. The large bazaar is divided into seven sections, one of which is used on each day of the week. There are two municipal gardens, with fine tanks and temples. A cotton mill, with 400 looms and 36,000 spindles, employs 1500 hands. The high school had 339 pupils in 1896–97. There are six printing-presses, each issuing a vernacular newspaper.

The district of Sholapur has an area of 4542 square miles; population (1881), 583,411; (1891), 750,689, showing an increase of 29 per cent. after the famine of 1876–77; average density, 165 persons per square mile. In 1901 the population was 720,978, showing a decrease of 4 per cent. The land revenue and rates are Rs.13,49,501, the incidence of assessment being just over 8 annas per acre; cultivated area (1897–98), 1,948,084 acres, of which 105,677 were irrigated from wells, &c., including 9145 from Government canals; number of police, 588; children at school (1897–98), 9710, being 1·3 per cent. of the total population; registered death-rate (1897), 44·81 per thousand. The principal crops are millet, oil seeds, and pulse. The Ekruk tank, near Sholapur city, is the second largest irrigation work in the Deccan. The capital outlay has been Rs.13,40,000. In 1897–98 the gross receipts were Rs.16,883, and the expenditure Rs.33,730, showing a loss of Rs.16,847. There are manufactures of silk and cotton cloth, and blankets. The chief trading mart is Barsi, in a tract surrounded by the Nizam's dominions, with 8 factories for ginning and pressing cotton. Pandharpur is a popular place of pilgrimage. The Great Indian Peninsula Railway runs through the district for 115 miles, with a junction for the Southern Mahratta railway (8 miles), and another junction for the Barsi light railway (22 miles), now being extended to Pandharpur (30 miles).

Shooting.—The taste for sport of all descriptions has developed so rapidly in modern times that, as regards shooting alone, for one person who handled a gun fifty years ago, probably twenty do so now, while the head of game reared and preserved for sporting in the United Kingdom had increased at least 50 per cent. during the same period. As a consequence, the art of gunmaking has improved in proportion, and in view of the modern hammerless ejector gun, with its choke-bore, single-trigger, snap-action, and nitro-powder cartridges, it seems impossible to believe that in the middle of the 19th century sportsmen were still using muzzle-loaders and black powder. None the less it is open to discussion whether modern guns and powders can claim any extraordinary superiority of killing power: their supremacy lies in the case with which they can be loaded and fired, and, in the case of powders, in the absence of recoil and smoke.

For all practical purposes a 12-bore gun, weighing about 6¾ lb with 30-inch barrels, is the most useful for sportsmen of average physical capacity; lesser gauges can only be recommended for the aged or constitutionally infirm. Too great care cannot be exercised in the choice of such a weapon, and, despite the considerable initial expense, it will eventually prove an economy for the intending purchaser to place himself in the hands of a firm of London gunmakers of repute, and pay a good price for a good

article. Such a gun will practically last a lifetime, while the care bestowed on its "fit" and finish proves a source of increased skill in shooting, and of consequent satisfaction to its owner. From this, however, it must not be supposed that there are not many excellent provincial gunmakers, nor that the price of a gun is an invariable proof of its excellence. A really first-class London-made, fitted, and proved gun should be obtained for £40 or £45, and a pair for from 90 to 100 guineas; though these prices are of course susceptible of considerable modification or increase. Single-trigger guns, the latest fashion, are not specially desirable, nor is excessive choking to be recommended. A pattern of 140 for the right and of 160 for the left barrel is ample for ordinary game shooting, while a load of 40 to 42 grains of nitro-powder, with 1 or $1\frac{1}{4}$ oz. of No. 5 or 6 shot, is sufficient for general purposes.

Although many varieties of game and wild-fowl exist in the United Kingdom, it is not within the scope of the present article to do more than merely touch on the shooting of those most commonly met with. Foremost among them must be placed the grouse, and it is hard to say whether grouse-shooting over dogs or grouse-driving be the more enjoyable form of sport. Until recent years the latter form of grouse-shooting was almost entirely confined to the English moors, but it is now very generally practised in Scotland as well; though here, in the writer's opinion, it has not proved an unqualified success, at all events in the Highlands. The main advantage claimed for grouse-driving is that, by killing off the old birds which usually come first to the guns, the younger and healthier birds are left as a breeding stock, and on the English and Lowland Scottish moors, which are naturally adapted to driving, this has produced the most astonishing results. But in the rugged and mountainous Highland districts it is not possible properly to work the "tops" and summits, which are the strongholds of the noxious old cocks it is so desirable to exterminate, and consequently—with some notable exceptions—driving has but too often had a retrogressive effect. The best proof of this is a comparison of the bags obtained in the Highlands a generation ago, when driving was not practised, with those of the present day. In laying out a moor for grouse-driving, special attention should be paid to its configuration, and to the probable flight of the birds, which as a rule always follow the depressions and "slacks" in its surface. Where possible, the "butts" should always be placed in a hollow of the ground; this not only helps to conceal them from the birds, but also produces higher and prettier shots. Very long drives are to be deprecated; moderately short ones, where the birds can be kept constantly moving, and sent backwards and forwards over the same line of butts, will be found the most effective, as by this means the coveys get broken up. In grouse-driving, where birds are fairly plentiful, the sportsman should never turn to fire at those which have passed him; he will kill four birds in front of his butt for every one behind it. He should not crouch in his butt nor seek to conceal himself by stooping, but remain perfectly motionless, until the moment when he throws his gun up to his shoulder to fire. Above all, he should not reserve his fire until the birds are close upon him—a very common mistake among tyros in grouse driving, which considerably lessens the probability of killing the grouse, and which moreover leads to a cramped and "poking" style of shooting. It is a good plan before the beginning of a drive to mark some object about 40 yards in front of one's butt—a white stone or a prominent tuft of heather—and to open fire as soon as the grouse have come within that range. Grouse-shooting over dogs is a fine sport where grouse can be found to lie to them, but its main features are so well known and its methods so simple that it hardly merits further description. Two rules, obvious, but frequently ignored, should be borne in mind—during the heat of the day grouse will generally be found near water, and in wild stormy weather they should be sought on the lower slopes, and not on high ground. Large, big-boned setters are the best dogs for grouse-shooting; small, light-framed animals are unable to bear the heavy work, and pointers are more easily affected by the cold, damp climate of the Highlands.

It is commonly but erroneously presumed that partridge-shooting over dogs is a thing of the past, but there are still many parts of Great Britain where the use of dogs—preferably pointers—is not only customary, but essential to success. Nor can the present wildness of partridges be ascribed, as it so often is, to the short stubbles left by the modern reaping-machine; grouse have become equally wild of late years, and the reaping-machine argument, which is quoted *ad nauseam*, can hardly be applied to them. Moreover, even if knee-deep stubbles—presuming them to have ever existed—have disappeared within the last half-century, root and clover crops, which afford far better cover, have increased in the proportion of two to one in the same period. The wariness of modern game must be attributed to its real cause—the enormous increase in shooters, and the corresponding improvements in firearms. The most general method of shooting partridges nowadays is to drive them off the stubble and grass fields into the root crops, and then walk them up in line—a rather uninteresting form of sport. Care should always be taken to walk across the drills; and when, as must frequently happen, a dead or wounded bird cannot be found at once, it is advisable not to waste time in looking for it at the moment, but to beat the field out, as otherwise any game still in front of the guns will run down the furrows and rise out of shot. A stick should be thrust into the ground where the bird was seen to fall, and it can be looked for afterwards; but the best plan, where practicable, is to have an attendant keeper with a couple of steady retrievers, whose sole business is to stay behind the line of guns to look for such lost or running birds. As with grouse so with partridges, the tendency of the age is to drive them where practicable, and of all forms of what may be termed "artificial" shooting, not one is so difficult of consummation as partridge-driving. To attempt it in an unsuitable locality without careful attention to the usual line of flight of the birds, or above all, under the direction of a keeper who does not understand the art of driving—and how many are there who do?—is merely to court disaster, and to spoil what otherwise might have been an excellent day's shooting "in line" or over dogs. But, given the necessary essentials to success, partridge-driving is a delightful sport, which, moreover, tends enormously to increase the stock of birds. To kill driven partridges neatly and consistently is the highest test of skill in shooting, requiring great quickness of hand and eye, and, it is needless to remark, considerable experience. Space only permits of mention of one axiom for success. The shooter should stand as far back as possible from the hedge behind which he is placed, and as the covey tops it, concentrate his attention on the bird which first catches his eye, and not allow it to be diverted to another. Wherever possible, the guns should stand in a grass field—where running or wounded birds are more easily retrieved—equidistant between two fields of roots, so that the birds, being gradually collected into the one, can be sent out of it over the guns into the other, and unless the ground or the wind be unfavourable, brought back again in a return drive; the more partridges are broken up and kept on the move, the better. Frequent change of blood is essential

where it is intended to maintain a large stock of partridges, and all superfluous cocks should be killed off before the commencement of the breeding season; this is easily done by an experienced keeper.

In dealing with pheasant-shooting, or, to give it its modern title, "covert-shooting," it is essential to point out that, except when treated as a "rocketer," the pheasant is an uninteresting bird of sport, which, unless forced to the contrary, invariably seeks to escape by running instead of flying. A rocketer is therefore an artificial production; it is made, not born, and it has been rightly described as a bird flying high and fast towards the shooter; but as such, if only it be high and fast enough, the pheasant has no superior from a shooting point of view. In order to ensure "rocketers," pheasants, if possible, should always be driven down hill; on flat ground, where this is not practicable, the guns should be placed at such a distance from the covert as enables the birds to rise high and get well on the wing before coming over them. In such localities, too, it will be found a good plan to cut away the undergrowth for a yard or two at the end of the covert to which the pheasants are driven; this generally has the effect of making them fly high. Where pheasants exist in any number, a "false covert" of spruce and fir loppings should be made at the point to which it is desirable to force the birds; they will collect in this, and can then be sent over the guns in small lots at a time. As in grouse and partridge driving, much of the success of a day's covert-shooting depends on the organizing skill of the head keeper and the manner in which he beats his coverts and places his "stops." With regard to ground game, owing to legislation, the days have long since passed when hares would form one of the chief accessories to a day's shooting. Whether this be advantageous from a national point of view it is not within the province of this article to discuss, but from a sportsman's point of view it is regrettable. Not, it must be confessed, that hares either afford great sport or demand much skill in shooting, but they form an agreeable addition to a bag, and supply an excellent article of food for the table. Rabbits, on the other hand, which are far more injurious animals to vegetation of every description, show no signs of extinction. Where they are found in large quantities, the most generally practised method of shooting is to ferret them out of their burrows, which are then filled in with soil or drenched with paraffin, to induce the rabbits to remain above ground, when they are walked up in line, affording most excellent sport. Where cover is scarce, brushwood and fir-loppings should be strewn about for them to shelter under. Rabbits will readily lie out under such conditions for two, or even three, nights, provided only the weather be dry, but in the event of snow or rain nothing will prevent them from going to ground again. First-rate sport is obtained during the summer months by stalking rabbits with a pea-rifle, but this should only be practised where there is no danger to live-stock or human beings from a stray or deflected bullet. Similar, but far finer, sport may be enjoyed by stalking black-cock, in districts where these beautiful birds are to be found.

Finally, with regard to the art of shooting. It is hardly necessary to point out that no amount of theoretical instruction can produce proficiency in this, and that only experience and constant practice can ensure success. But the young or inexperienced shooter should bear one golden rule in mind—that in firing at a moving object his purpose should be to place his charge of shot not where such object actually is at the moment of pulling the trigger, but where it will be by the time the shot reaches it; in other words, the game should fly, or run, into the shot. Moreover, he should train himself to effect this not by dwelling on his game with his gun at his shoulder—a clumsy and dangerous style of shooting—but by firing at an imaginary point in front of it. This of course is a knack only to be acquired by practice; but, paradoxical as it may seem, the man who wishes to acquire a quick and good style of shooting should refrain from aiming at—and consequently dwelling on—what he is trying to kill. Brain, eye, and hand must all operate in instantaneous sympathy, and the actions of throwing the gun up to the shoulder and discharging it should be almost simultaneous.

Rifle Shooting.—Of late years there has been a remarkable tendency towards the use of small-bore rifles both for military and sporting purposes, on account of their low trajectory, extraordinary velocity, and absence of recoil and report. For thin-skinned animals, such as antelope or deer, the ·256 Mannlicher, with a bullet specially prepared to expand on impact, is probably the most perfect weapon extant. But it must be borne in mind that small-bore rifles do not inflict the "shock" of the larger gauges and heavier loads; and although the largest and most dangerous game may be, and often is, killed by one of these tiny bullets, yet they are not to be relied on in those situations, occasionally inevitable in big game shooting, where the sportsman has to stop the charge of a dangerous and infuriated animal. Where such a possibility may occur, the use of a heavy rifle, a 10 or 12 bore, or a ·577 Express, is to be preferred; but gunmakers are now beginning to produce sporting rifles of moderate weight and gauge, ·400 and ·450 bores, for use on dangerous game, which fire cordite instead of black powder, the "smashing" powers of which are claimed to far exceed those of the old-fashioned large-bore rifles.

Among a score of useful works on shooting may be cited the volumes of the "Badminton Library" dealing with this subject; *Hints to Young Shooters*, by Sir R. PAYNE-GALLWEY; *The Fur and Feather* series, published by Messrs Longmans, Green and Company; and *Wild Beasts and their Ways*, by Sir SAMUEL BAKER. (P. ST.)

Shoreham, a town and urban district, England, Sussex, in the Lewes parliamentary division of the county, at the mouth of the river Adur, 5 miles east of Worthing, with a station at the junction of the Horsham branch of the London, Brighton, and South Coast Railway with its coast line. Formerly it returned two members to Parliament, but in 1885 its representation was merged in that of the county. The trade of the small port is chiefly in coals, corn, and timber. Shipbuilding is also carried on. It was from Shoreham that Charles II. escaped to Fécamp after the battle of Worcester, 1651. The population of the parish and urban district of New Shoreham was in 1891, 3393; in 1901, 3837.

Shorncliffe, a military station, Kent, England. See SANDGATE.

Shorthand.—The distinctive features in recent shorthand history have been the widely-extended employment of the art, the increased attention paid to instruction, and the growth of stenographic societies. Throughout the civilized world the systems employed are those of the leading authors of the 19th century; earlier systems have now a numerically small number of practitioners. Shorthand has become an almost indispensable qualification for the amanuensis, and practical stenographic ability is a necessary equipment of the typewriter operator. In professional and commercial offices, and more recently in the services, dictation to shorthand writers has become general. Shorthand has been included among examination subjects for the army, navy, civil service, and medicine in the United Kingdom, and to a certain extent in other countries. Its inclusion in the Technical Instruction Act of 1889 was the first recognition of shorthand by the British Parliament,

and it was subsequently comprised in the codes of elementary day and evening continuation schools. It first became an examination subject for secondary schools in the Oxford Local Examination in 1888, but the Society of Arts has examined students of polytechnics, &c., in shorthand since 1876. Examinations in connexion with the phonographic system of Isaac Pitman date from 1845.

In 1887 the tercentenary of the origination of modern shorthand by Timothy Bright and the jubilee of Isaac Pitman's phonography were celebrated by the holding of the first International Shorthand Congress in London. Subsequent congresses were held at Paris (1889), Munich (1890), when a statue of Gabelsberger was unveiled; Berlin (1891), Chicago (1893), Stockholm (1897), and Paris (1900). These gatherings have promoted the improved organization of stenographic practitioners in the respective countries. After the first congress, three national organizations were established in Great Britain by Pitman writers, which take the place of the Phonetic Society (established in 1843 and dissolved in 1895). In America the formation of national associations for reporters and teachers followed the fifth congress. The inventor of phonography, Sir Isaac Pitman (1813–97), was knighted three years before his death for his "great services to stenography." An enumeration made in 1894 showed that 95 per cent. of British newspaper reporters write Pitman's system. Recent essays in English shorthand authorship are almost entirely in the direction of script characters with connected vowels, as contrasted with the geometric forms and disjoined vowels of Pitman's phonography. The majority are founded on the French system of the brothers Duployé, but *Cursive Shorthand* (Cambridge, 1889), by Professor H. L. Callendar, and *Current Shorthand* (Oxford, 1892), by H. Sweet, LL.D., may be noted as original methods, the first having a phonetic, and the second both an orthographic and a phonetic, basis.

The earlier article on SHORTHAND in the *Encyclopædia Britannica* (xxi. 836) contains a full account of the subject. Among the later publications dealing fully with the history and practice of shorthand are the *Transactions* of the London Congress in 1887, and similar publications in connexion with later congresses; *Bibliography of Shorthand*, by J. WESTBY-GIBSON, LL.D. (London, 1887), treating of English, colonial, and American authors; *Shorthand Instruction and Practice*, by J. E. ROCKWELL, of the United States Bureau of Education (Washington, 1893), dealing with shorthand work throughout the world; and *Examen Critique des Sténographies Françaises et Étrangères*, by Dr THIERRY-MIEG (Versailles, 1900). For Sir Isaac Pitman see *Biography*, by T. A. REED (London, 1890); *History of Our Own Times*, vol. v., by JUSTIN M'CARTHY (1897); and *Dictionary of National Biography*, third supplementary volume (1901). An interesting discovery in shorthand biography may be noted, namely, that Samuel Taylor, the author of the system bearing his name, died in 1811; see M. LEVY in *The Times*, 10th April 1902, and *Notes and Queries*, 24th May 1902. (E. PI.)

Shorthouse, Joseph Henry (1834– ——), novelist, was born in Great Charles Street, Birmingham, 9th September 1834, eldest son of Joseph Shorthouse, chemical manufacturer, and Mary Ann, daughter of John Hawker, of the same town. He was educated at Grove House, Tottenham, where he proved a promising and industrious pupil, and upon leaving school entered his father's business, in which he was all his life actively engaged. He married, in 1857, Sarah, daughter of John Scott, of Birmingham. His literary interest was fostered by a local essay club, to which he contributed many papers. It was not until he was nearly fifty years old that Shorthouse made his public appearance as an author, and even then his remarkable story, *John Inglesant*, had undergone vicissitudes. It was kept for over three years in MS., and the author eventually printed one hundred copies for private circulation. One of these found its way into the hands of Mrs Humphry Ward, who recommended it to a publishing house. Its first appearance was a quiet one; but Gladstone was at once struck by its quality, and made its reputation by his praise. It became the most discussed book of the day, and its author was suddenly famous. Besides *John Inglesant* (1881), Mr Shorthouse published *The Little Schoolmaster Mark* (1883), *Sir Percival* (1886), *The Countess Eve* and *A Teacher of the Violin* (1888), and *Blanche, Lady Falaise* (1891); but none of these has been so popular as his first novel. He will always remain known to fame as "the author of *John Inglesant*." Mr Shorthouse was originally a Quaker, but the appeal of the Anglican Church was insistent with him, and he was baptized into its body before the appearance of his story. Something of his own stress of religious transition appears in the character of his hero, who is pictured as living in the time of the Civil War, a pupil of the Jesuits, a philosopher and a Platonist, who is yet true to the National Church. The story, which is deeply mystical and imaginative, has for its central idea the dangers of bigotry and superstition, and the necessity of intuitive religion to progress and culture. It is a work full of opulent colour and crowded life, no less than of philosophy and spiritual beauty. Mr Shorthouse's work is always marked by high earnestness of purpose, a rich and luxuriant manner, and a naturally religious spirituality. He lacks dramatic faculty and the workmanlike conduct of narrative, but he has almost every other quality of the born novelist.

Shoshong. See BECHUANALAND.

Shotts, a mining and manufacturing parish of Lanarkshire, Scotland, comprising five villages and parts of two others, and two stations on the North British and three on the Caledonian Railway. The parish contains large iron works, tile, fire-clay, and brick works, and quarries. There are four Established churches, three United Free, an Original Secession, a Congregational Union, and a Roman Catholic. Seven public schools had in 1898–99 an average attendance of 1399, and a Roman Catholic school 755. Population (1891), 11,957; (1901), 15,561.

Shreveport, a city of Louisiana, U.S.A., the capital of Caddo county. It is situated in 32° 30′ N. and 93° 45′ W., in the north-western part of the state, at an altitude of 180 feet. It has seven railways, the Queen and Crescent, the Houston and Shreveport, the Port Arthur Route, the St Louis South-Western, the Shreveport and Red River Valley, the Texas and Pacific, and the Sherman, Shreveport, and Southern. These, with boats on the river, which is navigable, give the city a large trade. The surrounding country is a rich agricultural region, mainly devoted to the production of cotton, for which Shreveport serves as the principal shipping point. It contains cotton gins, compresses, and oil mills. Population (1890), 11,979; (1900), 16,013, of whom 726 were foreign-born and 8542, or 53 per cent., were negroes.

Shrewsbury, a municipal and parliamentary borough, capital of Shropshire, England, in the Newport parliamentary division of the county, 30 miles south of Chester by rail. The wards of the municipal borough were rearranged in 1891. The church of St Mary's, much injured in 1894 by the fall of 50 feet of its spire, has been restored, and also the church of the Holy Cross, while that of Holy Trinity has been rebuilt with the exception of the chancel. The Shire Hall and Guildhall, burned down in 1881, were rebuilt in 1884 at a cost of over £30,000. The free library and museum installed in the old building of the grammar school were opened in 1885, and a new theatre was built in 1898. The Royal Grammar School

was removed in 1882 to Kingsland, on the Hereford side of the river, where a tract of 27 acres, formerly the scene of the Shrewsbury Show, had been acquired. The buildings of the old foundling hospital, originally costing £12,000, were adapted to the purposes of the school; other buildings were erected, including residences for masters; and a handsome school chapel, part of which forms a memorial to Dr Kennedy, headmaster, 1836–1866, was dedicated in 1883. In 1894 the Jubilee Baths were built. Population (1891), 26,967; (1901), 28,396.

Shropshire, or SALOP, a north-western county of England, on the borders of Wales, bounded on the N. by Cheshire and an interpolated portion of Flint, on the E. by Stafford, on the S.E. by Worcester, on the S. by Hereford, on the S.W. by Radnor, on the W. by Montgomery, and on the N.W. by Derby.

Area and Population.—The area of the ancient and administrative county, as given in the census returns of 1891, is 859,576 acres, or 1343 square miles, with a population in 1881 of 248,022, in 1891 of 236,339, of whom 116,736 were males and 119,603 females; and in 1901 of 239,321; the number of persons per square mile being 178, and of acres to a person 3·5. In 1895 the following changes were made in the area of the administrative county:—To Hereford was transferred the part of the parish of Lantwardine in Shropshire, to Stafford the part of the parish of Bobbington in Shropshire, to Worcester the parish of Dowles, and to Shropshire the parish of Tittenley from Cheshire, the part of the parish of Ludford in Hereford, and the part of the parish of Sheriff Hales in Stafford. The area of the registration county is 952,842 acres, with a population in 1891 of 254,765, of whom 84,549 were urban and 170,216 rural; and in 1901 of 259,093. Within the registration area there was between 1881 and 1891 a decrease in the population of 4·18 per cent. The excess of births over deaths between 1871 and 1881 was 29,072, but the decrease in population was 11,112. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	1500	7750	4619	339	281
1890	1612	6858	4442	283	235
1898	1772	6898	4055	254	240

The number of marriages in 1899 was 1779, of births 6718, and of deaths 4366.

The following table gives the marriage-, birth-, and death-rates per 1000 of the population, with the percentage of illegitimate births, for a series of years:—

	1870-79.	1880.	1880-89.	1890.	1888-97.	1898.
Marriage-rate	12·6	11·3	11·9	12·6	13·1	14·4
Birth-rate	31·8	29·1	28·7	26·8	27·6	28·0
Death-rate	19·1	17·3	17·4	17·4	17·2	16·5
Percentage of illegitimacy	8·6	8·0	8·2	7·6	7·4	7·2

The percentage of illegitimacy is exceptionally high for an English county. In 1891 there were in the county 797 natives of Scotland, 1284 natives of Ireland, and 2118 foreigners.

Constitution and Government.—Neither the parliamentary nor the judicial arrangements have undergone any change since 1886. There are six municipal boroughs: Bishop's Castle (1378), Bridgenorth (6049), Ludlow (4552), Oswestry (9579), Shrewsbury (28,396), and Wenlock (15,866). The following are urban districts: Church Stretton (816), Dawley (7522), Ellesmere (1945), Newport (3241), Oakengates (10,837), Wellington (6273), and Whitchurch (5219). The ancient county, which is in the dioceses of Hereford, Lichfield, and St Asaph, contains 261 ecclesiastical parishes and districts, and parts of 24 others.

Education.—Shrewsbury is the seat of a famous public school. The number of elementary schools in the county on 31st August 1899 was 310, of which 36 were board and 274 voluntary schools, the latter including 254 National Church of England schools, 5 Wesleyan, 7 Roman Catholic, and 8 "British and other." The average attendance at board schools was 6732, and at voluntary schools 28,030. The total school board receipts for the year ended 29th September 1899 were £23,806. The income under the Agricultural Rates Act was over £1010.

Agriculture.—About five-sixths of the total area is under cultivation, and of this area about five-eighths is in permanent pasture. There are also about 35,000 acres in hill pasturage, 4800 under orchards, and 50,000 under woods. The acreage under corn crops has been diminishing, the diminution being chiefly in the acreages under wheat and barley, oats tending rather to increase. About five-sixths of the acreage under green crops is occupied by turnips, cattle being largely kept specially for dairy purposes. The following table gives the acreages of the main divisions of the cultivated area at intervals from 1885:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	716,599	150,085	61,101	71,470	426,859	6978
1890	720,431	143,678	58,696	70,946	441,553	5296
1895	717,963	131,809	57,076	69,526	455,521	3577
1900	719,080	132,590	55,044	71,149	458,027	1873

The following table gives the numbers of the principal live stock for the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1885	32,323	162,932	60,976	438,664	61,067
1890	32,683	166,660	60,669	479,880	74,025
1895	35,205	164,928	59,406	437,987	81,560
1900	33,736	180,113	63,604	470,577	66,594

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 14,318, as compared with 13,706 in 1896. Woollen goods are manufactured. Non-textile factories employed 10,644 persons, there being an increase between 1895 and 1896 of 18·2 per cent., and between 1896 and 1897 of 1·2. Of these, 3201 were employed in the manufacture of machines, appliances, conveyances, tools, &c. (chiefly agricultural implements at Ludlow, Oswestry, Shrewsbury, Wellington, &c.), 2130 in the founding and conversion of metals, 2064 in the clay and stone industries (including earthen and china ware, bricks and tiles, encaustic tiles, and tobacco pipes in the Broseley district). Workshops employed 3014 persons, 1447 being employed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1899 was 5487. The same year 272,037 tons of igneous rocks were raised, 172,651 tons of limestone, 131,748 tons of clay, and 36,757 tons of sandstone. There is a general decline in the output of the more valuable minerals, but a considerable quantity of pig-iron is produced by the blast furnaces at Ironbridge and Shifnal, the quantity in 1885 amounting to 44,732 tons, in 1890 to 43,084 tons, in 1895 to 49,010 tons, and in 1899 to 40,597 tons. Lead is obtained at Minsterley, and barytes at Minsterley, Pontesbury, Stiperstones, and Chirbury. The following table gives particulars regarding some of the more valuable minerals in 1890 and 1899:—

Year.	Barytes.		Coal.		Iron.		Lead.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	4838	£6088	766,629	£229,988	44,680	£17,852	1972	£18,927
1899	5080	4567	766,219	287,832	28,571	16,394	1468	14,414

RECENT AUTHORITIES.—WALCOTT. *Introduction to Sources of Salopian Topography.* Shrewsbury, 1879.—LA TOUCHE. *Handbook to the Geology of Shropshire.* 1886.—BORDERER. *Hunting and Sporting Notes in Shropshire.* London, 1885–86.—HUGHES. *Sheriffs of Shropshire, 1831–86.* Shrewsbury, 1886.—WARTER. *An Old Shropshire Oak,* 4 vols. London, 1886–91.—FLETCHER. *Religious Census of Shropshire in 1676.* London, 1891.—CRANAGE. *Architectural Account of the Churches of Shropshire.* Wellington, 1894–99.—TIMMINS. *Nooks and Corners of Shropshire.* London, 1899.—Various antiquarian and other items are also to be found in *Shropshire Notes and Queries.* (T. F. H.)

Shusha, a district town of Transcaucasia, Russia, in the government and 87 miles south-south-east of the town of Elizabethpol, situated at an altitude of 1380 feet. Various domestic industries, the chief of which are silk-weaving and the manufacture of leather, are carried on by its inhabitants. In 1897 its population was 25,656.

Shustav. See ARABISTAN.

Shuválof (sometimes written SCHOUVALOFF), **Peter Andreivitch,** COUNT (1827–1889), was born in 1827 of an old Russian family which rose to distinction

and imperial favour about the middle of the 18th century. Several of its members attained high rank in the army and the civil administration, and one of them may be regarded as the founder of the Moscow University and the St Petersburg Academy of the Fine Arts. As a youth Count Peter Andreivitch showed no desire to emulate his distinguished ancestors. He studied just enough to qualify for the army, and for nearly twenty years he led the agreeable, commonplace life of a fashionable officer of the Guards. In 1864 Court influence secured for him the appointment of Governor-General of the Baltic Provinces, and in that position he gave evidence of so much natural ability and tact that in 1866, when the revolutionary fermentation in the younger section of the educated classes made it advisable to place at the head of the political police a man of exceptional intelligence and energy, he was selected by the Emperor for the post. In addition to his regular functions, he was entrusted by his Majesty with much work of a confidential, delicate nature, including a mission to London in 1873. The ostensible object of this mission was to arrange amicably certain diplomatic difficulties created by the advance of Russia in Central Asia, but he was instructed at the same time to prepare the way for the marriage of the Grand Duchess Marie Alexandrovna with the duke of Edinburgh, which took place in January of the following year. At that time the Emperor Alexander II. was anxious to establish cordial relations with Great Britain, and he thought this object might best be attained by appointing as his diplomatic representative at the British Court the man who had conducted successfully the recent matrimonial negotiations. Count Shuválof was accordingly appointed ambassador in London; and he justified his selection by the extraordinary diplomatic ability he displayed during the Russo-Turkish war of 1877–78 and the subsequent negotiations, when the relations between Russia and Great Britain were strained almost to the point of rupture. After the publication of the Treaty of San Stefano, which astonished Europe and seemed to render a conflict inevitable, he concluded with Lord Salisbury a secret convention which enabled the two Powers to meet in congress and find a pacific solution for all the questions at issue. In the deliberations and discussions of the congress he played a leading part, and defended the interests of his country with a dexterity which excited the admiration of his colleagues; but when it became known that the San Stefano arrangements were profoundly modified by the Treaty of Berlin, public opinion in Russia condemned him as too conciliatory, and reproached him with having needlessly given up many of the advantages secured by the war. For a time Alexander II. resisted the popular clamour, but in the autumn of 1879, when Prince Bismarck assumed an attitude of hostility towards Russia, Count Shuválof, who had been long regarded as too amenable to Bismarckian influence, was recalled from his post as ambassador in London; and after living for nearly ten years in retirement, he died at St Petersburg in 1889. (D. M. W.)

Shwebo, a district in the Sagaing division of Upper Burma; area, 8376 square miles; population (1891), 230,779; (1901), 287,049, an increase of 24·4 per cent. It lies between the Katha, Upper and Lower Chindwin, and Mandalay districts. The Irrawaddy forms the dividing line on the east. The physical features of the district vary considerably. The Minwun range runs down the whole eastern side, skirting the Irrawaddy. In the north it is a defined range, but at Sheinmaga, in the south, it sinks to an undulation. West of the Mu river, in the centre of the district, there is a gradual ascent to the hills which divide Sagaing from the Upper Chindwin. Between these ranges and on both sides of the Mu is a plain, unbroken except for some isolated hills in the north and north-east and the low Sadaung-gyi range in the south-east. The greater part of this plain is a rice-growing tract, but on the sloping ground maize, millets, sesamum, cotton, and peas are raised. A good deal of sugar is also produced from groves of the Tari palm. The Mu river is navigable for three months in the year, from June to August, but in the dry weather it can be forded almost anywhere. A good deal of salt is produced in a line which closely follows the railway. Coal is worked at Kabwet.

There are about 1050 square miles of protected forest east of the Mu, and in the Ye-u subdivision, to the west of the river, there are 800 square miles reserved. The Ye-u forests are much more valuable than those to the east on the Minwun and the Mudein. Extensive irrigation works existed in the Shwebo district, but they fell into disrepair in King Thebaw's time. Chief of these was the Mahananda Lake. A scheme to restore the old works has been prepared. The rainfall follows the valleys of the Mu and the Irrawaddy, and leaves the rest of the district comparatively dry. It varies from an average of 31 to 34 inches in Shwebo. The average temperature is 90° in the hot weather, and falls to 60° or 61° in the cold season, the maximum and minimum readings being 104° and 56°. There were in 1898–99, 1200 villages, paying Rs.5,29,292. The amount of cultivated land in the same year was 217,654 acres, and there remained 653,421 acres available.

Sialkot, a town and district of British India, in the Rawalpindi division of the Punjab. The town is 72 miles north-east of Lahore. Population (1881), 45,762; (1891), 65,087; municipal income (1897–98), Rs.1,01,032; death-rate (1897), 33 per thousand. It is a military cantonment. It has manufactures of paper, cotton cloth, and shawl-edging. There are Scottish and American missions and a Scottish mission college, with 14 students in 1896–97, four high schools, a Christian training institute, and 4 secondary schools for girls.

The district of SIALKOT has an area of 1991 square miles; population (1881), 1,012,148; (1891), 1,119,817, showing an increase of 11 per cent.; average density, 562 persons per square mile. In 1901 the population was 1,084,515, showing a decrease of 3 per cent. The land revenue and rates in 1897–98 were Rs.16,91,323, the incidence of assessment being R.1:2:9 per acre; cultivated area, 820,056 acres, of which 504,363 were irrigated, almost all from wells; number of police, 563; number of schools, 411, attended by 13,875 boys, being 14 per cent. of the boys of school-going age; death-rate (1897), 24·9 per thousand. The principal crops are wheat, barley, maize, millet, sugar-cane, and cotton. There are no Government canals. The district is crossed by a branch of the North-Western Railway from Wazirabad to Jamu.

Siam, known to its inhabitants as Muang Tai, the last independent kingdom of Indo-China, consists geographically of two distinct portions. 1. Upper Siam, constituting the heart of the Indo-Chinese peninsula, is bounded, to the east of Chieng Sen (20° 15′ N. and 100° 5′ E.), by the Me Kong or Cambodia river, which, after the Franco-Siamese treaty of 1893, formed the western frontier of the French Indo-Chinese possessions down to 13° 13′ N. By the Franco-Siamese Convention of October 1902, the frontier between Siam and Cambodia starts on the left bank of the Great Lake from the mouth of the Stang Rolnos river, and follows the parallel of latitude eastwards until it meets the Prek Kompong Tiam river. Then, turning northwards, it coincides with the meridian from this point of meeting up to the Pnom Dang Rek mountains. Thence it follows the watershed between the Nam Sen and Me Kong basins on the one hand, and meets the Pnom Padang chain, the summit of which it follows eastwards to the Me Kong, leaving to France the old Cambodian province of Meluprey and the Laos province of Bassac. The northern frontier between Luang Prabang (right bank) and the provinces of Muang Phichaï and Muang Nan was also rectified. Westwards from Chieng Sen and southwards to Kra (10° 30′ N.), the frontier dividing Siam from British Burma is formed by the high forested ranges which make the water-parting between the Bay of

Physical geography.

Bengal and the Gulf of Siam with the exception of an interval between the 15th and 19th parallels, where the Salween and the Taung-yin rivers form a portion of the frontier line. 2. Lower Siam comprises the portion of the Malay Peninsula under Siamese rule, which, from the 10th parallel southwards until Province Wellesley is reached in 5° 33′ N., stretches from sea to sea. It includes the protected Malay states of Keda on the west and of Kelantan and Trengkanu on the east, the frontier between the Siamese possessions and the British protected states of Perak and Pahang running in a general east-south-east direction to the coast in about 4° 20′ N., which is the southernmost point of Siam.

The two important geographical features of Upper Siam are the basin of the Me Nam and the Korat plateau, which lies at a mean elevation of about 600 feet above sea-level and occupies a rectangular area of over 70,000 square miles. It is characterized by tracts of open shadeless jungle, alternating with wide swamps and salt wastes. It is drained by a number of unimportant streams flowing to the Me Kong; the only river of importance is the Nam Mụn, which drains the whole of the southern portion of the plateau. The Lao population is sparsely scattered in small villages, usually along the river banks, there being only four towns of any importance—Korat, Ubon, Bassac, and Nawng Kai. But it is the Me Nam basin which constitutes in more senses than one the heart of Siam. Geographically, the tributaries of the river form trenches cut from north to south through the rough hill country of the Lao states. The successive capitals of the Siamese were planted by the banks of the Me Nam, and the greater part of the population of the country is to this day settled upon it and its many creeks. At the north-east and north-western corners of the gulf the two rivers, the Bang Pa Kong and the Me Kong, flow to the sea, draining—the one the southern slopes of the Dawng Praya Yen and the rich rice districts of Pachim, Nakawn-Nayok, and Petriu; the other, the steep eastern valleys of the Tenasserim frontier range and the garden lands of Kanburi and Ratburi. Both these rivers are connected by an admirable series of navigable canals with the Me Nam and Tachin channels.

The mountain districts encircling the head-waters of the Me Nam, which deflect the Me Kong eastwards along the 20th parallel, do not rise to any considerable height. On the west the watershed between the Salween and the Me Nam is more marked, and develops as it stretches southwards into the well-defined granite wall which, with a slight interruption at Kra, forms the backbone of the Malay Peninsula as far as Junk Ceylon, in 8° N., from which point a fresh range, rising to the eastwards in the province of Nakawn Si Tamarat, takes up its functions.

On the eastern side of the gulf, between the 11th and 13th parallels, the hill system of the Patat range and of Chantabun occurs, cutting off the Cambodian plains from the sea, and itself quite isolated from the hill districts of Indo-China by the plains of the Kabin and Sisopon rivers on the north and east. At the same time the geological conditions may be compared with those of the Me Kong valley of the 20th parallel. The basaltic outcrops, in the neighbourhood of which the gem deposits of both districts occur, although of different ages, are similar in their mode of occurrence; the metamorphic schists of the Me Kong are represented in the Chantabun area by hard quartz grits. The limestones of the Kaw Chang group of islands show much the same symptoms of dislocation as those which form the prominent peaks of the Me Kong region. The general geological structure of both areas, however, in contradistinction to that of the Malay Peninsula, is of a very complicated nature, and needs a more careful and detailed examination than has yet been possible. The limestones referred to are a most striking feature of Indo-China, and appear to be of Carboniferous age. The fragments of this once vast formation are found tilted, contorted, and weathered in inaccessible peaks and precipices from Perak to Tongking, their caves affording protection to many Buddhist shrines and to colonies of nesting swiftlets (chiefly Peate's *Collocalia spodiopygia*), from which Chinese epicures derive their birds'-nest soup. In many parts of Siam, on the other hand, dolomitization has taken place on a large scale.

Climate.

Although enervating, the climate of Siam, as is natural from the position of the country, is not one of extremes. The wet season—May to October—corresponds with the prevalence of the south-west monsoon in the Bay of Bengal. The full force of the monsoon is, however, broken by the western frontier hills; and while the rainfall at Mergui is over 180, and at Moulmein 240 inches, that of Bangkok seldom exceeds 54, and Chiengmai records an average of about 42 inches. Puket and Chantabun, being both on a lee shore, in this season experience rough weather and a heavy rainfall; the latter, being farther from the equator, is the worst off in this respect. At this period the temperature is generally moderate, 65° to 75° F. at night and 75° to 85° by day; but breaks in the rains occur which are hot and steamy. The cool season begins with the commencement of the north-east monsoon in the China Sea in November. While Upper Siam enjoys a dry climate with cool nights (the thermometer at night often falling to 40°–50° F., and seldom being over 90° in the shade by day), the eastern coast of the Malay Peninsula receives the full force of the north-easterly gales from the sea. This lasts into February, when the northerly current begins to lose strength, and the gradual heating of the land produces local sea breezes from the gulf along the coast-line. Inland, the thermometer rises during the day to over 100° F., but the extreme continental heats of India are not known. The comparative humidity of the atmosphere, however, makes the climate a trying one for Europeans.

The rainy season is generally the most unhealthy, various forms of malarial fever, especially violent in the hill districts, being then prevalent. By far the largest percentage of deaths among the people are due to this cause. Dysentery and cholera, which are endemic, are most frequent in the plains at the conclusion of the dry season and during the first rains. Cholera is for the most part confined to the natives, and in Bangkok is principally due to the want of a proper water-supply, the people drinking the water of the river and canals.

Flora.

In its flora and fauna Siam combines the forms of Burma and the Shân States with those of Malaya, farther south, and of Cambodia to the south-east. The teak tree grows all over the hill districts north of latitude 15°, but seems to attain its best development on the west, and on the east does not appear to be found south of 17°. Most of the so-called Burma teak exported from Moulmein is floated down from Siamese territory. Among other valuable forest products are thingan wood (*Hopea adorata*), largely used for boat-building; damar oil, taken throughout Indo-China from the *Dipterocarpus levis*; agilla wood, sapan, rosewood, iron-wood, ebony, rattan, and a number of finely-grained woods, which, with cotton, silk, tobacco, and many spices, will become accessible to the market as communications improve. Among the chief productions of the plains are rice (the staple export of the country); pepper (chiefly from Chantabun); sirih, sago, sugar-cane, cocoa-nut and betel, Palmyra or sugar and attap palms; many forms of banana and other fruit, such as durian, orange-pommelo, guava, bread-fruit, mango, jack fruit, pine-apple, custard-apple, mangosteen. In the hill country of the northern Lao States more temperate forms, such as oak, pine, and chestnut, are found.

Fauna.

Few countries are so well stocked with big game as is Siam. Chief of animals is the elephant, which roams wild in large numbers, and is extensively caught and tamed by the people for transport. The tiger, leopard, fishing-cat, leopard-cat, and other species of wild-cat, as well as the honey-bear, large sloth-bear, and one- and two-horned rhinoceros, occur. Among the great wild cattle are the formidable gaur, or seladang, the banting, and the water-buffalo. The goat antelope is found, and several varieties of deer. Wild pig, several species of rats, and many bats—one of the commonest being the flying-fox, and many species of monkey—especially the gibbon—are also met with. Of snakes, 56 species are known, but only 12 are poisonous, and of these 4 are sea-snakes. The waters of Siam are particularly rich in fish. The crocodile is common in many of the rivers and estuaries of Siam, and there are many lizards—the largest, the water monitor, growing to a length of over 7 feet. The country is rich in birds, a large number of which appear to be common to Burma and Cambodia.

The mineral products of Siam include tin; gold, which is dis-

seminated in small quantities in nearly all the important river deposits; isolated reef workings have not as yet met with very great success; iron (limonite and hematite), which is locally worked; and other ores which, owing to the inaccessibility of the most mineralized zones, cannot in present circumstances pay commercially, and have not as yet been adequately prospected. Salt is also produced in some quantities for local consumption. Sapphires are worked by Shân diggers at Pailin on the eastern slopes of the Patat range, and have been found at Chieng Kawng and elsewhere. The Siam rubies, mostly from Chantabun, are generally inferior in colour to the Burma stones.

Minerals.

The total population is roughly estimated at 9,000,000, of whom a third are Siamese, a quarter Chinese or of Chinese descent, and the remainder mainly Lao, with about 500,000 of Cambodian and the same number of Malay origin. There are about 600 Europeans in Bangkok, of whom a third are British, about a quarter are American, and the rest principally German, Danish, and Belgian. There are over 10,000 British Asiatic subjects registered at the consulate. There are, however, no accurate statistics of the population; owing to the high death-rate, it does not multiply at the rate which might be expected. The Siamese race has intermarried so largely with the Chinese and the surrounding peoples that, except in Rayong and some places on the Malay Peninsula, very few undoubtedly pure-blooded Siamese can now be found. The immigration of the Chinese, which dates from very ancient times, continues uninterruptedly; a regular supply is also kept up to all the mining districts of the Malay Peninsula. As has occurred wherever immigrant Chinese have come into contact with the easy-going natives of the neighbouring tropical countries, the Chinese in Siam have acquired the most important share in the trade and industries of the country. There are practically no Chinese women in the country, but the men freely intermarry with Siamese women, and there is growing up a considerable mixed population, especially in the neighbourhood of the capital, who are called *Lukchins*. The Chinese are not loved by the Siamese, but they are tolerated. In fact, they are indispensable, and every form of work and business would be at a standstill without them.

Population.

Another immigration from the north-east has been constant since 1882: that of the Ka Muk and other hill peoples coming from the highlands of south-western China; but the acquisition by France of Luang Prabang and the neighbourhood of the Nam U valley will have the tendency in all probability of checking this movement. While the plain dwellers of Upper Siam consist mainly of the Tai (Siamese in the south and Lao in the north), the population which has been thrust by the Tai immigration into the hill country presents many different types. The Karens of the western frontier range extend northwards from latitude 13°. In the Lao country the Ka peoples, variously named Lawa, Lamet, Ka Hok, Ka Yuen, and Ka Mu, are met with; and in the Me Kong valley and farther east come the Lu, Yao, Yao Yin, Lanten, Meo, and Musur, all of whom have many distinct Yunanese characteristics, and are fine, hardy mountaineers. Around the forest edges of the Korat plateau are found small numbers of Suey, aboriginal tribes answering to the Chong people of the Chantabun and Battambang Chongs hill districts farther south. In the Malay Peninsula, below the southernmost Karen settlements, Malays begin to be met with near the sea, and inland small roving bands of the Sakei and Samang inhabit the higher ranges.

There are very few towns with a population of over 10,000 inhabitants in Siam, the majority being merely scattered townships or clusters of villages, the *muang*, which gives its name to the province, being often merely a few houses round the governor's residence. The more important towns of the delta include Petriu, Pechim, and Kabin on the Bang Pa Kong; Kanburi, Ratburi, and Petchaburi on the west; Ayuthia, the old capital of Siam, Lophaburi, Angtong, Chainat, and Paknam Po on the Me Nam; Saraburi and Lom Sak on the Nam Sak; Pitsunalok, Pichai, and Utaradit on the upper Me Nam, and Raheng on the western branch; while Korat, Ubon, Bassac, and Nawngkai are the only places of importance on the Korat plateau. In the Malay Peninsula, besides Singora on the east coast and Puket on the west, the important points are Bangtapan, Champawn, Chaiya, Nakawn Si Tamaraj, Tani, Kelantan, and Treng Kanu on the east, and Renawng Takua Pa, Trang, and Keda on the west. The principal towns on the Cambodian side are Chantabun, Battambang, Siemrap, and Sicopon. (For the principal centres of population in the Lao States, see under LAO.) The majority of these places are little more than jungle settlements, forming administrative and commercial centres of merely local importance. The capital, Bangkok, has a population of about half a million, and is the seat of a highly centralized system of government; it also contains the residences of all the chief nobles and officials. The town next to Bangkok in importance is Chiengmai, the so-called capital of the north, with a population of at least over 50,000.

The Government of Siam is an absolute monarchy, and the succession to the throne is now limited to the oldest princes of the blood, who are sons of the king. The old office of second king was abolished on the death of its last occupant. There is a council consisting of nine ministers at the head of the departments of foreign affairs, interior, finance, household, war, justice, local government, public works, and education, together with the chief of the staff and the European general adviser. There is also a legislative council, of which the ministers of state are *ex-officio* members, consisting of about sixty nobles appointed by the king. The council exercises legislative functions, and meets every Tuesday for the transaction of its ordinary business. The king is an autocrat in practice as well as in theory. He has an absolute power of veto, and the initiative of measures rests largely with him, though now, with the increasing complexity of government, he naturally leaves many details of administration to his ministers and council. Most departments have the benefit of European advisers, though but little executive power is entrusted to these officials. The Government offices are conducted more or less on European lines. The Christian Sunday is observed as a holiday, and regular hours are prescribed for attendance. But the numerous palace and other functions form a great call on the ministers' time, and the majority of them continue to be very irregular and unbusinesslike in their methods. The king frequently keeps his courtiers in attendance on him through most of the night, so that early hours are, as a rule, impossible for high officials. There is nothing in the nature of a European civil service, and posts are usually obtained by favouritism; but the certificates of proficiency awarded by the education department are every year acquiring a greater value. The drawing up of the new codes, which are to replace the transitory laws, has been entrusted to committees in which European expert advisers are usually included. Among these measures may be mentioned regulations concerning the law of evidence, criminal and civil procedure, pawnshops, mining, harbour, timber marks, village administration, forests, marriage, and secret societies, which have all been drafted under expert European advice. For administrative purposes the kingdom is divided into *muntons* (or circles), at the head of which chief commissioners are appointed from Bangkok, who reside in the circle and are directly responsible to the central Government. Each munton is subdivided on the basis of the old existing provinces, each of which is under a governor (often hereditary), who is directly responsible to the chief commissioner. By the village regulations brought into force in 1897 every province is further subdivided into districts, each under an *amp'ur*, every district into villages under a *kamnan*, who is elected by the village elders, and each village into groups of from ten to twenty families, at the head of each of which an elder is appointed. With the exception of the metropolitan district of Bangkok, all the muntons are under the department of the interior, which also controls the gendarmerie recently established, with excellent results, for the suppression of dacoity. The police have been completely reorganized under Anglo-Indian officials.

Government.

The Siamese have not yet shaken off the system of personal feudalism, if it may be so called, which has prevailed for many centuries in the country. Every nobleman has a large number of retainers, in addition to debt slaves, and the great mass of the people are glad to rely upon some powerful personage for help and protection, and to give him their services in return. There is, however, no such thing as caste, or even caste feeling, and there is a remarkable absence of exclusiveness for so conservative and despotically governed a country, any man, however humbly born, being suffered to rise to the highest position, if only he have the opportunity. There are no hereditary titles, except in the case of royal princes, those in use being conferred for life, and being attached, in practice generally as well as theory, to some particular office. Thus the same title may be held in succession by the different holders of some post in a Government department, a practice which often leads to some confusion.

Social structure.

The revenue in 1898 was approximately estimated at £2,000,000, made up as follows:—

Duties on liquors and general imports, and rice and other exports	£100,000
Farms and monopolies (opium, spirits, gambling, &c.)	1,000,000
Land tax	200,000
Inland dues, taxes, &c.	700,000
Total	£2,000,000

But by 1901–2 the revenue had increased to £2,088,000, while the expenditure was stated to be £2,239,660. The methods of collection have greatly improved under the administration of European revenue officers, and there is much less corruption than formerly; but little has been done to alter the fundamentals of taxation, and the opium, spirit, and gambling monopolies still provide a large portion of the revenue. In 1898 a large number of transit dues were abolished, thus removing one of the most

Finance.

serious obstacles to commercial development. With the adoption of more business-like methods, no doubt the budget will be regularly published.

Army and navy. The army consists of a small standing force of about 4000 men. The navy comprises several steam gunboats under 600 tons, armed with small quick-firing guns; the king's yacht, a steel twin-screw cruiser of 2500 tons, armed with 6, 4·7, and other smaller quick-firing guns; and a number of small craft for river and coast work, which are manned by several thousand bluejackets and marines, who constitute a very efficient body of men. Most of the soldiers and sailors are descendants of old prisoners of war, and the obligation to this form of service is transmitted from father to son.

Justice. The department of justice has since 1893 been completely re-organized, and the reorganization of the provincial courts has been extended to seven muntons with admirable results. Extra-territorial jurisdiction is secured by treaty for the subjects of all the chief foreign Powers, who can therefore only be sued in their consular courts, while European assessors are employed in cases where foreigners sue Siamese. The prisons have been greatly improved, and a considerable check has been put on thieving in the capital by the passing of the Pawnshops Act in 1901.

Slavery. It may be stated here that the gradual abolition of slavery, which was the first important measure of the King Chulalongkorn's reign, was nearly completed by 1886, although the law is often evaded, as serfdom offers to many a convenient method of paying off debts. The corvée, which is quite distinct from slavery, and is the survival of the old system of personal feudalism which once prevailed in Siam, has been abolished in the outlying provinces, but still lingers in the neighbourhood of the capital. Obligation to personal service is being gradually commuted for money payment.

Religion. While the pure-blooded Malays of the Peninsula are Mahommedans, the Chinese in Siam adhere to the mixture of cowardice and superstition which does duty for a religion in most parts of China. The Siamese and Lao profess a form of Buddhism which is tinged by Cingalese and Burmese influences, and, especially in the more remote country districts, by the spirit-worship which is characteristic of the imaginative and timid Ka and other hill peoples of Indo-China. In the capital a curious admixture of early Brahminical influence is still noticeable, and no act of public importance takes place without the assistance of the divinations of the Brahmin priests. The Siamese, as Southern Buddhists, pride themselves on their orthodoxy; and now that Burma, like Ceylon, has lost its independence, the king regards himself in the light of the sole surviving defender of the faith. There is a close connexion between the laity and priesthood, as the Buddhist rule, which prescribes that every man should enter the priesthood for at least a few months, is almost universally observed, even young princes and noblemen who have been educated in Europe donning the yellow robe on their return to Siam. A certain amount of scepticism prevails among the educated classes, and political motives may contribute to their apparent orthodoxy, but there is no open dissent from Buddhism, and those who discard its dogmas still, as a rule, venerate it as an ethical system. Many of those, it is to be feared, who enter the priesthood for life do so from motives of laziness; and it is to be regretted that so much of the strength of Siamese manhood is thus frittered away, but the accounts given by some writers as to the profligacy and immorality in the monasteries are probably greatly exaggerated. Some of the temples in the capital are under the direct supervision of the king, and in these a stricter rule of life is observed. A few of the priests are learned in the Buddhist scriptures, and most of the Pali scholarship in Siam is to be found in temples, but there is no learning of a secular nature. There is little public worship in the Christian sense of the word. On the Buddhist Wan Phra (or Sunday) the temples are nearly empty, and those who do attend are entirely women. Religious or semi-religious ceremonies, however, play a great part in the life of the Siamese, and few weeks pass without some great function or procession, greatly to the detriment of public business. Among these the cremation ceremonies are especially conspicuous. The more exalted the personage the longer, as a rule, is the body kept before cremation. Thus the late Crown Prince was not cremated until six years after his death. The cremations of great people, which often last several days, are the occasion of public festivities and are celebrated with processions, theatrical shows, illuminations, and fireworks. The missionaries in Siam are entirely French Roman Catholics and American Protestants. They have met with little success among the Siamese, who take their religion as lightly as the rest of life, and discard Christianity as readily as they adopt it. There are, however, a fair number of Chinese converts, especially to Roman Catholicism, and the French cathedral in Bangkok is well attended. The missionaries have nevertheless done much to help on the general work of civilization, and the progress of education has been largely due to their efforts.

Education. As in Burma, the Buddhist monasteries scattered throughout the country carry on the whole of the elementary education of the country. By means of regular Government supervision and control, the monastic schools are to be brought into line with the new Government educational organization. In the metropolitan district of Bangkok there are 290 of these monasteries, containing 8700 monks and novices, of the former of whom more than 400 are teachers. There are 61 Government schools, of which 56 receive grants in aid and 5 are entirely supported by the Government. There are 5 Anglo-vernacular schools for boys and 2 for girls in Bangkok, and there is also a normal college for training teachers for English and Siamese schools. In the interior there are over 4400 monastic schools, with a total of nearly 50,000 inmates of all classes, and 4000 teachers in Siamese and Pali. There are also 70 Roman Catholic missionary schools in the country, with about 4000 pupils, and the Protestant missionaries have eight schools, with about 500 pupils, not including the Chiengmai district.

The education for the most part does not rise above the elementary standard, though the two chief Anglo-vernacular schools are developing into secondary schools. All the work in the upper classes of these schools is in English. French is an optional subject. The schools in the *wats* or temples are being gradually improved. The buildings are being adapted to educational requirements, the priests are provided as far as possible with lay assistants, and a system of inspection is being organized, while the sum spent annually on education was increased nearly fourfold between the years 1899 and 1901. Two scholarships are given every year to boys under nineteen for the purposes of education in Europe, and other students are sent to England and elsewhere at the king's or their parents' expense. The system of teaching boys in the *wats* has caused education to be widely diffused in Siam, and most men can read and write a little. But Siam has no literary or scientific achievements to boast of. The boys, however, are teachable, and up to a certain age distinctly bright and clever.

Communications. All travelling in the delta and far into the interior has been by boat along the rivers, canals, and creeks which intersect the country. Buffaloes and oxen are used for ploughing, and for carting when water transport is not available. In the hill country the elephant, the pack bullock, ponies, the Yunnanese mule, and even men, are used extensively.

Railways. A steam tram, 16 miles in length, from the capital to Paknam at the mouth of the river, opened in 1893, was the pioneer line of the country. That to Korat, 170 miles in length, was completed at the close of 1900, and has already shown an excess of earnings over expenses on sections below the forest belt. An extension northwards to Lophburi (26 miles) on what should be the main line to Chiengmai and the north was opened in January 1901. Another line was begun through the rich country of the delta westward of Bangkok to Ratburi and Petchaburi: it is to be hoped that the short-sighted policy of the Government in allowing the main canals of this easily accessible district to silt up and become useless will not be continued.

Roads. Though there are about 40 miles of good streets in Bangkok and 10 of carriage roads, there has been no road-building or bridging done in the country, with the exception of a few miles near Chiengmai and in various provinces of the Malay Peninsula, the result of abnormal energy and generosity on the part of local governors. Hence all overland travelling involves slow and laborious marching over rough jungle trails.

Posts and telegraphs. A postal service has been extended to all parts of Siam, the country having entered the Postal Union in 1885. The service works as well as can be expected in the present state of communications. Much enterprise has been shown in clearing and laying telegraph lines throughout the country; but few of them work satisfactorily for more than a few months at a time—a fact due as much to ignorance and carelessness on the part of the operators as to the ravages caused by floods and by inquisitive and playful elephants.

Trade. The trade of the port of Bangkok shows a steady increase. But, to estimate the total foreign trade of the country, it is necessary to add to its figure those of other routes. What trade there was across the Me Kong dwindled to vanishing-point after the acquisition of the left bank by France in 1893, though a revival may be hoped for in the future. The trade between French and Siamese Cambodia is also at present insignificant. The total exports for 1901 were £4,292,640, and imports £2,707,370, a total of over seven millions, of which nearly £6,000,000 are by Bangkok and about a million by the east and west coasts of the Malay Peninsula. Of the total, about 80 per cent. represents the value of the direct trade with British possessions, including Hong Kong, Bombay, the Straits, Burma, and the Shân States.

By the convention made between Great Britain and France, and signed at London on 15th January 1896, the Governments of those countries engaged not to advance armed forces into the region which is comprised in the basins of the Petchaburi, Me Kong,

Me Nam, and Bang Pa Kong (Petriu) rivers, and their respective tributaries, together with the extent of coast from Muang Bang Taphan (on the west) to Muang Pase (on the east side of the gulf), the basins of the rivers on which those two places are situated, and the basins of the other rivers the estuaries of which are included in that coast; and including also the territory lying to the north of the basin of the Me Nam, and situated between the Anglo-Siamese frontier, the Me Kong river, and the eastern watershed of the Me Ing. This guarantee affects by far the most populous and flourishing portion of Siam. (H. W. SM.)

HISTORY.

The history of modern Siam may be said to commence with the ratification of the treaty of friendship and commerce concluded with Great Britain in 1855, and negotiated through Sir John Bowring. There had been previous treaties, but this one first put the relations of Siam with Great Britain on their present basis, and it has been followed by treaties on similar lines with France, the United States, Germany, Russia, Japan, and other Powers. The most noteworthy feature of this treaty was the provision of extra-territorial consular jurisdiction, the result of which is that British subjects can only be tried for criminal offences or sued in civil cases in their own consular courts. A large portion of the work of the foreign consuls, especially the British, is consequently judicial, and in 1901 the office of judge was created by the British Government, one of the consuls being appointed to this post. Various commercial regulations were also included in the treaty of 1855, and subsequently trade steadily increased, especially with Great Britain and the British colonies of Hong Kong and Singapore.

The peaceful internal development of Siam seemed also likely to be favoured by the events that were taking place outside her frontiers. For centuries she had been distracted by wars with Cambodians, Peguans, and Burmans, but the incorporation of Lower Cochin China, Annam, and Tongking by the French, and the annexation of Lower and Upper Burma successively by the British, freed her from all further danger on the part of her old rivals. Unfortunately, she was not destined to escape trouble. The frontiers of Siam, both to the east and the west, had always been vague and ill-defined, as was natural in wild and unexplored regions inhabited by more or less barbarous tribes. The frontier between Siam and the new British possessions in Burma was settled amicably and without difficulty, but the boundary question on the east was a much more intricate one and was still outstanding. Disputes with frontier tribes led to complications with France, who asserted that the Siamese were occupying territory that rightfully belonged to Annam, which was now under French protection. France, while assuring the British Government that she laid no claim to the province of Luang Prabang, which was situated on the east or left bank of the upper Me Kong, roughly between the 18th and 20th parallels, claimed that farther south the Me Kong formed the true boundary between Siam and Annam, and insisted on the Siamese evacuating certain posts which they held to the east of the river. The Siamese refused to yield, and early in 1893 encounters took place between them and the French, in which a French officer was captured and French soldiers were killed. The Siamese continued to resist, though the British Government counselled moderation; and the French despatched two gunboats, which forced their way up the Me Nam on 13th July 1893, after a short engagement at the mouth of the river, and anchored at Bangkok, in spite of the protests of the Siamese, who, on their interpretation of clause 15 of the treaty of 1856, asserted that the French were not allowed to send war vessels beyond Paknam without their consent. The French now greatly increased their demands. They insisted on the Siamese giving up all territory to the east of the Me Kong, including the province of Luang Prabang, and also on the neutralization of a zone of 25 kilometres to the west of the Me Kong. After some delay, during which the French blockaded the Me Nam from 25th July to 3rd August for the purpose of enforcing their demands, the Siamese at length gave way, and a treaty was signed with the French on 3rd October 1893. It was agreed that the French should occupy Chantabun until the terms of the treaty were carried out. They remained in possession of it until the conclusion of the further treaty of 1902, which stipulated that it should be evacuated upon the handing over to France of the provinces of Meluprey and Bassac and the ceded territory generally, which extended altogether to 20,000 square kilometres. By this treaty the king of Siam further bound himself to permit ports, canals, and railways in the Siamese portion of the basin of the Me Kong to be constructed by French *personnel* and capital in the event of Siam being unable to accomplish such works unaided.

There remained the question of the frontier between the French and British possessions to the north of Siam. By its conquest of Upper Burma Great Britain had obtained suzerainty over the Burmese Shân States, which stretched across the river Me Kong to the north of Siam, and lay between the 20th and 23rd parallels. It was the intention of the British Government, by ceding the northern portion of these states to China and the southern portion to Siam, to create a buffer state between the French and British possessions, so that they should be nowhere coterminous. Prolonged negotiations took place between the French and British Foreign Offices, but the object of the British was not achieved, and the French were suffered to extend their frontier in this region also as far as the Me Kong. These negotiations, however, though their immediate purpose was not fulfilled, bore important fruit in the Anglo-French convention of 15th January 1896. The chief provision of this convention was the neutralization by Great Britain and France of the central portion of Siam, consisting of the basin of the river Me Nam, with its rich and fertile land, which contains most of the population and the wealth of the country. Neither the eastern provinces bordering on the French possessions nor those of the Malay Peninsula were included in this agreement, but nothing was said to impair or lessen in any way the full sovereign rights of the king of Siam over these territories. Siam thus constitutes a buffer state, with its independence guaranteed by the two European Powers who alone have interests in Indo-China, between Burma on the west and the French possessions on the east, though to the north of Siam the river Me Kong forms, from the point where it leaves China, the only division between the French and British spheres. Siam has therefore a considerable political interest for Europe, not unlike that of Afghanistan, which forms a buffer state between the Russian and British possessions on the north of India. This interest has, however, been for many years enhanced by the fact that Siam, apart from the value of her own trade and her actual and potential wealth, has been regarded in some quarters as affording a possible means of trade access to the provinces of southern China. The French undoubtedly had Chinese trade as their objective when they sent their expedition of exploration, under de Lagrée, up the Me Kong in 1866. This expedition proved a failure, the Me Kong being found to be of little use for purposes of navigation north of the 14th, or at most the 18th, parallel, owing to the prevalence of rapids. But though the French turned their attention subsequently to Tongking and the Red River, the events of 1893 seem to indicate that they still attach some value to the Me Kong as a waterway. The Me Nam is, however, vastly superior to the Me Kong in this respect; and when the Siamese complete the railway which they are building to the north through central Siam, important commercial and political developments may be expected to follow.

The importance of Siam, therefore, in European eyes must consist not only in the fact that it constitutes a buffer state between French and British possessions, but also in the large and increasing stake held by various Western nations in the commerce of the country, and the possibilities it has for the future. Great Britain and British colonies still retain the chief share of the trade, though British shipping in the port of Bangkok has decreased considerably, owing to the transfer of the Singapore and Hong Kong lines of steamships from British to German hands in 1899 and 1900. Other countries too, notably Germany and Denmark, have important trade interests. The independence and prosperity of Siam are therefore matters of no small moment to several European countries. It is impossible, however, to regard the external relations of Siam as not having an intimate connexion with its internal development. Siam is the sole surviving country of tropical Asia that has preserved its independence, and its continued autonomy must depend in great measure on the capacity it shows for self-government. It undoubtedly made great progress in the last quarter of the 19th century. (J. G. D. C.)

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Siberia.—A great deal of exploring work has been carried out in recent years in connexion with the Siberian railway, but, valuable though this has been as providing materials for the acquisition of a more detailed knowledge of separate regions, it has not modified our conception of the country generally, as expressed in the article in *Ency. Brit.* vol. xxii. (9th edition) under this head, while the exploration of Manchuria and the Stanovoi range along the coasts of the Sea of Okhotsk has only confirmed the views of the orographical conformation of the country previously set forth. The description of the physical features of Siberia given in the ninth edition still holds good, therefore; and it is sufficient to mention here that the results of recent exploration are especially valuable as regards the ethnology of the inhabitants of Yakutsk, the geography of the Kolyma region in the far north, on the Sea of Okhotsk, the hydrography of the Sea of Okhotsk and the Arctic Ocean, the geography of the Altai, and the economical conditions of the inhabitants of South Siberia.

Physical features.

Population.

At the general census taken in February 1897 the domiciled population was found to be 5,698,924. The natural increase (80,100 per annum) and the registered immigration (by land, 69,149 in 1897, 148,965 in 1898, and 181,895 in 1899; by sea, 2400, 4055, and 8300 respectively) have since added about 800,000, so that on 1st January 1901 the total population must have been about 6,500,000. In 1897 Russians numbered about 4,950,000 (87 per cent.) and the indigenous population about 750,000 (13 per cent.). The distribution of the population according to provinces, with the area of the same, was as follows :—

Province.	Area. Square Miles.	Russians (000 omitted).	Indigenous Population (000 omitted).	Total Population.	Density per Square Mile.
Tobolsk	539,659	1373	65	1,438,484	3
Tomsk	331,159	1865	64	1,929,092	6
Western Siberia	870,818	3238	129	3,367,576	4
Yeniseisk	987,186	517	42	559,902	1
Irkutsk	287,061	402	.105	506,517	2
Yakutsk	1,533,397	40	222	261,731	·2
Transbaikalia	236,868	467	197	664,071	3
Eastern Siberia	3,044,512	1426	566	1,992,221	·7
Amur	172,848	99	19	118,570	·9
Maritime	715,982	185	35	220,557	·3
Amur Region	888,830	284	54	339,127	·3
Sakhalin	29,336	...	...	28,166	1
Total	4,833,496	4948	749	5,727,090	1

The ethnographical composition of the population is given in the ninth edition. It may be added here that though at present forming only a small element in the population, the rapid increase of the Koreans and Chinese in certain districts is of importance. In the Maritime Province, before the Boxer uprising in 1900, 26 per cent. of the population of the North Usuri district and 36 per cent. of the population of the South Usuri district were Koreans and Chinese, and in the Amur province there were nearly 15,000 Manchus and Koreans.

As to Russian immigration to Siberia, it has been organized on new principles, the immigrants being now directed into the regions where there is free land available for them, so that they may avoid the great hardships which they used formerly to undergo. In the eighteen years 1882–99, 1,367,391 came into the country to settle by land, and 41,280 by sea. The former settled mostly in West Siberia (chiefly in the Altai region), while the latter went mainly to the South Usuri district. It is worthy of note that the main flow of immigration was from the fertile northern belt of the black-earth provinces of European Russia, and to a smaller degree from the Lithuanian provinces and the Ural provinces of Perm and Vyatka.[1]

Cities.—Only 8·1 per cent. of the population live in towns (6·4 per cent. only in the governments of Tobolsk and Tomsk). There are fifteen towns with a population of 10,000 or more, namely, Tomsk (52,000) and Irkutsk (51,000)—the capitals of Western and Eastern Siberia respectively; Blagoveschensk (32,000), Vladivostok (29,000), Tyumeñ (29,000) in West Siberia, head of Siberian navigation; Barnaul (29,000), capital of the Altai region; Krasnoyarsk (26,000) and Tobolsk (20,000), both mere administrative centres; Biysk (17,000), centre of Altai trade; Khabarovsk (15,000), administrative centre of the Amur region; and—all with from 10,000 to 11,000 inhabitants—Tchita, the capital of Transbaikalia; Kolyvañ, the centre of the trade of southern Tomsk; Yeniseisk, the centre of the gold-mining region of the same name; Kurgan, a growing town in Tobolsk; and Minusinsk, in the southern part of the Yeniseisk province, trading with north-west Mongolia. Several villages have sprung up very rapidly along the railway line.

Education.

Little has been done towards satisfying, or even giving free scope to, the growing demand for education in Siberia. The petitions for a university at Irkutsk, the money required for which has been freely offered to the Government, have been refused, and the imperative demands of the local tradesmen for technical instruction have likewise met with but little response. The Tomsk University remains incomplete, and has only 500 students. In 1901 the provision for education could be approximately tabulated as follows :—

Province.	Total Number of Schools.	Number in Towns.	Middle Schools.	Special Schools.	Total Number of Scholars.
Tobolsk	588	69[2]	9	5	21,000
Tomsk	2015	70	9	5	48,125
Yeniseisk	235	35	7	2	9,320
Irkutsk	412	70	7	6	13,755
Yakutsk	77	12[3]	...	...	1,507
Transbaikalia	375	45	4	6	12,760
Amur	73	...	..	...	4,600
Maritime Prov.	106	...	...	...	3,470
Sakhalin	28	...	...	...	870
Total	3909	...	...	...	115,407

If the figures in the above table are compared with the total populations of the several provinces, it will be seen at once how inadequate is the provision for education in Siberia. As a rule, the girls form from a quarter to a third of the total number of pupils.

[1] See *Siberia* (in Russian), a manual for immigration published by the Ministry of Agriculture in 1900, with maps of available lands, &c.

[2] 5650 pupils. [3] Also four at the gold mines.

There are 18 scientific societies in Siberia, which issue publications of great value. Twelve natural history and ethnological museums have been established by the exiles—the Minusinsk museum being the best. There are also 20 public libraries, and 11 papers are published in addition to the eparchial *Vyedomosti* published in each bishopric.

Exiles.—Up to 1901 nearly 20,000 exiles continued to be transported every year to Siberia, half of whom were exiled by mere orders of the local and central administration. It was, however, announced officially in 1901 that the system was to be discontinued, and the measures to be taken for this purpose again came under discussion by the St Petersburg committees.

Land Tenure.—Out of the nearly 3,240,000,000 acres of land in Siberia, 3,104,000,000 acres belong to the State, while the cabinet of his Majesty (the emperor reigning at the time being) owns 114,700,000 acres (112,300,000 in the Altai and 2,400,000 in Nerchinsk). Private property is insignificant in extent — purchase of land being only permitted in the Amur region. (In western Siberia it was only temporarily permitted in 1860–68.) In all there are only 1214 private estates, covering an aggregate area of 1,415,845 acres (256,046 acres in the Amur region). Siberia thus offers an example of the nationalization of land unparalleled throughout the world. Any purchase of land within a zone 67 miles wide on each side of the trans-Siberian railway was absolutely prohibited in 1895, and the extent of Crown lands sold to a single person or group of persons never exceeds 1080 acres unless an especially useful industrial enterprise is projected, when the maximum is fixed at 2700 acres. The land is now held by the Russian village communities in virtue of the right of occupation. Industrial surveys, having for their object the granting of land to the peasants to the extent of 40 acres per each male head, with 8 additional acres of wood and 8 acres as a reserve fund, were started many years ago, and after being stopped in 1887 were commenced again in 1898. At the present time the land allotments per male head vary greatly, even in the populated region of southern Siberia. In the case of the peasants the allotments vary on an average from 32 acres to 102 acres (in some cases from 21·6 acres to 240 acres); the Transbaikalian Cossacks have about 111 acres per male head, and the indigenous population from 108 acres to 154 acres.

Agriculture. The total cultivated area and the total area under crops every year have been estimated by A. Kaufmann as follows[1]:—

Province.	Area cultivated, Acres.	Under Crops (Acres). Total.	Average per Household.	Average per 100 Inhabitants.
Tobolsk	5,670,000	3,270,000	13·2	243
Tomsk	8,647,000	5,259,000	15·7	310
Yeniseisk	1,830,000	977,000	13·0	267
Irkutsk	1,800,000	910,000	13·2	265
Transbaikalia	1,415,000	872,000	9·4	159
Yakutsk	81,000	43,000	0·8	16
Amur (Russians)	143,000	143,000	19·4	275
South Usuri (peasants only)	151,000	151,000	24·0	375
	19,737,000	11,625,000	...	...

These figures are somewhat under-estimated, but the official figures for 1900, published by the Statistical Committee, are still lower, especially for Tomsk. The crops yielded in 1900 are officially given, for four governments only, as follows:—

1900.	Rye.	Wheat.	Barley.	Oats.
	Thousands of cwt.			
Tobolsk	1753	3888	467	3610
Tomsk	2338	5413	436	4351
Yeniseisk	1770	989	105	1154
Irkutsk	2065	517	265	863
Total	7926	10,807	1273	9978
Percentage of the average crops of 1895–99	62	53	52	59

These crops, as is seen from the last row of figures, were only between a half and two-thirds of the average crops for the five preceding years. The comparison with the crop of 1899 is still more unfavourable, the net produce of cereals available for the population being only 4·2 cwt. per inhabitant in 1900, as against 11·9 cwt. in 1899. This gives an illustration of the way in which the crops fluctuate in Siberia, and indeed the yield in a very good year will be almost three times that in a very bad one. The prices vary still more, the maximum being from 12 to 20 times (in 1892) higher than the minimum. Altogether it may be said that the southern parts of Tobolsk, nearly all the province of Tomsk (exclusive of the Narym region), southern Yeniseisk, and southern Irkutsk have in an average year a surplus of grain which may represent from 35 to 40 per cent. of the total crop, but that in bad years the crop falls short of the actual needs of the population. There is considerable movement of grain in Siberia itself, the populations of vast portions of the territory, especially of the mining regions, having to rely upon imported corn. Consequently at the present time Siberia is not a grain-exporting country of any importance, although it may become so, especially when the Altai region is more populated than it is now. (See ALTAI.) The forest area under supervision is about 30,000,000 acres (in Tobolsk, Tomsk, Yeniseisk, and Irkutsk), out of a total area of forest land of 63,000,000 acres.

Live Stock.—As an independent pursuit, cattle-breeding is carried on by the Russians in eastern Transbaikalia, by the Yakuts in the province of Yakutsk, and by the Buriats in Irkutsk and Transbaikalia, but elsewhere it is secondary to agriculture. The numbers of the live stock have been estimated by A. Kaufmann as follows (small cattle not being separated from the full-grown):—

Province.	Horses.	Horned Cattle.	Sheep and Goats.	Pigs.	Reindeer.
Tobolsk	736,230	985,520	1,097,810	226,520	186,460
Tomsk	2,307,740	1,919,890	3,694,090	535,330	...
Yeniseisk	470,750	297,740	590,000	52,000	...
Irkutsk[2]	234,490	314,610	322,170	62,630	...
Transbaikalia	628,290	1,405,110	1,379,430	138,760	...
Yakutsk	117,230	213,400	360	...	19,960
Amur[3]	22,190	25,520	3,680	...	...
Usuri[4]	10,080	32,610	13,790[5]	...	...
Total	4,527,600	5,194,400	7,101,930	1,015,240	206,420

Till lately, hides, tallow, and meat for the mining centres were the main exports of Siberia; butter was also exported, but of low quality. At the present time the making of butter in co-operative creameries, introduced by the Danish co-operators, has rapidly developed in West Siberia; improved machinery is being manufactured and used in the villages, and butter is already a substantial item in the goods traffic on the Siberian railway.

It is estimated that about one-half of the Russian agricultural population supplement their income by engaging in non-agricultural pursuits, but not more than from 18 to 22 per cent. carry on domestic trades, the others finding occupation in the carrying trade—which remains important, even after the construction of the railway—in hunting (chiefly squirrel-hunting), and in work in the mines. **Manufactures.** Domestic and petty trades are therefore developed only round Tyumeñ, Tomsk, and Irkutsk. The principal of these trades are the weaving of carpets —about Tyumeñ—which seem to find a sale even in London under various Eastern names; the making of wire sieves; the painting of ikons; the making of wooden vessels and of the necessaries for the carrying trade about Tomsk (sledges, wheels, &c.); the manufacture of felt boots and sheepskins; and, of recent introduction, the manufacture of dairy utensils and machinery. Weaving is also engaged in for domestic purposes. But all these trades are sporadic,

[1] *Russian Encyclopædic Dictionary*, vol. lix., 1900.

[2] District of Kirensk missing.
[3] Owned by Russian population only.
[4] Owned by the peasants only.
[5] All small cattle included.

belonging to limited areas, and often only to a few separate villages. In 1897 all the factories of Siberia numbered only 4651, and employed only 25,200 workers, their yearly returns hardly exceeding 20,000,000 roubles. In short, the want of communications, of technical education, and of skilled workers, coupled with the prospect of rapid enrichment by gold-mining, has hindered all manufacturing industries, though in respect of most fields of industry, the richness of much of the country and the abundant supply of raw materials afford every opportunity for a notable development.

This remark is especially true of mining, which is the main pursuit of the people, after agriculture. The chief centres for gold-mining are the Altai, the Mariinsk district of Tomsk, the southern parts of the province of Yeniseisk, the Yeniseisk district in the north of the same province, the Nerchinsk and the Vitim districts of Transbaikalia, the Olekma and Vitim district of Yakutsk, and the Bureya and Zeya districts of the Amur province; some gold is also extracted by the Chinese in the South Usuri region. All these gold-washings, which were especially flourishing in the 'eighties, employed in 1897, 41,235 workers, and produced 55,147 lb avoir. of gold dust ($\frac{9}{10}$ gold), valued at 24,555,000 roubles after all taxes had been paid. It is supposed that from 1800 to 3600 lb more were obtained fraudulently. Coal-mining is in its infancy, less than 50,000 tons of coal being extracted annually, including that obtained from Sakhalin. Great hopes are entertained, however, for the future of this industry, especially after the Eki-baz-tus mines of Akmolinsk have been connected by rail with the Setysh. Salt is obtained in antiquated works only to the amount of 1,000,000 cwt. per annum, and has to be imported. Its price stands very high in the villages of the interior, and the inhabitants feel the want of it greatly.

Mining.

Fishing is an important source of revenue, especially on the lower parts of the great Siberian rivers and on Lake Baikal; the Amur is as rich in salmon as the rivers of the Pacific slope in America. But the fisheries are still at a primitive stage of their existence, and are hampered by the high price of salt, tinplate materials, &c., and by the lack of skilled knowledge.

Commerce.—There are no figures from which even an approximate idea can be gained of the value of the internal trade of Siberia, but it is certainly considerable. The great fair at Irbit retains its importance, and there are, besides, 507 fairs in Tobolsk, 68 in Tomsk, 13 small ones in Yeniseisk, and from 3 to 12 in Transbaikalia, Irkutsk, and Yakutsk. The aggregate returns of all these is estimated at 25,000,000 roubles. There are also 71 fairs in Akmolinsk and Semipalatinsk, the returns for which are estimated at 13,500,000 roubles. The trade with the natives, which is a source of considerable income to the local merchants, continues to be mainly dependent on the sale of spirits, and to afford endless instances of abuse.

In the external trade the exports to Russia consist chiefly of grain, cattle, sheep, animal products, furs, game, feathers, and down. Trade with China is mainly in tea, which is imported. The total value of the imports from China is on an average about 20,000,000 roubles per annum, but the exports of Russian goods to China hardly attain 1,500,000 roubles per annum. This is because textiles and manufactured goods generally are imported much more advantageously by sea than by the long overland route, and it remains doubtful whether the completion of the trans-Siberian line will alter these conditions. The trade with China *viâ* the provinces of Akmolinsk and Semipalatinsk remains insignificant (total annual returns, about 1,150,000 roubles), as does the trade of Tomsk *viâ* Kom-agach, while the imports and exports from and to Mongolia, *viâ* Ulyasutai, total less than 1,000,000 roubles, and the trade along the Transbaikalian frontier (exclusive of Kyakhta) hardly exceeds 250,000 roubles. Cattle, however, are beginning to be imported in larger quantities from Mongolia. The trade with Manchuria, where large quantities of grain are bought, totals about 985,000 roubles for imports and about 1,100,000 roubles for exports. In 1896 Vladivostok was visited by 78 Russian and 189 foreign ships, the imports being 262,000 tons (60,000 tons for the State) and the exports 50,000 tons, to which the export of nearly 2000 tons by 800 small Chinese and Korean vessels must be added. The chief article of export was edible seaweed, of which about 13,700 tons was shipped to China. It is also estimated that nearly £260,000 worth of imported goods reach Blagoveschensk. The Amur region is no doubt a growing region, which requires various goods for its agricultural and mining population, but the disproportionately large excess of imports over exports clearly indicates that the high customs duties levied, and the difficulties of transport along the Usuri railway and farther up the Amur, prevent the development of the natural resources of the country. As to the northern maritime trade *viâ* the mouths of the Siberian rivers, its results were very satisfactory during the years 1896–98, especially as regards the import of machinery for the northern gold mines, and of brick tea, the sea route proving much more economical than the overland. But in 1899 none of the steamers which started for the Siberian rivers reached them, owing to the ice in the Kara Sea.

Inland Navigation.—Navigation on Siberian rivers has developed both as regards the number of steamers plying and the number of branch rivers traversed. In 1900, 130 private and several Crown steamers plied on the Ob–Irtysh river system as far as Semipalatinsk on the Irtysh, Biysk on the Ob, and Achinsk on the Chulym. Cartographical work of importance has been carried out in the estuaries of the Ob and Yenisei. The Ob–Yenisei canal is ready, but offers difficulties on account of the scarcity of water in the smaller streams forming part of that system, a difficulty which will probably be remedied by the formation of reservoirs. On the Yenisei 18 steamers ply from Minusinsk to Yeniseisk, and to Ghilghiha at its mouth; 10 steamers ply on its great tributary, the Angara, of which some rapids have been cleared, though the Padun rapids have still to be rounded by land; and 10 on the Selenga. On the Lena and the Vitim there are 20 steamers, and a small railway connects the Bodoibo river port with the Olekma gold-washings. On the Amur system, of which the Zeya, the Bureya, and the Amguñ are already navigated, there were 105 steamers in 1900.

Railways.—The first railway to reach Siberia was built in 1878, when a line was constructed between Perm, at which point travellers for Siberia used to strike off from the Kama eastwards, and Ekaterinburg, on the eastern slope of the Urals. In 1884 this line was continued farther into Siberia, so as to reach Tyumeñ, the head of navigation on the Siberian rivers, it being supposed at that time that this line would form part of the projected trans-Siberian railway. But farther south the Russian railway system had already reached as far east as Orenburg, and the Volga had been bridged at Syzrañ in 1880; accordingly, it was finally decided, in 1885, to give a more southerly direction to the great trans-Siberian railway, and to continue the Moscow–Samara line to Ufa, Zlatoust, in the Urals, and Chelyabinsk, in the West Siberian prairies, at the head-waters of one of the tributaries of the Ob. Once this point was reached—and the construction of the railway so far was soon accomplished, without any serious engineering difficulties being encountered—the line had evidently to be continued across the prairies to Kurgan and Omsk, and thence along the great Siberian highway to Krasnoyarsk and Irkutsk. As to its farther direction, it was decided that it would be best to follow, broadly speaking, the great highway round Lake Baikal to Tchita and Sryetensk on the Shilka; then to push down the Amur to Khabarovsk; and finally to proceed up the Usuri to Vladivostok. This general scheme was fixed upon in its broad outlines in 1891, and definitely accepted, after the necessary reconnoitring explorations, in 1892. The building of the railway was begun at several points at once; it had, indeed, been started before this time, the first stone of the line from Vladivostok to Grafskaya, on the Usuri, having been laid on 31st May 1891.

The several sections of the line as now built or planned, are as follows; it will be seen—under (6)—that in its last portions the route had to be somewhat modified: (1) Chelyabinsk to the Ob (Krivoschokovo village), 881 miles. On this stretch the line crosses a fertile prairie very similar to the Winnipeg prairies in Canada, and well populated; it crosses the Tobol, the Ishim, and the Irtysh. (2) From the Ob to Irkutsk, 1137 miles. This part of the line crosses first a slightly higher "rolling prairie" (similar to the Calgary rolling prairie of Canada), and at Achinsk enters the still higher plains of eastern Siberia, crossing the low spurs of the mountain region of South Yeniseisk. Excavations and high embankments had to be made on this last stretch, and several large rivers—Tom, Yaya, Kiya, Oka, Tchulym, all very rapid and liable suddenly to

inundate the surrounding country—had to be crossed, as well as the Yenisei, near Krasnoyarsk. (3) From Irkutsk to Listvenichnaya, on Lake Baikal (41 miles), along the rocky valley of the Angara. (4) Round the southern extremity of Lake Baikal. This section was not yet built in 1902, nor could it be built for some time, on account of the great difficulties offered by the high and craggy mountains (Khamar-daban), sloping precipitously towards the lake, and pouring into it hundreds of streams, each of which is a wild torrent at certain times of the year. Meanwhile two powerful ice-breakers carry the trains over the lake to the Mysovaya station in Transbaikalia. (5) From Mysovaya to Tchita and Sryetensk, on the Shilka, 687 miles. This line gradually ascends by way of the valleys of the Selenga and the Uda to the level of the plateau, and crossing the south-eastern border ridge of this—Yablonovoi Khrebet—at an altitude of 3412 feet, reaches the Tchita river near its junction with the Ingoda. This last river is followed to its junction with the Shilka, and the Shilka down to Sryetensk. (6) For reasons indicated elsewhere (see RUSSIA, *Railways*), it was found inadvisable to continue the railroad along the Shilka and the Amur to Khabarovsk, and negotiations with the Chinese Government for a trans-Manchurian railway were successfully carried out. This line connects Kaidalovo, 20 miles below Tchita, with Vladivostok, with a branch from Harbin, on the Sungari, to Dalny and Port Arthur. Those parts of it which run through Russian territory (in Transbaikalia, from Kaidalovo to Nagadan—216 miles; in the neighbourhood of Vladivostok, from Nikolsk to the Manchurian frontier—72 miles) were in 1902 in working order, and the trans-Manchurian line (1607 miles) was already opened for some traffic. However, parts of it were only in a preliminary state; the crossing of the Great Khingan would be gradually rendered less steep, and the bridge over the Sungari had still to be completed. (7) A line was constructed from Vladivostok to the Amur before it became known that the idea of following the latter part of the route originally laid down would have to be abandoned. This line, which has been in working order since 1898, is 477 miles long, and proceeds first to Grafskaya, across the fertile and populous South Usuri region, then down the right bank of the Usuri to Khabarovsk, across marshy and woody tracts, almost useless for purposes of cultivation.

Returning westwards, it may be noticed that Chelyabinsk has been connected with Ekaterinburg (150 miles); and that a branch line has been built to Tomsk (60 miles). Altogether the trans-Siberian line has been built very rapidly. In 1893, 256 miles of rail were laid down; in 1894, 552 miles; in 1895, 832 miles; in 1896, 454 miles; in 1897, 438 miles; in 1898, 478 miles; in 1899, 490 miles; and in 1900, 288 miles, making a total for the eight years of 3788 miles. The total cost of the 3721 miles already opened for traffic in the first months of 1901 was 327,794,685 roubles, to which the estimated cost of the 193 miles round Lake Baikal, that is, 37,618,900 roubles, has to be added. Various works have also been carried out along the Siberian rivers and at the port of Vladivostok in order to improve navigation, the total cost of which is estimated at 466,110,019 roubles. If the Perm–Kotlas railway and the feeding lines are taken into account, the whole enterprise had cost up to 1902 over 529,000,000 roubles.

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Sibonga, a town on the east coast of the island of Cebú, Philippine Islands, in 10° 00′ 06″ N. Agriculture is the principal occupation of its inhabitants, rice and copra being the most important products. It has a healthful, though hot, climate. The language is Cebú-Visayan. Population, 23,000.

Sibpur, a town of British India, in the Hooghly district of Bengal, situated in 22° 34′ N. and 88° 16′ E., on the right bank of the river Hooghly, opposite Fort William. It is a suburb of Howrah, with which town its statistics are included. It contains jute-mills, flour-mill, rope-works, brick-works, and other industrial establishments; the Government botanical garden (the Kew of India); and the engineering college, which has been reorganized, with electrical and mining departments and a boarding-house. In 1896–97 there were in all 310 students; and the total cost was Rs.1,09,226, of which Rs.96,481 was paid by Government.

Sibsagar, a town and district of British India, in the Brahmaputra Valley division of Assam. The town is situated on the Dikhu river, about 9 miles from the left bank of the Brahmaputra. Population (1881), 5868; (1891), 5249; municipal income (1897–98), Rs.11,463; death-rate (1897), 42·1 per thousand. The Government high school had 175 pupils in 1896–97, of whom 4 passed the Calcutta matriculation.

The district of SIBSAGAR has an area of 2855 square miles. Population (1881), 370,274; (1891), 457,274, showing an increase of 23 per cent., mainly due to the importation of tea coolies; average density, 160 persons per square mile. Classified according to religion in 1891, Hindus numbered 418,863; Mahommedans, 19,805; Christians, 1365, including 274 Europeans; hill tribes, 16,243; "others," 998. In 1901 the population was 598,642, showing an increase of 31 per cent. The land revenue is Rs.13,26,839, the incidence of assessment being Rs.2:10:11 per acre; number of police, 277; number of boys at school (1896–97), 11,222, being 31·04 per cent. of the male population of school-going age, the highest proportion in the province; death-rate (1897), 42·6 per thousand. Sibsagar is the chief centre of tea cultivation in the Brahmaputra valley, which was introduced by the Assam Company in 1852. In 1897 there were 171 gardens, with 70,644 acres under tea, employing 139,755 persons, of whom 44,193 had been imported under contract, and yielding 24,000,000 ℔, or 391 ℔ per acre. There are 3 timber mills, employing 200 hands, and producing 125,000 tea-chests, of the value of Rs.1,00,000. A small State railway of 2 feet gauge runs from Jorhat to the Brahmaputra, 27 miles long; but the district will shortly be traversed throughout by the Assam-Bengal railway, now under construction.

Sicily.—Sicily is an island separated from the Italian mainland by a strait which in its narrowest part (Strait of Messina) is hardly two miles wide. The area and population of the several provinces are shown in the subjoined table:—

Province.	Area in Square Miles.	Population, 1881.	Population, 1901.	Density per Square Mile, 1901.
Caltanissetta .	1263	266,379	330,972	262
Catania . .	1917	563,457	711,923	371
Girgenti . .	1172	312,487	371,471	317
Messina . .	1246	460,924	548,898	440
Palermo . .	1948	699,151	785,016	403
Syracuse . .	1442	341,526	427,429	296
Trapani . .	948	283,977	353,557	373
Total . .	9936	2,927,901	3,529,266	355

Thus between 1881 and 1901 the population increased at the rate of 20·5 per cent. The average density is extremely high for a country which lives almost exclusively from agriculture, and is much higher than the average for Italy in general, 293 per square mile.

Agriculture and agricultural products.

Sicily, formerly called the granary of Italy, exported grain until the end of the 18th century. Now, although the island still produces every year some 15 million bushels, the supply barely suffices for the consumption of a population of which bread is almost the exclusive diet. The falling-off in the exportation of cereals is not a consequence of any decadence in Sicilian agriculture, but rather of the increase of population, which nearly doubled within the 19th century. Two types of agriculture prevail in Sicily—the extensive and the intensive. The former covers mainly the interior of the island and half the southern coast, while the latter is generally adopted on the eastern and northern coasts. Large holdings of at least 500 hectares (a hectare equals about 2½ acres) are indispensable to the profitable pursuit of extensive agriculture. These holdings are usually called *feudi* or *latifondi*. Their proprietors alternate the cultivation of wheat with that of barley and beans. During the years in which the soil is allowed to lie fallow, the grass and weeds which spring up serve as pasture for cattle, but the poverty of the pasture is such that at least two hectares are required for the maintenance of every animal. This poverty is due to the lack of rain, which, though attaining an annual average of 74 centimetres (29 inches) at Palermo, reaches only 53 centimetres (21 inches) at Syracuse on the east coast, and 49 centimetres (about 19½ inches) at Caltanissetta, on the central high plateau. The system of extensive cultivation proper to the *latifondi* gives an annual average gross return of about 200 lire per hectare (£3, 4s. 5d. per acre).

Intensive agriculture in Sicily is limited to fruit trees and fruit-bearing plants, and is not combined with the culture of cereals and vegetables, as in central and parts of northern Italy. Originally the Sicilian system was perhaps due to climatic difficulties, but now it is recognized in most cases to be more rational than combined culture. Large extents of land along the coasts are therefore exclusively cultivated as vineyards, or as olive, orange, and lemon groves. Vineyards give an annual gross return of between £11 and £13 per acre, and orange and lemon groves between £32 and £48 per acre. Vegetables are grown chiefly in the neighbourhood of large cities. Almonds are freely cultivated, and they seem to be the only trees susceptible also of cultivation upon the *latifondi* together with grain. A large export trade in almonds is carried on with north and central Europe. Hazel nuts are grown in woods at a level of more than 1200 feet above the sea. These also are largely exported to central Europe for use in the manufacture of chocolate. The locust bean (used for forage), figs, and peaches are widely grown, while in certain special zones the pistachio and the manna-ash yield rich returns. On the more barren soil the sumach shrub, the leaves of which are used for tanning, and the prickly pear grow freely. The latter fruit constitutes, with bread, the staple food of the poorest part of the rural population for several months in the year. The cultivation of cotton, which spread during the American War of Secession, is now rare, since it has not been able to withstand the competition of more favoured countries. All these branches of intensive cultivation yield a higher gross return than that of the extensive system. Along the coast landed property is as a rule broken up into small holdings, usually cultivated by their owners.

Climatic conditions prevent cattle-raising in Sicily from being as prosperous an undertaking as in central Italy. The total number of bullocks in the island is calculated to be less than 200,000; and although the ratio of consumption of meat is low in proportion to the population, some of the cattle for slaughter have to be imported. Sheep and goats, which subsist more easily on scanty pasturage, are relatively more numerous, the total number being calculated at 700,000. Yet the wool harvest is scarce, and the production of butter a negligible quantity, though there is abundance of the principal product of Sicilian pasture lands, cheese of various kinds, for which there is a lively local demand. The Sicilian race of horses would be good, but that it is not prolific, and has degenerated in consequence of insufficient nourishment and overwork. A better breed of horses is being obtained by more careful selection, and by crossing with Arab and English stallions imported by the Government. Donkeys and mules of various breeds are good, and would be better were they not so often weakened by heavy work before attaining full maturity.

Forests.

The absence of forests, which cover hardly 3 per cent. of the total area of the island, constitutes a serious obstacle to the prosperity of Sicilian pastoral and agrarian undertakings. The few remaining forests are almost all grouped around Etna and upon the high zone of the Madonian Mountains, a range which rises 40 miles west of Palermo, running parallel to the northern coast almost as far as Messina, and of which many peaks reach nearly 6000 feet above the sea.

In that part of the island which is cultivated intensively some four and a half million hectolitres of wine are annually produced. Had not the phylloxera devastated the vineyards during the last decade of the 19th century, the production would be considerably higher. Three hundred and fifty thousand hectolitres of olive oil and 2500 million oranges and lemons are also produced, besides the other minor products above referred to. The zone of the *latifondi*, or extensive culture, yields, besides wheat, nearly 3,000,000 hectolitres of barley and beans every year.

Mining.

The most important Sicilian mineral is undoubtedly sulphur, which is mined principally in the provinces of Caltanissetta and Girgenti, and in minor quantities in those of Palermo and Catania. Up to 1896 the sulphur industry was in a state of crisis due to the competition of pyrites, to the subdivision of the mines, to antiquated methods, and to a series of other causes which occasioned violent oscillations in and a continual reduction of prices. The formation of the Anglo-Italian sulphur syndicate arrested the downward tendency of prices and increased the output of sulphur, so that the amount exported in 1899 was 4,240,183 quintals, worth 43,461,876 lire (£1,738,475), whereas some years previously the value of sulphur exported had hardly been 20,000,000 lire (£800,000). Now nineteen-twentieths of the sulphur consumed in the world is drawn from Sicilian mines, while some 50,000 persons are employed in the extraction, manufacture, transport, and trade in the mineral.

Another Sicilian mineral industry is that of common salt and rock-salt. The former is distilled from sea-water near Trapani, and the latter obtained in smaller quantities from mines. The two branches of the industry yield about 180,000 tons per annum, worth 2,000,000 lire (£80,000). About half this quantity is exported, principally to Norway. Besides salt, the asphalt mining industry may be mentioned. Its centre is the province of Syracuse. The value of the annual output is about 1,000,000 lire (£40,000).

Fisheries.

Deep-sea fisheries give employment to some twenty thousand Sicilians, who exercise their calling not only off the coasts of their island, but along the north African shore, from Morocco to Tripoli. In 1894 (the last year for which accurate statistics have been issued) 350 fishing smacks were in active service, giving a catch of 2480 tons of fish. Approximately, the value of the annual catch may be reckoned at from 15 to 20 million lire (£600,000 to £800,000).

Industries.

The majority of the scanty Sicilian industries are directly connected with various branches of agriculture. Such, for instance, is the preparation of the elements of citric acid, which is manufactured at an establishment at Messina. Older and more flourishing is the Marsala industry. Marsala wine is a product of the western vineyards situated slightly above sea level. In 1899 more than 38,000 hectolitres were exported to the value of more than 3,000,000 lire (£120,000). The quantity consumed in Italy is far greater than that exported.

Another flourishing Sicilian industry carried on by a large number of small houses is that of preserving vegetables in tins. Artichokes and tomato sauce are the principal of these products, of which several dozen million tins are annually exported from Sicily to the Italian mainland, to Germany, and to South America. Manufactories of furniture, carriages, gloves, and leather exist in large number in the island. They are, as a rule, small in extent, and are managed by the owners with the help of five, ten, or at most twenty workmen. Within the last decade several glass works have been established at Palermo, a match factory at Caltanissetta, a cotton dyeing works at Messina, and a large metal foundry at Palermo. Large shipbuilding yards and a yard for the construction of trams and railway carriages are now being laid out in the latter city.

Ways of communication.

Naturally Sicilian trade is almost all sea-borne. The ports of Palermo and Messina register a gross traffic of over three million tons annually. Prior to 1860 there was not a single kilometre of railway in Sicily. The total length of Sicilian railways is now 1000 miles. Their construction was rendered very costly by the mountainous character of the island. Traffic returns on the whole are not high, but are steadily increasing.

Like all southern Italy, Sicily in 1860 was poor, notwithstanding the possession of notable reserves of monetary capital. On the completion of Italian unity part of this pecuniary capital was absorbed by the sudden increase of taxation, and a much greater part was employed by private individuals in the purchase of lands formerly belonging to the suppressed religious corporations. These lands covered about one-fifth of the surface of the island. Both the revenue acquired by taxation and the proceeds of the land sales were almost entirely spent by the State in northern Italy, where the new Government, for administrative and military reasons, had been obliged to establish its principal organizations, and consequently its great centres of economic consumption. It was therefore necessary to meet from scanty local revenues the continually-increasing expenditure necessary for public instruction, ways of communication, hygienic improvements, and, generally, for introducing modern European civilization among a people who until then had lived penuriously, ignorant of many needs, consuming little, and resembling in many respects an Oriental population. Thus it is easy to understand that while in some respects the island has made rapid progress and the large cities have been beautified and developed, in other respects it remains in a backward state, many communes of the *latifondi* zone being still in the moral and material conditions of a century ago. As a general rule, trade and the increase of production have not kept pace with the development of the ways of communication.

Economic, intellectual, and moral conditions of the population.

The poverty of the Sicilian population is accentuated by the unequal distribution of wealth among the different classes of society. A small but comparatively wealthy class—composed principally of the owners of *latifondi*, who are not invariably descended from the barons of former times—resides habitually in the large cities of the island, or even at Naples, Rome, or Paris. Yet even if all the wealthy landowners resided on their estates, their number would not be sufficient to enable them to play in local public life a part corresponding to that of the English gentry. On the other hand, the class which would elsewhere be called the middle class is in Sicily extremely poor. The origin of most of the abuses which vitiate Sicilian political life, and of the frequent scandals in the representative local administrations, is to be found in the straitened condition of the Sicilian middle classes. The artisan class in the cities is not appreciably poorer than in other parts of Italy. The condition of the peasant in the zone of intensive culture is also bearable, many of the peasants being themselves small proprietors. The peasants of the *latifondi* zone, on the contrary, are as a rule poverty-stricken.

Emigration, which might improve the condition of the agricultural proletariat, only attained serious proportions within the last decade of the 19th century. In 1897 the permanent emigation from the island was 15,994, in 1898, 21,320, and in 1899, 24,604.

Emigration.

The moral and intellectual defects of Sicilian society are in part results of the economic difficulties above described, and in part the effect of bad customs introduced or maintained during the long period of Sicilian isolation from the rest of Europe. When, in 1860, Sicily was incorporated in the Italian kingdom, hardly a tenth of the population could read and write. Upon the completion of unity, elementary schools were founded everywhere; but, though education was free, the indigence of the peasants in some regions prevented them from taking full advantage of the opportunities offered. Thus, even now, nearly 60 per cent. of the Sicilian conscripts come up for military service unable either to read or to write. Secondary and superior education is much more diffused, and Sicily perhaps furnishes more students to the lycées and universities in proportion to population than any part of Italy.

Public instruction.

Brigandage of the classical type has almost disappeared from Italy. The true brigands number hardly more than a dozen, and haunt only the most remote and most inaccessible mountains. Criminal statistics, though slowly diminishing, are still high—murders, which are the most frequent crimes, having been 27 per 100,000 inhabitants in 1897–98. Violent assaults with infliction of serious wounds are also frequent. While explicable in part by the violent temperament of the Sicilians and in part by the insufficiency and incapacity of the police, this readiness to commit bloodshed is still more attributable to the influence of the Maffia. The Maffia is not, as is generally believed, one vast society of criminals, but is rather a sentiment akin to arrogance which imposes a special line of conduct upon persons affected by it. In substance the *maffioso* considers it dishonourable to have recourse to lawful authority to obtain redress for a wrong or a crime committed against him. He therefore hides the identity of the offender from the police, reserving vengeance to himself or to his friends and dependants. This sentiment, still widely diffused among the lower classes of many districts and not entirely unknown to the upper classes, renders difficult legal proof of culpability for acts of violence, and multiplies sanguinary private reprisals.

Brigandage and Maffia.

The nature of Sicilian moral sentiment explains the elevated standard of family life, the small number of illegitimate births, the respect for women even among the lowest classes (the assertions of superficial observers notwithstanding), the scrupulous fidelity with which a Sicilian workman executes his task, and the discipline and bravery of Sicilian soldiers and sailors—attributable to their personal devotion towards their officers. If to these qualities be added an almost universal industry, a certain spirit of dignity, order and thrift in all classes, and, finally, the general sobriety of the population (drunkenness is practically unknown in the island), it will be seen that elements exist by means of which Sicily may in time become a prosperous and morally elevated country when Italy, which has already passed through the laborious period which followed her national unification, shall have completed that work of economic and moral restoration which may already be considered as well begun. (G. Mo.)

The family.

Sidgwick, Henry (1838–1900), English philosopher, born at Skipton, in Yorkshire, on 31st May 1838, was educated at Rugby and Cambridge, where his career was a brilliant one. In 1859 he was senior classic, 33rd wrangler, and Chancellor's medallist. In the same year he was elected to a fellowship at Trinity, and soon afterwards appointed to a classical lectureship there. This post he held for ten years, but in 1869 exchanged his lectureship for one in moral philosophy, a subject to which he had been turning his attention more and more. In the same year he resigned his fellowship on conscientious grounds, when the question of the abolition of religious tests for fellowships was being pressed, a reform actually carried two years later. In 1874 Sidgwick published his *Method of Ethics*, which first won him a reputation outside his university. In 1875 he was appointed prælector on moral and political philosophy at Trinity, in 1883 he was elected Knightbridge professor of moral philosophy, and in 1885 his college once more elected him to a fellowship. In 1883 he published the *Principles of Political Economy*; in 1885 the *Scope and Method of Economic Science*; in 1886 *Outlines of the History of Ethics*, enlarged from the article "Ethics" in the *Encyclopædia Britannica*; and in 1891 the *Elements of Politics*, intended to supply the want of an adequate treatise on the subject by starting from the old lines of Bentham and Mill. Besides his lecturing and literary labours, Sidgwick took an active part in the business of the university, and in many forms of social and philanthropic work. He was a member of the General Board of Studies from its foundation in 1882 till 1899; he was also a member of the Council of the Senate of the Indian Civil Service Board and the Local Examinations and Lectures Syndicate, and chairman of the Special Board for Moral Science. He was one of the founders of the Society for Psychical Research and of the Metaphysical Society. None of his work is more closely identified with his name than the part he took in promoting the higher education of women. He helped to start the higher local examinations for women, and the lectures held at Cambridge in preparation for these. It was at his suggestion and with his help that Miss Clough opened a house of residence for students; and when this had developed into Newnham College, and in 1880 the North Hall was added, Mr Sidgwick, who had in 1876 married Miss Eleanor Mildred Balfour, went with his wife to live there for two years. After Miss Clough's death in 1892, Mrs Sidgwick became principal of the college, and she and her husband resided there for the rest of his life. During this whole period Professor Sidgwick took the deepest interest in the welfare of the college. Early in 1900 he was forced by ill-health to resign his professorship, and he died in August of the same year. (See Ethics.) (A. Z.)

Sidmouth, a watering-place and market town in the Honiton parliamentary division of Devonshire,

England, pleasantly situated at the mouth of the Sid, 15 miles by rail east by south of Exeter. The harbour is inaccessible for vessels over 200 tons. The church of St Nicholas contains a window, presented by Queen Victoria, 1866, in memory of the duke of Kent, who died here. There is a Roman Catholic convent, and public edifices are the market buildings, a Masonic hall, a volunteer drill-hall, public baths, a promenade sea-wall, and a cottage hospital. Area of parish (an urban district) prior to extension in 1899, 1563 acres. Population (1891), 3758; (1901), 4201.

Sidney, a city of Ohio, U.S.A., capital of Shelby county. It is on the river Miami, the Miami and Erie canal, and the Cleveland, Cincinnati, Chicago, and St Louis and the Cincinnati, Hamilton, and Dayton railways, in the western part of the state. Population (1890), 4850; (1900), 5688, of whom 282 were foreign-born and 108 negroes.

Sidon (now *Saidá*), a small town on the Syrian coast between Beirût and Súr (Tyre). The population is 11,000 (Moslems 8000, Christians 2500, Jews 500). The exports comprise olive oil and fruit, especially oranges and lemons. In 1887 tomb chambers were discovered close to the town, which contained several fine Greek and Phœnician sarcophagi, including the "Alexander" sarcophagus, a unique work of art in the form of a Greek temple, and the sarcophagus of Tabnith, king of Sidon. These sarcophagi are now in the Imperial Museum at Constantinople. Remains have been found of a building which apparently belongs to the Persian period.

Siedlce (Russian, *Syedlets*), a government of Russia in the east of Poland, with an area of 5535 square miles and a population which was 630,240 in 1884 and 775,316 (census population, domiciled only) in 1897, when there were 382,896 women and the urban population numbered 110,995. The inhabitants are chiefly Little Russians (43 per cent.), Poles (40 per cent.), Jews (15 per cent.), and Germans. The government is divided into nine districts, the chief towns of which are the capital, Siedlce (23,714 inhabitants), Biała (13,123), Konstantinow (1840), Garwolin (5554), Łukow (8317), Radzyn (5718), Sokołow (7246), Węgrow (8679), Włodawa (6758). The main occupation is still agriculture; 1,035,300 acres were under crops in 1900, and the average yield in 1895–99 was: rye 3,086,000 cwt., wheat 730,000 cwt., oats 1,485,600 cwt., barley 436,500 cwt.—all cereals, 6,198,000 cwt.; also potatoes, 10,280,000 cwt., they being largely grown for distilleries. The area under forests in 1898 was 97,300 acres. Cattle-breeding is second in importance only to agriculture; in 1897 there were 84,250 horses, 323,240 horned cattle, 341,640 sheep, and 165,450 pigs. Manufactures and trade are insignificant.

Siegburg, a town of Prussia, in the Rhine province, on the river Sieg, 16 miles by rail south-east of Cologne. It has a royal projectile factory, calico-printing mills, lignite mines, stone quarries, and tobacco factories. The parish church, dating from the 13th century, possesses several richly-decorated reliquaries of the 12th to 15th centuries. A former Benedictine abbey, founded in 1066, is now used as a prison. Population (1885), 7514; (1900), 14,164.

Siegen, a town of Prussia, province of Westphalia, 63 miles by rail east of Cologne. It is the centre of the iron-mining, iron-smelting, and tanning industries of southern Westphalia. In the town are two castles of the former princes and counts of Nassau-Siegen, and an equestrian statue of the Emperor William I. Population (1885), 16,676; (1900), 22,111.

Siemens, Ernst Werner von (1816–1892), German electrician, was born on the 13th December 1816 at Lenthe, in Hanover. After attending the gymnasium at Lübeck, he entered the Prussian army as a volunteer, and for three years was a pupil in the Military Academy at Berlin. In 1838 he received a commission as lieutenant in the artillery, and six years later he was appointed to the responsible post of superintendent of the artillery workshops. In 1848 he had the task of protecting the port of Kiel against the Danish fleet, and as commandant of Friedrichsort built the fortifications for the defence of Eckernförde harbour. In the same year he was entrusted with the laying of the first telegraph line in Germany, that between Berlin and Frankfort-on-Main, and with that work his military career came to an end. Thenceforward he devoted his energies to furthering the interests of the newly-founded firm of Siemens and Halske, which under his guidance became one of the most important electrical undertakings in the world, with branches in different countries that gave it an international influence; in the London house he was associated with Sir Charles Siemens, one of his younger brothers. Although he had a decided predilection for pure research, his scientific work was naturally determined to a large extent by the demands of his business, and, as he said when he was admitted to the Berlin Academy of Sciences in 1874, the filling up of scientific voids presented itself to him as a technical necessity. Considering that his entrance into commercial life was almost synchronous with the introduction of electric telegraphy into Germany, it is not surprising that many of his inventions and discoveries relate to telegraphic apparatus. In 1847, when he was a member of the committee appointed to consider the adoption of the electric telegraph by the Government, he suggested the use of gutta-percha as a material for insulating metallic conductors. Then he investigated the electrostatic charges of telegraph conductors and their laws, and established methods for testing underground and submarine cables and for locating faults in their insulation; further, he carried out observations and experiments on electrostatic induction and the retardation it produced in the speed of the current. He also devised apparatus for duplex and diplex telegraphy, and automatic recorders. In a somewhat less specialized sphere, he was an early advocate of the desirability of establishing some easily reproducible basis for the measurement of electrical resistance, and suggested that the unit should be taken as the resistance of a column of pure mercury one metre high and one square millimetre in cross-section, at a temperature of 0° C. Another task to which he devoted much time was the construction of a selenium photometer, depending on the property possessed by that substance of changing its electrical resistance according to the intensity of the light falling upon it. He also claimed to have been, in 1866, the discoverer of the principle of self-excitation in dynamo-electric machines, in which the residual magnetism of the iron of the electro-magnets is utilized for excitation, without the aid of permanent steel magnets or of a separate exciting current. In another branch of science he wrote several papers on meteorological subjects, discussing among other things the causation of the winds and the forces which produce, maintain, and retard the motions of the air. In 1866 he devoted half a million marks to the foundation of an imperial institute of technology and physics, and in 1888 he was ennobled. He died at Berlin on the 6th of December 1892. His scientific memoirs and addresses were collected and published in an English translation in 1892, and three years later a second volume appeared containing his technical papers. (H. M. R.)

Siemrat, or SIEMRAP, one of the south-eastern provinces of Siam, situated at the north end of the Talé Sap, the lake of Cambodia. The total population cannot exceed 10,000, and consists mostly of Cambodians and descendants of former Siamese garrisons, who have adopted that language. Agriculture and fishing are the chief pursuits of the people. The trade is very small; the sandy soil produces a red-grained rice which has not a good reputation for quality. Close by the chief town—a mere village of some 2000 inhabitants—there are the remains of the old brick kampeng, or fort, erected by Praya Bodin after the capture of this province from the Cambodians in the 18th century. But Siemrat is best known for the great ruins of Angkor, or Nakawn, Wat, which stand a mile or two to the northward buried in dense forest, an unending source of awe and mystery to the native and of admiration to the European visitor. These, with the extensive remains of Nakawn Luang, the old city close by, form remarkable relics of the architectural genius of the Khmer race, which between the 8th and 12th centuries had spread itself from the sea to Korat and the Me Kong.

AUTHORITIES.—THOMSON. *Straits of Malacca, Indo-China, and China; Antiquities of Cambodia.*—GARNIER. *Voyage d'Exploration en Indo-Chine.*—HENRI MOUHOT. *Travels in Indo-China.*—CURZON, Lord. *Geogr. Journal*, vol. ii. No. 3.—MORRISON, Dr. "*Times*" *Letters from Indo-China.* 1896.—H. WARRINGTON SMYTH. *Five Years in Siam.*—ÉTIENNE AYMONIER. *Le Camboge.* Paris, 1900.

Siena, a town and archiepiscopal see of Italy, Tuscany, capital of the province of Siena, 61 miles by rail south of Florence. The Victor Emmanuel hall in the town hall, adorned by frescoes by the Sienese artists Aldi, Cassioli, and Maccari, was opened in 1891. In 1882 some frescoes by Pinturicchio were discovered in an apartment of the palace which was built for Pandolfo Petrucci in 1508. The church of San Francesco was finally restored in 1885–92. The university was attended by 231 students in 1898, and there were 31 professors. Siena is a place of some industrial activity, and possesses a school of the industrial arts and sciences. Population (1881), 23,445; (1901), 28,678.

Siero, a town of Spain, in the province of Oviedo, to the south of Gijon, on the river Nora, and on the Laviana–Gijon and Leon–Gijon railways. It is in the centre of a fertile agricultural district, in which live stock is extensively reared. There are coal mines in the neighbourhood, and the local industries include tanning and manufactures of soap, coarse linen, and cloths. Population (1897), 22,456.

Sierra Leone, a British colony on the west coast of Africa. Sierra Leone proper consists of a peninsula, about 26 miles in length to Cape Shilling, by about 12 in breadth, with an area of about 300 square miles. The colony, as distinct from the protectorate, now takes in the entire seaboard southwards to the Mano river, which forms the Liberian boundary, including Sherbro Island, Banana, Turtle, Plantain, and other minor islands· also Turner's peninsula, a narrow strip of land from Bahol, Shea Bar, extending in a south-east direction about 60 miles to the Kase Lake and lying between the Bum Kittam river and the North Atlantic—thence the coast is continued to the ports of Sulima and Mano Salija, Garinga, about 8 miles up the Mano river, being the extreme limit of the colony proper. Northwards, the Isles de Los, Yellaboi, Kortimo, and Leopard Islands, and other small islets are also included. There is no further room for extension, the whole being hemmed in—one-third by the North Atlantic, one-third by French territory, and the remaining one-third by Liberia.

In 1896 the entire area beyond the colony proper, containing about 30,000 square miles, now described as the protectorate, was proclaimed as such, and was divided into five sections or districts, each under a European commissioner, namely, Ronietta, Karene, Bandajuma, Panguma, and Koinadugu. The protectorate extends on the northern coast-side of the colony to Kiragba, between the Great Scarcies river and the Mellacouri river, and then follows the defined Anglo-French and Anglo-Liberian delimitations. Upon first acquaintance it is difficult to realize that a country presenting such naturally beautiful surroundings can have a climate which is so deadly to the European. Gambia was administratively separated from Sierra Leone in 1888, so that Sierra Leone now stands alone as a distinct government. After 1875 a complete transformation took place in the geographical disposition of the British sphere of influence, in the delimitation of British territory by the various boundary commissions, and in the introduction of a governmental interior policy which has led to the protectorate being proclaimed, with a population estimated at about 1,000,000.

Freetown.

Freetown, the capital, which has a reputed population of about 30,000 inhabitants, mostly negroes, has come into greater prominence from its having been made a coaling station of the Imperial Government, the natural open roadstead, 5 miles from the Cape, being capable of receiving the largest ships of war, and is the finest and safest harbour on the west coast of Africa. Freetown is the headquarters of His Majesty's military forces on this coast, the barracks being at Tower Hill, Kortright Hill, Mount Oriel, and Wilberforce. The forces consist of a battalion of the West India regiment, detachments of Royal Engineers and Royal Artillery, and in 1898 was raised the West African regiment from local native tribes, commanded by Imperial European officers. For the protectorate there are the frontier police, a native colonial force numbering 600, under European military officers; and for the colony proper there are the Sierra Leone police, about 270 strong, under a European superintendent and inspector, for the performance of civil duties. There has been cable communication from Freetown to all parts of the world since 1886, and sea communication is weekly by mail steamers from Liverpool, supplemented by frequent steamers from Hamburg. A Government light railway was begun at Freetown in 1897, and the first section, costing £150,000, as far as Songo Town, a distance of 30 miles, was opened for traffic early in 1899; it passes through the villages of Kissi, Wellington, Hastings, Waterloo, and Newton, the journey occupying 3 hours 20 minutes. The railway has been continued across the Ribbi river to Moyamba, 45 miles; and it is contemplated to advance a considerable way into the interior, where the heavier natural productions will be met with, which should yield a revenue for the maintenance of the line.

Commercially, Freetown is a great trading centre and depot for supplying the rivers; it produces nothing in the way of exports; the villages around cultivate ginger, coffee, fruits, vegetables, cassada, and Indian corn, and raise poultry, all of which articles find a ready market in the capital. The exports comprise palm oil, palm kernels, kola nuts, peppers, benni seed, all from the Sherbro district and the protectorate, which also produce rice.

Freetown is noted for the abundance and excellence of its water, which comes down from the hills; but the sanitation of the town calls for great improvement, and the lighting remains surprisingly behind the times, kerosene lamps being still in use in the streets. Horses do not live, consequently all wheeled traffic is drawn by manual labour—hammocks and sedan-chairs are the customary means of locomotion. The principal buildings in the town are the cathedral, the Wilberforce Hall, the fruit market, the railway station, the model school, the courts of justice, the post office, the hospital, the Government buildings, and the gaol. Outside the town are the Princess Christian Hospital, Bishop's Court, Fura Bay College, and the railway depot at Clinestown.

Statistics of Sierra Leone.

According to the census returns of 1891, the whole population in the colony proper, *i.e.*, at places indicated in the following table, was:—

	White.		Coloured Population.		Total.	
	Males.	Females.	Males.	Females.	Males.	Females.
Freetown District:						
St George's Parish	169	30	16,142	13,602	16,311	13,722
Eastern Division	..	..	2,100	2,113	2,100	2,113
Mountain Division	2	2	3,082	2,994	3,084	2,996
Western District	..	..	2,876	2,565	2,876	2,565
Eastern District	1	..	6,494	6,186	6,495	6,186
Sherbro	19	1	7,324	6,164	7,343	6,165
The Isles de Los	..	..	814	764	814	764
Kaikonki	..	..	71	19	71	19
Factories (Govt.) in S.L. River	..	..	26	9	26	9
Tasso	..	..	680	360	680	360
Sulima Sub-District	..	..	..	..	..	..
	191	33	39,609	34,866	39,800	34,899

The total population was thus 74,699. The white population, owing to the influx of numerous military officers, officials for the protectorate, and extended mercantile operations, has greatly increased. The dangers of the climate on the coast from malaria and fever remain unabated, and the colony justly retains its evil reputation: 40 or 50 miles inland, the country is much healthier, and is tolerable for Europeans; but the isolated life they are compelled to lead, surrounded by savagery, is prejudicial to any lengthened residence.

The rainfall of Sierra Leone, according to the colonial hospital observations at Freetown for three years, was as follows:—1896, 203 inches; 1897, 164 inches; 1899, 144 inches. The months of January, February, and March are practically rainless near the coast; desultory showers occur in April to the early part of May; towards the end of that month the wet season sets in, and continues until the end of October. With November the rain is again desultory, gradually ceasing with December. Tornadoes open and close the seasons, which is considered the unhealthiest time, the best time being the middle of the rains or "dries." The Harmattan wind, known as "the smokes," comes in with December, and lasts from two to three months—generally daily, from early morning to noon. This is a north-east dry and desiccating wind, making the atmosphere cool and invigorating, though treacherous to the newcomer.

The following figures show the value of the principal exports for the four years enumerated:—

	Benni Seed.	Kola Nuts.	Ginger.	Hides.	Palm Kernels.	Palm Oil.	Rubber.	Gum Copal.
	£	£	£	£	£	£	£	£
1896 . .	12,577	38,352	14,145	13,641	151,846	17,546	79,196	12,258
1897 . .	7,555	46,552	13,506	5,030	120,910	9,149	79,787	13,142
1898 . .	5,260	49,670	11,935	602	112,003	3,405	52,504	9,058
1900 . .	4,559	79,218	6,233	501	171,774	7,436	25,740	6,953

From these figures it will be seen that there was a falling off in everything except kola nuts, which, however, are chiefly exported to Gambia and to Senegal, and in palm kernels; the cultivation of ground nuts, which was formerly one of the large exports, has been superseded by exports from India. On their extinction rubber was discovered, and has continued to be worked, most of it coming from the northern side. The vine is plentiful in Upper Mendi, but as yet the Mendis have not given it much attention.

History. Before the rising of the natives in 1898, the whole country had been in a particularly tranquil state since 1890, when the Government adopted a firm and greatly extended policy for the interior, it having been obvious for some time previously that the internecine wars which devastated and depopulated large areas, and were of constant recurrence, greatly hindered the prosperity of the colony. Travelling commissioners were appointed to explore the hinterland, and to enter into friendly treaties with the paramount chiefs; and the frontier police were organized. The abolition of slavery followed; and with the introduction of the Protectorate Ordinance in 1897, a house tax of 5s. each was imposed, to come into operation in the three first-named districts on the 1st January 1898. Chief Bai Burch, in the Timini country, broke out into open war, necessitating a military punitive expedition. He was at length captured, and deported. In April 1898 the Mendi tribes rose, and massacred several American missionaries at Rotifunk and Taiama, some native officials in the Imperri district, and a large number of police throughout the country. Speedy retribution followed, which effectually put down the revolt. A Royal Commission was appointed to inquire into the disturbances, which resulted in a continuance of the house tax. The disturbances would appear to have arisen from a desire on the part of the paramount chiefs (who arranged and disseminated a powerful fetich "swear," called "Poro," to compel the people to join) to cast themselves off from British rule, owing to the abolition of the slave trade and a longing to revert to their old heathenish customs and practices.

The principal port for the shipping of the largest item of export—palm kernels—is Sherbro, lying about 90 miles to the south-east of Sierra Leone. Bonthe is the seat of government, situated upon Sherbro Island.

Commerce. The channel for ocean steamers has been buoyed by the Government at considerable expense. Sherbro is now producing a revenue of over £30,000 a year. The total quantity of kernels shipped in 1899-1901 from Sherbro averaged about 13,456 tons a year. The oil palms, from which the nuts are gathered twice a year, extend all over Sherbro and its hinterland, the Mendi country, and are practically unlimited, the production being entirely Nature's work, as the natives never plant them.

Sherbro and Mendi produce large quantities of kola nuts and rice, and, in smaller quantities, benni seed, pepper, piassava, and rubber. Cotton for local consumption is extensively grown. It is from the Sherbro side of the colony that the heavy natural productions are obtained and exported; but there is much scope for far greater export, when the great barrier to the development of the hinterland—the overland transport difficulty—shall have been overcome; at present all inland produce is brought down, in palm-leaf hampers upon the backs of native carriers, to some riverside trading factory, whence it is conveyed in canoes and lighters to the port of Sherbro for shipment to the ocean steamers, the anchorages being off the Bonthe channel and off York Island.

So far as salt water extends, the banks of the waterways are covered by mangrove trees, the haunts of crocodiles, but with fresh water the vegetation becomes mixed and of the usual tropical descriptions. The system of barter still prevails, though it is not so universal as formerly; the stationing of Imperial troops and colonial police in the protectorate is causing a great deal of British coin to be circulated, which is much appreciated by the natives. The country generally is plentifully watered, many places which in the "dries" are mere streams and rivulets, to be stepped over, become in the rains so swollen as to be unfordable; hence the difficulty of interior travelling during the wet season.

The total shipping entered and cleared for four years is as follows: 1897, 1,084,745 tons; 1898, 1,110,228 tons; 1899, 1,681,748 tons; 1900, 1,290,933 tons; about three-fourths British. The revenue of the colony was as follows: 1888, £63,035; 1897, £107,033; 1898, £117,682; 1900, £168,668; and the expenditure for corresponding years: 1888, £63,288; 1897, £111,678; 1898, £121,112; 1900, £156,421. The total imports: 1888, £250,147; 1897, £457,389; 1898, £606,349; 1900, £558,271. Total exports: 1888, £339,047; 1897, £400,748; 1898, £290,991; 1900, £362,471.

See the Annual Blue-book and Colonial Office Report thereon; Colonial Office List.—BANBURY. *Sierra Leone, the White Man's Grave.* 1888.—INGHAM. *Sierra Leone after a Hundred Years.* 1894.—LUCAS. *Historical Geography of the British Colonies*, vol. iii. 1896.—PIERSON. *Seven Years in Sierra Leone.* 1897.—ALLDRIDGE. *The Sherbro and its Hinterland.* 1901. (T. J. A.)

Sifan. See LOLOS.

Sigmaringen, a town of Prussia, chief town of the province of Hohenzollern, on the right bank of the upper Danube, 55 miles by rail south of Tübingen. The castle of the Hohenzollerns crowns a high rock above the river, and contains a collection of pictures, an exceptionally interesting museum (textiles, enamels, metal-work, &c.), an armoury, and a library. On the opposite bank of the Danube there is a war monument to the Hohenzollern men who fell in 1866 and 1870–71. Population (1900), 4576.

Signals (Army).—There are two systems of signalling in use in the British army, (1) the Morse (or dot

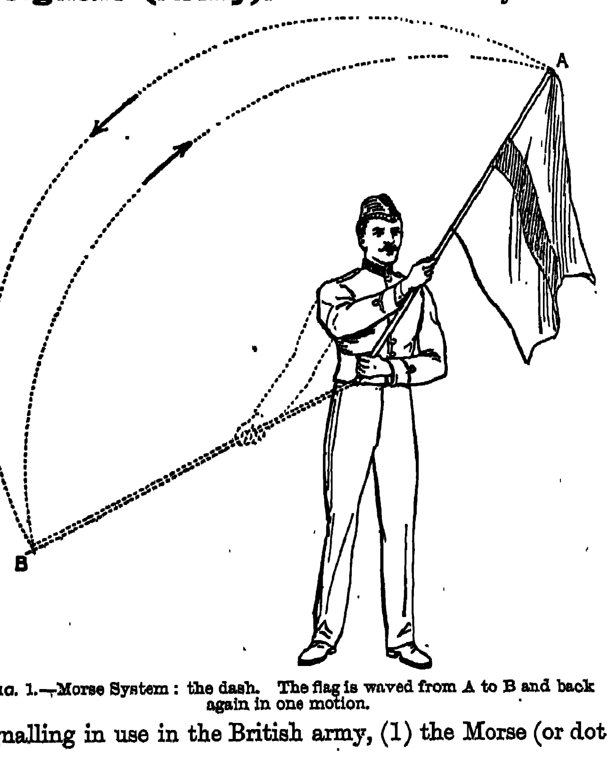

FIG. 1.—Morse System: the dash. The flag is waved from A to B and back again in one motion.

and dash, Figs. 1, 2), (2), the semaphore (Figs. 3, 4). The first is the more generally used, and is also employed in telegraphy and naval signalling. It is carried on by means of a flag or heliograph by day, and lamps by night. The flag is either dark blue or white with a horizontal line, according to the background. It is made in two sizes, the larger having drapery 3 feet square with a pole 5 feet 6 inches in length, the smaller 2 feet square of drapery and a 3 feet 6 inch pole. The former is visible with an ordinary telescope from 5 to 7 miles, but with a good glass can

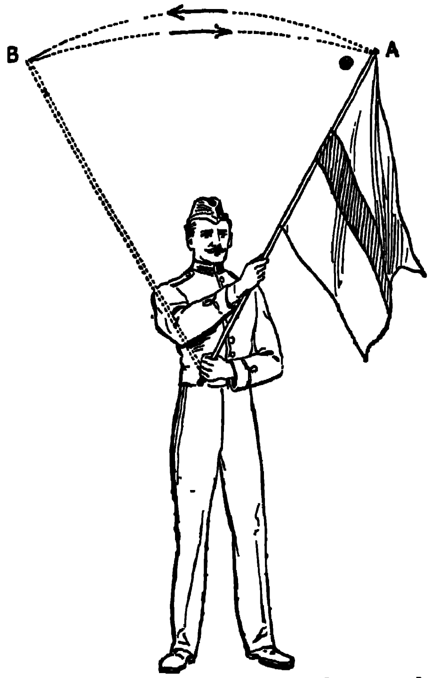

FIG. 2.—Morse System: the dot. The flag is waved from A to B and back again in one motion.

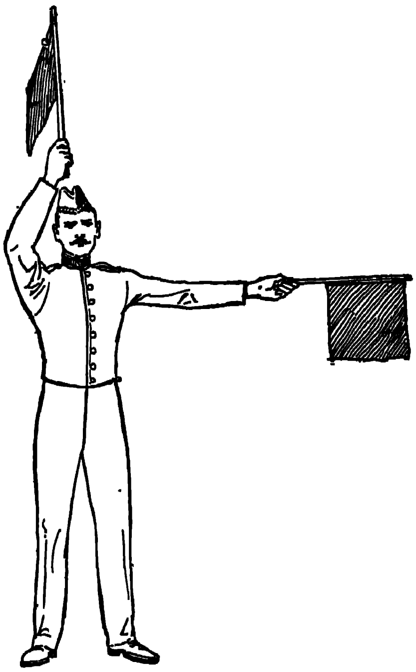

FIG. 3.—Semaphore System: letter J.

be seen at a much greater distance. The latter under similar conditions is visible from 3 to 4 miles. To form the dot and dash the flag is waved in a short or long arc, the latter being regulated to three times the length of the former. The heliograph, as its name implies, can only be used in conjunction with the sun (Figs. 5, 6). It consists of a circular movable mirror, generally 5 inches or 3 inches in diameter, so arranged that it may reflect the rays of the sun on and off a distant station. The dot and dash are formed by the length of time the rays are allowed to

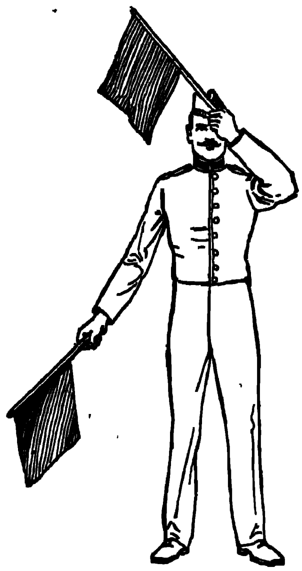

FIG. 4.—Semaphore System: letter I.

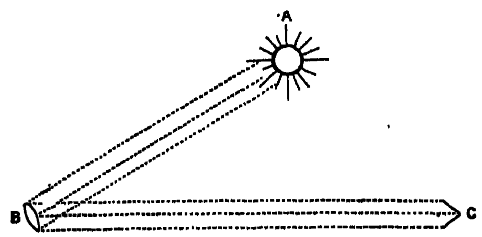

FIG. 5.—The Heliograph. A, the sun; B, signalling mirror; C, distant station.

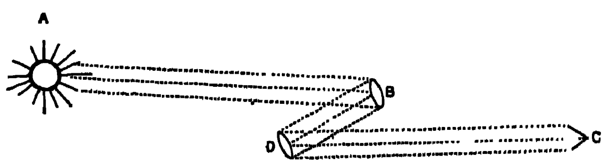

FIG. 6.—The Heliograph. A, the sun; B, signalling mirror; C, distant station; D, duplex mirror.

remain on the station. When the sun makes an angle of more than 120 degrees with the mirror and the station, a duplex mirror is employed, the sun rays being collected on the signalling mirror, thence reflected on to the duplex mirror, and from there again to the station required. Three kinds of lamp are used for signalling by night:—(1) the ordinary hand-lamp, which is an enlarged bull's eye burning colza or other vegetable oil, with a shutter for exposing and obscuring the light, visible 3 to 4 miles; (2) the Begbie, made in three sizes, burning kerosene oil and visible with glasses 10, 20, and 40 miles respectively—these are principally used in India; (3) the limelight

apparatus, visible 10 to 15 miles or more according to atmospheric conditions. The semaphore system is used for comparatively short distances. It is simpler and more rapid than the Morse system, but is only adapted for use during the day. Two small flags are employed, and the letters of the alphabet are formed by the positions in which they are held.

In every regiment of cavalry on the higher establishment there are 4 signallers per squadron; those on the lower establishment, household regiments, and regiments abroad, have 3 per squadron; and there are at least 2 supernumeraries per service squadron. In the royal garrison artillery there are 4 signallers per company, and 3 per mountain battery. In the infantry there are 6 signallers per battalion, and at least 1 supernumerary per company. In addition to the above, 1 officer is appointed as instructor and 1 non-commissioned officer as assistant-instructor, both of whom should hold certificates from one of the schools of instruction. Signallers are inspected annually, and are required to send, transmit, and read messages accurately at a rate of not less than 6 words a minute. Those who qualify receive 15s. each and the right to wear a badge until the following year's inspection. Signallers employed in the field may be combined to form either brigade or special signalling companies. The former consist of men drawn from regiments on the spot, and may contain any available number under an officer. A special signalling company is an independent unit of an army corps; it may be mounted or dismounted, and the signallers are taken from regiments not in the field.

Signalling is used on most campaigns to a large extent. In the Tirah expedition, 1897 and 1898, one signal station received and sent, between the 1st and 18th November, as many as 980 messages by heliograph, some of which were 200 to 300 words in length. It is often used as an auxiliary to the field telegraph, especially in mountainous countries, and when the wire is liable to be cut and stolen by hostile natives. In the Waziri expedition, 1881, communication was maintained direct for a distance of 70 miles with a 5-inch heliograph. In the Boer war, 1899–1902, the system of heliographic signalling was employed very extensively by both sides.

The electric search-light is occasionally used for signalling purposes; and when the intervening ground intercepts the light, the rays are projected on to a cloud, and thence read by the distant station. (G. A. BR.)

Signals (Naval).—A system of naval signals comprises different methods of conveying orders or information between ships or with the shore by signs. In the British navy, which serves as a model to most others, visual signals are made with flags or pendants, the semaphore, flashing, and occasionally fireworks. Sound signals are made with fog-horns, steam-whistles, sirens, and guns. The number of flags in use in the naval code, comprising what is termed a "set," are 58, and consist of 26 alphabetical flags, 10 numeral flags, 16 pendants, and 6 special flags. Flag signals are divided into three classes, to each of which is allotted a separate book. One class consists of two alphabetical flags, and refers to orders usual in the administration of a squadron, such as, for example, the flags LE, which might signify "Captain repair on board flagship." Another class consists of three alphabetical flags, which refer to a coded dictionary, wherein are words and short sentences likely to be required. The remaining refers to evolutionary orders for manœuvring, which have alphabetical and numeral flags combined. The flags which constitute a signal are termed a "hoist." One or more hoists may be made at the same time. Although flag signalling is a slow method compared with others, a fair rate can be attained with practice. For example, a signal involving 162 separate hoists has been repeated at sight by 13 ships in company in 76 minutes. Semaphore signals are made by the extension of a man's arms through a vertical plane, the different symbols being distinguished by the relative positions of the arms, which are never less than 45° apart. To render the signals more conspicuous the signaller usually holds a small flag on a stick in each hand, but all ships are fitted with mechanical semaphores, which can be worked by one man, and are visible several miles. Flag signalling being comparatively slow and laborious, the ordinary message work in a squadron is generally signalled by semaphore. The convenience of this method is enormous, and by way of example it may be of interest to mention a record message of 350 words which was signalled to 21 ships simultaneously at the rate of 17 words per minute. Flags being limited in size, and only distinguishable by their colour, signals by this means are not altogether satisfactory at long distances, even when the wind is suitable. For signalling at long range the British navy employs a semaphore with arms from 9 to 12 feet long mounted at the top of the mast and capable of being trained in any required direction, and worked from the deck. Its range depends upon the clearness of the atmosphere, but instances are on record where a message by this means has been read at 16 to 18 miles.

Night signalling is carried out by means of "flashing," by which is meant the exposure and eclipse of a single light for short and long periods of time, representing the dots and dashes composing the required symbol. The dots and dashes can be made mechanically by an obscuring arrangement, or by electro-mechanical means where magnets do the work, or by simply switching on and off specially manufactured electric lamps. The ordinary rate of signalling by flashing is from 7 to 10 words per minute. In the British navy, as in the army, dots and dashes are short and long exposures of light; but with some nations the dots and dashes are short and long periods of darkness, the light punctuating the spaces between them. The British navy uses the European modification of the so-called Morse code used in telegraphy, but with special signs added suitable to their code. The introduction of the "dot and dash" system into the navy was entirely due to the perseverance of Vice-Admiral Colomb, who, in spite of great opposition, and even after it had once been condemned on its first trial at sea, carried it through with the greatest success. The value of this innovation made in 1867 may be gauged by the fact that now it is possible to handle a fleet with ease and safety in darkness and fog—a state of affairs which did not formerly exist. The simplicity of the dot and dash principle is its best feature. As the system only requires the exhibition of two elements it may be used in a variety of different manners with a minimum of material, namely, by waving the most conspicuous object at hand through short and long arcs, by exhibiting two different shapes, each representing one of the elements, or dipping a lantern in a bucket, and so on. Its adoption has not only contributed very materially to the increased efficiency of the British navy, but it has been made optional for use with the mercantile marine. Curiously enough, flashing is not to any great extent used in foreign navies, who rely more on some system of coloured lights at night. This system generally takes the form of four or five double-coloured lanterns, which are suspended from some part of the mast in a vertical line. Each lantern generally contains a red and a white lamp, either of which can be switched on. By a suitable keyboard on deck any combination of these coloured lanterns can be shown. The advantage of this system lies in the fact that each symbol is self-evident

in its entirety, and does not require an expert signalman to read it, as is the case with flashing, which is a progressive performance.

For long distances at night the search-light, or some other high power electric arc light, is utilized on the flashing system. Dots and dashes are then made either by flashing the light directly on the object, or else waving the beam up and down for short and long periods of time. Sometimes when a convenient cloud is available the reflection of the beam has been read for nearly 40 miles, with land intervening between the two ships. In a fog signals are made by the steam-whistle, fog-horn, siren, or by guns. Except for the latter method the dot and dash system is employed in a similar manner to flashing a light. Guns are sometimes used in a fog for signalling, the signification being determined by certain timed intervals between the discharges. The larger British ships are supplied with telegraph instruments for connexion with the shore, and heliographs are provided for land operations. Marine galvanometers are also provided, and can be used to communicate through submarine cables. To the various methods of naval signalling must be added Signor Marconi's system of wireless telegraphy, which in its application to ships at sea bids fair to solve some problems hitherto impracticable. (See TELEGRAPHY, WIRELESS.)

The international code of signals, for use between ships of all nations, is perhaps the best universal dictionary in existence. By its means mariners can talk with great ease without knowing a word of one another's language. By means of a few flags you can ask any question and make any answer. The number of international flags and pendants used with the international code is 27, consisting of a complete alphabet and a special pendant characteristic of the code. At night flashing may be used. (A. F. E.)

Sigurðsson, Jón (1811–1879), Icelandic statesman and man of letters, was born in the west of Iceland in 1811. He came of an old family, and received an excellent education. In 1830 he was secretary to the bishop of Iceland, the learned Steingrímr Jónsson. In 1833 he went to the university of Copenhagen and devoted himself to the study of Icelandic history and literature. His name soon became prominent in the learned world, and it may safely be said that most of his historical works and his editions of Icelandic classics have never been surpassed for acute criticism and minute painstaking. Of these we may mention *Lögsögumannatal og Lögmanna á Islandi* ("Speakers of the Law and Law-men in Iceland"); his edition of *Landnáma* and other sagas in *Islendinga Sögur*, i.–ii. (Copenhagen, 1843–47); the large collection of Icelandic laws edited by him and Oddgeir Stephensen; and last, not least, the *Diplomatarium Islandicum*, which after his death was continued by others. But although he was one of the greatest scholars Iceland has produced, he was still greater as a politician. The Danish rule had, during the centuries following the Reformation, gradually brought Iceland to the verge of economic ruin; the ancient Parliament of the island, which had degenerated to a mere shadow, had been abolished in 1800; all the revenue of Iceland went into the Danish treasury, and only very small sums were spent for the good of the island; but worst of all was the notorious monopoly which gave away the whole trade of Iceland to a single Danish trading company. This monopoly had been abolished in 1787, and the trade had been declared free to all Danish subjects, but practically the old arrangement was continued under disguised forms. Jón Sigurðsson began a hard struggle against the Danish Government to obtain a reform. In 1854 the trade of Iceland was declared free to all nations. In 1840 the Althing was re-established as an advisory, not as a legislative body. But when Denmark got a free constitution in 1848, which had no legal validity in Iceland, the island felt justified in demanding full home rule. To this the Danish Government was vehemently opposed; it convoked an Icelandic National Assembly in 1851, and brought before that body a Bill granting Iceland small local liberties, but practically incorporating Iceland in Denmark. This Bill was indignantly rejected, and, instigated by Jón Sigurðsson, another was demanded of far more liberal tendencies. The Danish governor-general then dissolved the assembly, but Jón Sigurðsson and all the members with him protested to the king against these unlawful proceedings. The struggle continued with great bitterness on both sides, but gradually the Danish Government was forced to grant many important reforms. High schools were established at Reykjavik, and efforts made to better the trade and farming of the country. In 1871 the Danish Parliament (Riksdag) passed a law defining the political position of Iceland in the Danish monarchy, which, though never recognized as valid by the Icelanders, became *de facto* the base of the political relations of Iceland and Denmark. At last, in 1874, when King Christian IX. visited Iceland at the festival commemorating the millenary of the colonization of Iceland from Norway, he gave to the country a Constitution, with full home rule in all internal matters. An immense victory was gained, entirely due to Jón Sigurðsson, whose high personal qualities had rallied all the nation round him. He was a man of fine appearance, with an eloquence and diplomatic gifts such as no others of his countrymen possessed, and his unselfish love of his country made itself felt in almost every branch of Icelandic life. Recognizing the value of an intellectual centre, he made Reykjavik not only the political, but the spiritual capital of Iceland by removing all the chief institutions of learning to that city; he was the soul of many literary and political societies, and the chief editor of the *Ny Félagsrit*, which has done more than any other Icelandic periodical to promote the cause of civilization and progress in Iceland. After Iceland had got home rule in 1874, the grateful people showered on Jón Sigurðsson all the honours it could bestow. He lived the greater part of his life in Copenhagen, and died there in 1879; but his body, together with that of his wife, Ingibjörg Einarsdóttir, whom he had married in 1845, and who survived him only a few days, was taken to Reykjavik and given a public funeral. On his monument was placed the inscription: "The beloved son of Iceland, her honour, sword, and shield." (S. BL.)

Sikkim, called by Tibetans, Dejong (the rice country), a protected state of India, situated in the eastern Himalaya, between 27° 5′ and 28° 10′ N. and between 88° 4′ and 88° 58′ E. It comprises an area of 2818 square miles of what may be briefly described as the catchment basin of the headwaters of the rivers Tista and Rungit. On the S. and S.E., branches of these rivers form the boundary between Sikkim and British India, while on the W., N., and N.E. Sikkim is separated from Nepal, Tibet, and Bhutan by the range of lofty mountains, which culminate in Kanchinjunga (28,156) and form a kind of horse-shoe, whence dependent spurs project southwards, gradually contracting and lessening in height until they reach the junction of the Rungit and the Tista. Thus the country is split up into a succession of deep valleys surmounted by open plateaux cut off from one another by high and steep ridges, and lies at a very considerable elevation, rising from 1000 feet above sea-level at its southern extremity to 16,000 or 18,000 feet on the

north. The main trade-passes into Tibet, such as the Jelep (14,500), Chola (14,550), and Kangra-lama (16,000), are not nearly so high as those met with in the western Himalaya, while those into Nepal are less than 12,000 feet.

Formerly the area of the state was much more extensive, but in the beginning of the 18th century Bhutan appropriated a large tract of country on the east, while the close of the century saw the Gurkha kingdom of Nepal absorb a much larger slice on the west; on the south the present British district of Darjiling was carved out of the residue at various times from 1835 to 1861. Tibet, moreover, appears to have resumed the Am-mochu valley towards the end of the 19th century.

Physical features. Small though the country is now a wide variation of climate makes it peculiarly interesting. From a naturalist's point of view it can be divided into three zones. The lowest, stretching from 1000 to 5000 feet above sea-level, may be called the tropical zone; thence to 13,000 feet, the upper limit of tree vegetation, the temperate; and above, to the line of perpetual snow, the alpine. Down to about 1880 Sikkim was covered with dense forests, only interrupted where village clearances had bared the slopes for the purposes of cultivation, but at the present time this description does not apply below 6000 feet, the upper limit at which Indian corn ripens; for here, owing to increase of population (particularly the immigration of Nepalese settlers), almost every suitable spot has been cleared for cultivation. The exuberance of its flora may be imagined when it is considered that the total flowering plants and ferns together comprise some 4000 species; there are more than 200 different kinds of ferns, 400 orchids, 20 bamboos, 30 rhododendrons, 30 to 40 primulas, and many other genera are equally profuse; in fact Sikkim contains types of every flora from the tropics to the poles, and probably no other country of equal or even larger extent can present such infinite variety. Butterflies abound and comprise about 600 species, while moths are estimated at 2000. Birds are profusely represented, numbering between 500 and 600 species. Mammals, however, are not numerous, only amounting to 85 different kinds. Reptiles, though existent in some variety, are not commonly met with, and fatal cases of snake-bite are almost unknown. Copper and lime are the chief minerals found and worked in Sikkim, but they are of little commercial value at present.

Government and population. The population is essentially agricultural, each family living in a house on its own land: there are no towns or villages, and the only collection of houses, outside the Lachen and Lachung valleys, are the few that have sprung up round country market-places, such as Rhenock, Dikkeling, and Gantok; but in the above-mentioned valleys the inhabitants, who are Bhutanese in origin and herdsmen in occupation, have large clusters of well-built houses at various altitudes up the valleys, which they occupy in rotation according to the season of the year.

The seat of government, or in other words the palace of the Raja, was, until the irruption of the Nepalese, situated at Rubdentze, in the western centre of the state; but when that place was taken and destroyed by the Ghurkhas, a new palace was built at Tumlong, close to the eastern and Tibetan boundary, while a subsidiary summer residence was erected on the other side of the Chola range at Chumbi, in the Am-mochu valley. At the present time the Raja and his court remain in the more open country at Gantok, where the British political officer and a small detachment of native troops are also stationed.

The earliest inhabitants of Sikkim were the Rong-pa (ravine folk), better known as the Lepchas, probably a tribe of Indo-Chinese origin; but when or how they migrated to Sikkim is unknown. The reigning family, however, is Tibetan, and claims descent from one of the Gyalpos or princelings of eastern Chinese Tibet; their ancestors in course of several generations found their way westwards to Lhasa and Sakya, and thence down the Am-mochu valley: finally, about the year 1604, Penchoo Namygé was born at Gantok, and in 1641, with the aid of Lha-tsan Lama and two other priests of the Duk-pa or Red-hat sect of Tibet, overcame the Lepcha chiefs, who had been warring among themselves, established a firm government and introduced Buddhist Lamaism as a state religion. His son, Tensung Namgyé, very largely extended his kingdom, but much of it was lost in the succeeding reign of Chak-dor Namgyé (1700–17), who is credited with having designed the alphabet now in use among the Lepchas.

History. Between 1776 and 1792 Sikkim was constantly at war with the victorious Ghurkhas, who were, however, driven out of part of their conquests by the Chinese in 1792; but it was not until 1816 that the bulk of what is known to us as Sikkim was restored by the British, after the defeat of the Nepalese by General Ochterlony.

The British resumed the whole of the plains (Terai) and the outer hills, as punishment for repeated insults and injuries caused by the rulers of Sikkim, who had become wholly pro-Tibetan in feeling and policy. Matters grew so bad that in 1886 the Raja Tho-tub Mamgyé refused to carry out his obligations under the treaty of 1861, and defiantly persisted in living in Tibet; his administration was neglected, his subjects oppressed, and a force of Tibetan soldiers was allowed, and even encouraged, to seize the road and to erect a fort within sight of Darjiling. After months of useless remonstrance, the Government was forced in 1888 to send an expedition, which drove the Tibetans back over the Jelep pass. A convention was then concluded with China in 1890 whereby the British protectorate over Sikkim was acknowledged and the boundary of the state defined; to this was added a supplemental agreement relating to trade and domestic matters, which was signed in 1893. Since that time the government has been a semi-independent one under the Maharaja, assisted by a council of seven or eight of his leading subjects, and guided by a resident British officer. Crime, of which there is little, is punished under local laws administered by local kazis or petty chiefs.

Statistics. No trustworthy census has ever been taken in Sikkim; prior to 1886 the population was put down at between 7000 and 10,000, but in 1891 a rough enumeration gave a population of 30,500; of this number 5800 were Lepchas, 5000 Bhuteas or Tibetans, 12,000 Limbus, Gurungs, Murmis, and other hillmen more or less allied to one another, and in religion Hindu tainted with Lamaism, while the balance was made up of pure Nepalese. The census of 1901 gave a population or 59,242.

The state religion is Buddhism as practised in Tibet, but is not confined to one particular sect; while among the heterogeneous population of Sikkim all manner of religious cults can be found. Education is at a low ebb, though the monasteries are supposed to maintain schools, and missionary enterprise has established others.

The revenue of Sikkim has under British guidance increased from Rs.20,000 a year to nearly Rs.3,50,000, derived chiefly from a land and poll tax, excise, and sale of timber; the chief expenditure is in the maintenance of the state, which practically means the Raja's family, as there are no soldiers and no police; and also in the improvement of communication. The country can now boast a very complete system of mountain roads, bridged and open to animal (but not cart) traffic. British trade with Central Tibet is carried over the Jelep route, on the south-eastern border of Sikkim, and in 1898 amounted to 21½ lakhs in exports and imports, but in 1901 it did not exceed 13 lakhs, though to this another 4½ lakhs must be added for the Bengal–Sikkim trade.

Rajas of Sikkim (Dejong-Gyalpo): Penchoo Namygé (1641–70), Tensung Namgyé (1670–1700), Chak-dor Namgyé (1700–17), Gyur-mé Namgyé (1717–34), Penchoo Namgyé (1734–80), Tenzing Namgyé (1780–90), Cho-phoe Namgyé (1790–1861), Sikhyong Namgyé (1861–74), Tho-tub Namgyé, 1861, the present Maharaja.

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SILCHAR, a town of British India, in the Cachar district of Assam, of which it is the headquarters; situated in 24° 49′ N. and 92° 51′ E., on the left bank of the river Barak, with a railway station; 271 miles north of Chittagong. Population (1881), 6567; (1891), 7523; municipal income (1897–98), Rs.19,721; incidence of taxation, R.1.5.6; death-rate (1897), 65·53 per thousand. Silchar is the centre of an important tea industry. The military cantonment had 336 men in 1898. Silchar is the headquarters of the volunteer corps known as the Surma Valley Light Horse. The Government high school had 185 pupils in 1896–97, and there is a law class and an unaided school for girls. A branch railway (19 miles) from Badarpur, the terminus of the Assam–Bengal line, was opened in November 1898.

SILCHESTER, a parish of Hampshire, England, lying half-way between Reading and Basingstoke. It has become one of the most interesting sites for archæological excavation. Here, on a hill with a wide prospect east and south and west, is an open space of 100 acres, in shape an irregular hexagon, enclosed, in a circuit of a mile and a half, by the massive ruins of a city wall, still standing here and there some twenty feet high (Fig. 1). Outside, on the east, is the grassy hollow of a tiny amphitheatre; on the west a line of earthworks runs in wider circuit than the walls. The area within the walls is a vast expanse of cultivated land,

unbroken by any vestige of antiquity; yet the soil is thick with tile and potsherd, and in hot summers the unevenly growing corn reveals the remains of streets and houses close beneath the surface. This is the Romano-British town Calleva Atrebatum. Ptolemy and the Itinerary tell us its name; of its history nothing is known; its character has been disclosed for us by the spade.

Casual excavations were made here in 1744 and 1833; more systematic ones intermittently between 1864 and 1884 by the Rev. J. G. Joyce and others; finally, in May 1890, the complete uncovering of the whole site was commenced by Mr G. E. Fox and others, with the aid of the London Society of Antiquaries. The work was carried on with splendid perseverance, and in 1902 was three-quarters finished. The chief results concern the buildings of the town. Though these have vanished wholly from the surface, the foundations and lowest courses of their walls survive fairly perfect below ground: thus the plan of the town can be minutely recovered, and evidence accumulates on two points—the character of the buildings which made up a town like Calleva, and the character of Romano-British buildings generally. On the other hand, little that is new has been learnt either as to the history of the place or as to that wide topic, the smaller details of ancient life; for instance, the developments of Roman provincial pottery have received scanty illustration. This is partly because Silchester has yielded few small objects of note, partly because its remains do not usually lie in strata which can be dated, and partly because the excavators have concentrated themselves on plans of buildings. Of these buildings the chief are:—

(1) *Forum.*—Near the middle of the town was a rectangular block, covering two acres. It comprised a central open court, 132 feet by 140 feet in size, surrounded on three sides by a corridor or cloister, with rooms opening on to the cloister (Fig. 2). On the fourth side was a great hall, with rooms opening into it from behind. This hall was 270 feet long and 58 feet wide; two rows of Corinthian columns supported the roof, which may have stood 50 or 60 feet above the floor; the walls were frescoed or lined with marble, and for ornament there was probably a statue or two. Finally, a corridor ran round outside the whole block. This was the Forum where the local authorities had their offices, justice was administered, traders trafficked, citizens and idlers assembled. We cannot apportion the rooms to their precise uses, but the great hall was plainly the Basilica, for meetings and business; the rooms behind it were perhaps law courts, and some of the rooms on the other three sides may have been shops. Similar municipal buildings existed in most towns of the western Empire, whether they were full municipalities or (as probably Calleva was) of lower rank. The Callevan Forum seems in general simpler than others, but its Basilica is remarkably large. Probably the British climate compelled more indoor life than the sunnier south. Many Fora have been examined in other provinces; this is the only instance adequately excavated in Britain.

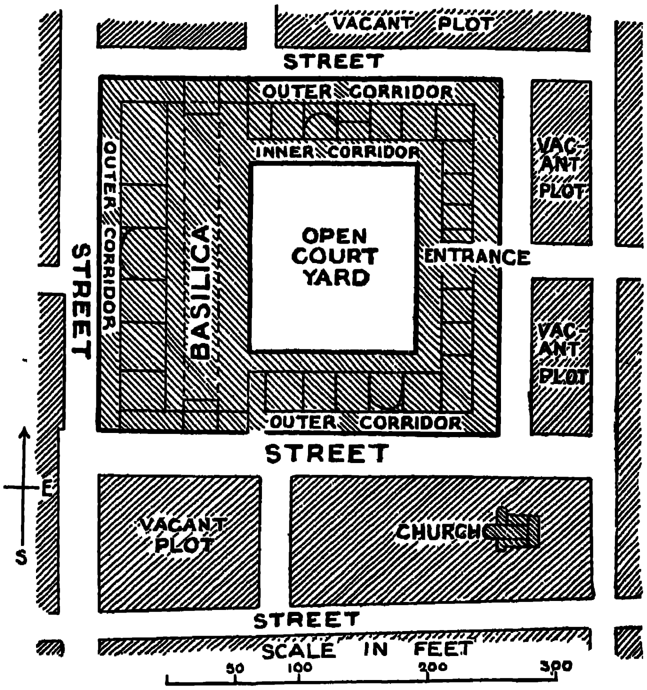

Fig. 2.—Plan of Forum, Basilica, and Surroundings.

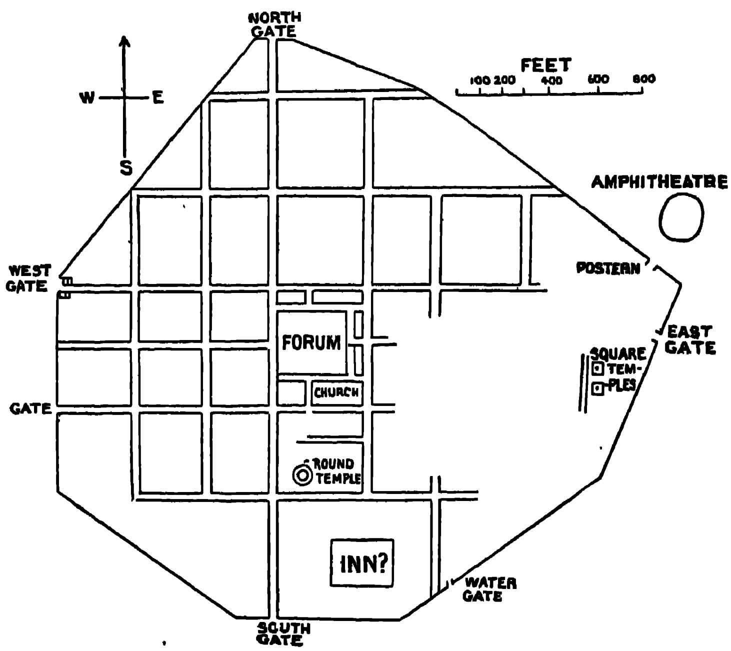

Fig. 1.—General Plan.

(2) *Temples.*—Two small square temples were in the east of the town; the cella of the larger measured 42 feet square, and was lined with Purbeck marble. A third, circular, temple stood between the Forum and the south gate.

(3) *Church.*—Close outside the south-east angle of the Forum was a small edifice, 42 feet long by 27 feet wide, consisting of a nave and two aisles, which ended at the east in a porch of the width of the building, and at the west in an apse and two flanking chambers (Fig. 3). The nave and porch were floored with plain red tesseræ: in the apse was a simple mosaic panel in red, black, and white. Round the building was a yard, and in it a well near the apse, and a small structure of tile with a pit near the east end. No direct indication of date or use was discovered. But the ground plan is that of an early Christian church of the "basilican" type. This type comprised nave and aisles, ending in an apse and two chambers resembling rudimentary transepts, and having at the other end a porch (*narthex*). Previous to A.D. 420 the porch was often at the east end and the apse at the west; the altar, often movable, stood in the apse—at Silchester perhaps on the mosaic panel. A court enclosed the whole; near the porch was a laver (*cantharus*) for the ablutions of intending worshippers.

Several such churches have been found abroad, especially in Roman Africa; no other satisfactory instance is known in Britain.

(4) *Private Houses.*—The private houses of Silchester are of two types. They consist either of a row of rooms,

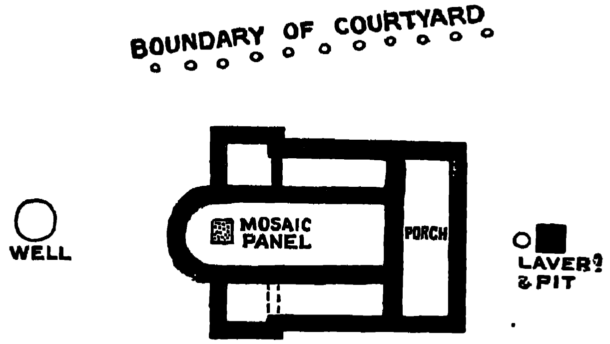

FIG. 3.—Plan of Christian Church.

with a corridor along them, and perhaps one or two additional rooms at the ends; or of three such corridors and rows of rooms, forming three sides of a large square yard. They are necessarily detached houses, standing each in its own garden. The country houses of Roman Britain have long been recognized as embodying these (or allied) types; now it becomes plain that they are the normal types throughout Britain. They differ widely from the town houses of Rome and Pompeii: they are less unlike some country houses of Italy and Roman Africa; but their real parallels occur in Gaul, and they may be Celtic types modified to Roman use, like Indian bungalows. Their internal fittings—hypocausts, frescoes, mosaics—are everywhere Roman; those at Silchester are average specimens

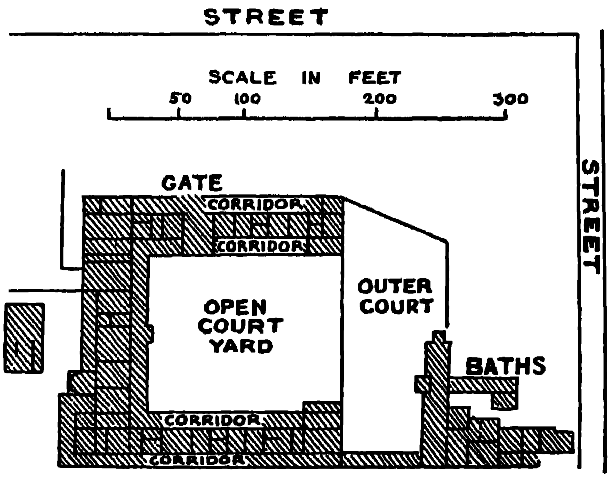

FIG. 4.—Plan of Supposed Inn and Baths.

and, except for one mosaic, not individually striking. The largest Silchester house, with a special annexe for baths, is usually taken to be a guest-house or hotel for travellers between London and the west (Fig. 4). Altogether, the town probably did not contain more than seventy or eighty houses of any size, and large spaces were hardly built over at all.

(5) *Industries.*—Shops are conjectured in the Forum and elsewhere, but were not numerous. Remains of dyers' furnaces, of a little silver refinery, and perhaps of a bakery have been noted.

(6) *Streets, &c.*—The streets were paved with gravel: they varied in width up to 28½ feet. They intersect regularly at right angles, dividing the town into square blocks, like Mannheim or Turin: plainly they were laid out all at once, possibly by Agricola (*Tac. Agr.* 21), possibly later. There are four principal gates: the eastern and western gates are not exactly opposite. The walls are constructed of flint, "bonded" with stone, and backed with earth; they have no external bastions or towers. In the plans (but not in the text) of the excavators' reports they are shown as erected subsequent to the streets.

No traces of theatre, meat-market, public baths, or aqueduct have been found; water was got from wells lined with wooden tubs, and must have been scanty in dry summers. Smaller objects—pottery, coins, window and bottle glass, bronze ornaments, iron tools, &c.—abound, but few pieces are individually notable. The most important feature is the absence of "Late Celtic" artistic traditions and the dominion of Roman fashions: with which we may join the fact, proved by inscriptions, that even the lower classes spoke Latin. The old tribal centre of the Atrebates had become a Romanized country town. Such, sometimes larger, more often smaller, were (we may think) the country towns which sheltered most of the town life in Roman Britain.

See *Archæologia*, xl., xlvi., lii., and following vols.; *Victoria History of Hampshire*, i. 271, 350. Reading Museum has a rich collection of objects, models, &c. (F. J. H.)

Silesia, Austrian (German, *Oesterriechisch-Schlesien*), a duchy and crownland of the cis-Leithan part of the Austro-Hungarian monarchy. Population in 1890, 605,649; in 1900, 680,529, equivalent to 342·5 per square mile. In some parts of this crownland, next to Lower Austria the most densely populated of the monarchy, there are 1000 inhabitants per square mile. The proportion of females to males in 1890 was 1096 to 1000; 48 per cent. German, 30 per cent. Poles, and 22 per cent. Czechs; 84·4 per cent. Roman Catholics, 13·91 per cent. Protestants, and 1·65 per cent. Jews. In 1897 the marriage-rate was 8·49, the birth-rate 39·9, or excluding still-births, 38·8, and the death-rate 27·16 per thousand. Of the births 10·6 per cent. were illegitimate.

Austrian Silesia sends 12 members to the Reichsrath, of whom 2 are returned by the new universal suffrage curia (9 German Opposition, 1 Pan-Germanic, 1 Social Democrat, and 1 Pole). The Diet is composed of 25 Germans, 3 Czechs, and 3 Poles.

There are 9 gymnasia and *real* gymnasia, a Protestant theological seminary, 15 technical agricultural and other schools, 10 intermediate and 505 public elementary schools (220 German, 116 Czech, 139 Polish, 30 mixed, &c.). In 1890 the proportion of illiterates was 8·7 per cent., a reduction of 3·1 per cent. in the preceding decade. Of the 49 periodicals published, 34 are German, 9 Polish, 5 Czech, and 1 Italian.

Since 1885 there has been a diminution of 7 per cent. in the proportion engaged in agricultural and forestry, now 41·25 per cent., and an increase of 15 per cent. in the proportion engaged in mining and industry (42·12 per cent.). This has been accompanied by comparatively little change in the nature either of the agricultural or industrial production. The mountainous parts are largely devoted to dairy-farming, the breeding of sheep, geese, and pigeons, hunting and fishing being also important resources. The coal-mines furnish some 5½ million tons annually, equivalent to 41½ per cent. of the entire Austrian product. With the exception of a small quantity of lignite, it is the only mineral produced. The staple textile, iron and steel industries flourish. There were in 1899, 357 miles of railway, 2303 miles of roads, and 17 miles of waterway. There were 183 post and 73 telegraph offices, with 761 miles of line and 2270 miles of wire.

The political life of the province turns upon the efforts of the Poles and Czechs to secure increased educational facilities in their own languages, in which they are encouraged by their compatriots in the adjoining provinces, and upon the occasional explosions of the chronic discontent of the mining and industrial population.

See PETER. *Das Herzogthum Schlesien.*—SLAMA. *Oesterreichisch Schlesien.* (Æ. O'N.)

Silesia, an eastern province of Prussia, with an area of 15,566 square miles, and population (1895), 4,415,309; (1900), 4,668,857; the largest province of the kingdom in area, and in respect of population the second (after the Rhine province). The density per square mile amounts to 300 persons. The south-eastern extremity of the province contains one of the principal coal-fields of the Prussian monarchy, and is the centre of the zinc-mining industry of Germany. In 1900 the mines yielded 29,596,750 tons (in 1881, 16,220 tons) of coal, valued at £11,420,500; 802,500 tons of lignite, valued at £150,750; 437,370 tons of iron-ore, valued at £142,400; 521,570 tons of zinc, valued at £774,350; 39,575 tons of lead, valued at £214,900; and 7280 tons of iron pyrites, valued at £3450. In 1900 the number of workmen employed in the coal-mines was 93,286, in the other mines about 15,600. The smelting furnaces yielded 742,820 tons of iron, valued at £2,493,450; 102,130 tons of zinc, valued at £1,984,400; 24,925 tons of lead, valued at £424,200; 286,250 oz. of silver, valued at £46,050; and 84,415 tons of sulphuric acid, valued at £116,400. The iron foundries, forges, &c., had an output of 681,900 tons of pig iron, iron bars, rails, &c., of the aggregate value of £5,177,550. In 1900 the live stock included 1,526,987 cattle, 951,577 pigs, 398,049 sheep, and 319,857 horses. In the same year 130 tons of tobacco were gathered off 250 acres of ground. In 1900 the sugar refineries and factories produced 238,650 tons of sugar; the breweries, 77,945,000 gallons of beer; and the distilleries, 10,985,950 gallons of pure alcohol. (For further particulars, see under PRUSSIA).

Silistria, an ancient fortified town, chief town of a department of Bulgaria, on a peninsula of low ground projecting into the Danube, 60 miles below Rustchuk. There are extensive vineyards in the neighbourhood, and tobacco is also cultivated. The town possesses flour-mills, cloth factories, and tanneries, and has a considerable trade in wine, corn, and wood. Population (1892), 11,718; (1900), 12,133.

Silver.—From the metallurgical point of view, silver ores may be classified as real silver ores and argentiferous ores. The former consist of silver minerals and gangue (vein matter, country-rock). The leading silver minerals are native silver, Ag; cerargyrite, AgCl; argentite, Ag_2S; proustite, $3Ag_2S+As_2S_3$; pyrargyrite, $3Ag_2S+Sb_2S_3$; dolybasite, $9Ag_2S+As_2S_3$; and stephanite, $5Ag_2S+Sb_2S_3$. The silver is commonly recovered by milling, *i.e.*, amalgamation or lixiviation. Argentiferous ores consist of silver-bearing base-metal minerals and gangue. Lead and copper ores, carrying silver in some form or other, are the leading representatives. The silver is extracted from the gangue with the base metal, usually by smelting, and the two are then separated by special processes (see LEAD; COPPER). Milling is cheaper than smelting, but the yield in silver is lower. Often it is more profitable to smelt real silver ores with argentiferous ores than to mill them, the greater cost being more than balanced by the increased yield. Milling is practised mainly in isolated localities near the mine producing the ore. As any given region is opened up by railways, cheapening transportation, milling is apt to give way to smelting. Thus on the American continent, which produces the bulk of the world's silver, milling is still prominent in South America and Mexico, while in the United States it has to a considerable extent been replaced by smelting.

Amalgamation is based on the property of quicksilver to extract the silver from finely-pulverized ore and collect it in the form of an amalgam. When the rock has been separated from the amalgam by a washing operation, the quicksilver is recovered by distillation in an iron retort, and the remaining crude retort-silver melted into bars and shipped to a refinery, which removes the impurities, the leading one of which is copper. A silver ore is either free-milling or refractory, that is, the silver mineral is readily amalgamated or it is not. In free-milling ore the silver is present either in the native state, or as chloride or as simple sulphide. Complex silver minerals (sulph-arsenides and antimonides) which are difficult to amalgamate must be made amenable to quicksilver, and the simplest way of doing this is to convert the silver into chloride. This is imperfectly accomplished, in the wet way, by cupric and cuprous chloride solutions, but completely so, in the dry way, by roasting with salt (chlorodizing roasting). According as a preliminary chlorodizing roast has or has not been given, the process is classed as roast-amalgamation or raw-amalgamation. The leading raw-amalgamation processes are the Patio and Washoe; then follow the Cazo, Fondon, and Kröhnke; of the roast-amalgamation processes, the European Barrel or Freiberg, the Reese River, and the Franck-Tina are the most important.

The *Patio* process (for an outline of which see *Ency. Brit.* vol. xxii. p. 70) is carried out principally in Mexico. It aims at amalgamating the silver in the open in a circular enclosure, the floor of which is generally built of flagstones. In order to facilitate the decomposition of the silver-mineral, salt and magistral are worked into the wet pulp spread out on the floor. Magistral is cupriferous pyrites roasted to convert the copper into soluble sulphate, which is the active agent. The amalgamation proceeds very slowly, as the sole extraneous heat is that of the sun. According to Laur, at Guanaxuato, Mexico, 92·77 per cent. of the total silver recovered was extracted after 12 days, 97·55 per cent. after 25 days, 99·70 per cent. after 28 days, and 100 per cent. after 33 days. The loss of quicksilver in the process is large, owing to the formation of calomel which is not saved. The yield in silver is low unless the ores are exceptionally free-milling; the bullion produced is high-grade, as refractory silver minerals are hardly attacked. The process is suited to easy ores and a region where the climate is warm and dry, and horse- or mule-power, labour, and quicksilver are cheaper than fuel and water.

The *Washoe* process is the leading raw-amalgamation process of the United States, where it was invented in 1859 by A. B. Paul. It consists in wet-stamping coarsely crushed ore, settling the sands and slimes produced, and grinding and amalgamating them in steam-heated iron pans with or without the use of chemicals (salt and blue vitriol). The ores may contain a larger proportion of sulphurets and complex silver minerals than with the Patio process and still give a satisfactory extraction. They are crushed to egg-size in a rock-breaker, and pulverized to pass a 40-mesh sieve in a California stamp-mill, which treats in 24 hours about 3 tons per stamp. A 10-stamp mill is fed by one rock-breaker, and discharges the liquid pulp into 10–15 wooden settling tanks, 9 by 5 by 8 feet, the settled contents of which are shovelled out and charged into the pans. The pan in general use is the combination pan. It has a flat cast-iron bottom, 5 feet in diameter, and wooden sides about 30 inches high, the lower parts of which are lined with cast iron. In the centre is a hollow cone, through which passes the driving shaft, geared from below. This turns the grinding apparatus (driver with muller), which can be raised and lowered. The speed is 60–90 revolutions per minute. To the bottom and muller are attached grinding plates (shoes and dies), which are replaced when worn; and to the sides three wings, to deflect the moving pulp towards the centre, and thus establish the necessary pulp current. The lower side of the bottom has also a steam-chest. A 10-stamp mill has 4–6 pans, which receive 2-ton charges. In working, the muller is raised half an inch, the pan charged with water and then with ore, the muller is lowered, salt and blue vitriol are added, and the charge ground for 3–4 hours. The pulp is heated with live steam to about 90° C., and kept at that temperature by exhaust steam in the bottom-chest. After grinding, the muller is raised and quicksilver added, and the silver then amalgamated in 3–4 hours. In amalgamating without the use of chemicals, finely divided iron, worn from the shoes and dies in the stamp-mill and the pan, decomposes cerargyrite and argentite, and the liberated silver is taken up by the quicksilver; the process is hastened by adding salt. When salt and blue vitriol are added to the charge, they form sodium sulphate and cupric chloride ($2NaCl+CuSO_4=Na_2SO_4+CuCl_2$), both of which are readily soluble in water. Cupric chloride acts upon argentite ($Ag_2S+CuCl_2=2AgCl+CuS$), proustite ($4Ag_3AsS_3+12CuCl_2=$

$8AgCl, 2Ag_2S, 2CuS, As_2S_3, 5S$), pyrargyrite ($2Ag_3SbS_3 + 4CuCl = 6AgCl + 2CuS + Sb_2S_3 + S$), and is also reduced to cuprous chloride by metallic iron ($2CuCl_2 + Fe = Cu_2Cl_2 + FeCl_2$). This salt, insoluble in water but soluble in brine, also acts upon argentite ($Ag_2S + Cu_2Cl_2 = 2AgCl + CuS + Cu$) and pyrargyrite ($2Ag_3SbS_3 + Cu_2Cl_2 = AgCl + Ag_2S + 2Ag + 2CuS + Sb_2S_3$), and would give with silver sulphide in the presence of quicksilver, the Patio-reaction: metallic silver, cupric sulphide, and mercurous chloride ($2Ag_2S + Cu_2Cl_2 + Hg = 4Ag + 2CuS + Hg_2Cl_2$), but the iron decomposes the quicksilver salt ($Hg_2Cl_2 + Fe = Hg_2 + FeCl_2$), setting free the quicksilver. The amalgamation is rapid. Thus Austin found that at the Charleston mills, Arizona, 92·13 per cent. of the total silver recovered was extracted after 1 hour, 94·10 per cent. after 2 hours, 95·92 per cent. after 3 hours, and 100 per cent. after 4 hours. The loss in quicksilver is small, as there is no chemical loss inherent in the process; the yield is relatively high, but the bullion is liable to be low-grade, on account of copper being precipitated and amalgamated. When the charge has been worked, the contents of the pan are discharged into a settler, in which the amalgam is separated from the sands. It has the same general construction as the pan. It is 8 feet in diameter and 3 feet deep. The bottom, slightly conical, has a groove near the circumference to catch the amalgam, which is withdrawn through a discharge-spout into a bowl. In the sides at different levels are three discharge-holes for water and sand. The muller reaches to within three inches of the bottom and makes 12–15 revolutions per minute. In settling, the pulp is diluted by a small stream of water, and the thinned pulp drawn off, first through the top discharge-hole and then through the other two, the bottom one being about 8 inches above the amalgam. Settling takes about half the time required to work a charge in the pan, hence one settler serves two pans. The amalgam is dipped out from the bowl into a canvas bag (the strainer), to separate the excess of the quicksilver from the pasty amalgam, which is then retorted and melted. The cost of treating a ton of ore in the western part of the United States is from \$3 to \$7. At some works treating ores containing sulphurets which do not yield their silver to quicksilver, concentration apparatus (see ORE-DRESSING) is inserted between the stamps and the settling tanks to remove the sulphurets, which are worked by themselves; at other works they are recovered from the sands after these have left the settlers. In order to do away with the handling of the wet pulp, and to obtain a higher extraction, M. P. Boss has modified the ordinary plant by making the pulp flowing from the stamps pass through a grinding pan, then through a series of amalgamating pans followed by a row of settlers.

A 20-stamp mill is served by 12 men in 24 hours. The Washoe process is independent of the climate, but it requires cheap power and an abundance of water.

In the *Cazo, Caldron*, or *Hot* process the pulverized silver ore is boiled in a copper-bottomed wooden vat, first with brine until the silver has been reduced by the copper, and then with quicksilver. The *Fondon* is an improvement on the Cazo. Bars of copper drawn over the bottom by mules or water-power (like the stone drags in the arrastra) grind off fine particles of copper, which hasten the reduction of the silver and diminish the formation of calomel. In the *Kröhnke* process the silver mineral of the pulverized ore is decomposed in a revolving barrel by a hot solution of cuprous chloride in brine in the presence of zinc or lead and quicksilver.

Chlorodizing Roasting. — In a chlorodizing roast chlorine produces its effect as nascent chlorine or gaseous hydrochloric acid. The leading reagents are salt (NaCl), sulphur trioxide (SO_3, produced in the roasting), and water vapour (H_2O). The decomposition of salt is expressed by $2NaCl + 2SO_3 = Na_2SO_4 + SO_2 + Cl_2$. In the presence of water-vapour the following reaction takes place: $2NaCl + SO_3 + H_2O = Na_2SO_4 + 2HCl$. As some water-vapour is always present, hydrochloric acid will invariably be formed with the chlorine. The roasting is carried on in hand and mechanical reverberatory furnaces, occasionally in muffle-furnaces. A chloridation of over 90 per cent. silver is the rule.

The *European Barrel or Freiberg* process (see *Ency. Brit.* vol. xxii. p. 70), perfected at Freiberg, Saxony, was abandoned there in 1856. In the United States it was used quite extensively in Colorado and Nevada, but has now been given up. The main reasons for this are the length of time required to finish a charge, on account of the absence of any extraneous source of heat, and the great care with which operations have to be carried out in order to obtain satisfactory results. The *Reese River* process consists in dry-stamping crushed dried ore and dried salt (separately or together), charging them into a roasting furnace, and amalgamating the chlorodized ore in an iron pan. The general arrangement and construction of a mill resemble those of the Washoe process. The apparatus for drying ore and salt varies greatly, drying-floors, dry-kilns, and continuous mechanical reverberatory furnaces with stationary and revolving hearths being used. The general construction of the pan is the same as in the Washoe process; the management, however, differs. The steam-chest is not used to such an extent, as the bottom would be prematurely corroded; less water is used, as the pulp would become too thin on account of the soluble salts (sodium chloride, sulphate, &c.) going into solution; and the roasted ore is not ground, as the hot brine readily dissolves the silver chloride from the porous ore, and thus brings it into intimate contact with iron and quicksilver. Chemical reagents are sometimes added—lime or sulphuric acid, to neutralize an excess of acid or alkali; bluestone, to form cuprous chloride with sodium chloride; and iron and zinc, to make the galvanic action more energetic and reduce the consumption of iron. The rest of the apparatus (settler, retort, crucible furnace) is the same as with the Washoe process. The Reese River process costs from half as much again to twice as much as the Washoe process.

The *Franck-Tina* process was developed in Bolivia for the treatment of refractory ores rich in zinc blende (ZnS) and tetrahedrite $4(Cu_2, Fe, Zn, Ag_2, Hg_2)S + (Sb, As, Bi)_2S_3$. The ore is given only a partial chlorodizing roast, on account of the great loss in silver that would be caused by the formation of zinc chloride ($ZnCl_2$). The large amount of soluble sulphates of iron and copper formed in the roast is made to act upon salt charged in a copper-bottomed amalgamating pan; the chlorides formed finish in the wet way the imperfect chloridation obtained in the furnace.

Lixiviation.—Ores suited for amalgamation can, as a rule, be successfully leached. In leaching, the silver ore is subjected to the action of solvents, which dissolve the silver; from the solution the silver is precipitated and converted into a marketable product.

The leading solvents are aqueous solutions of hyposulphite salts. Sodium chloride, characteristic of the Augustin process (see *Ency. Brit.* vol. xxii. p. 70), has almost wholly fallen into disuse; and potassium cyanide, which has become a very important solvent for finely divided gold, is rarely used in leaching silver ores. The use of sodium hyposulphite as solvent, and sodium sulphide as precipitant, was proposed in 1850 by Hauch and Percy, and put into practice in 1858 by Patera (*Patera* process); calcium hyposulphite with calcium polysulphide was first used by Kiss in 1860 (*Kiss* process, now obsolete); sodium hyposulphite with calcium polysulphide was adopted about 1880 by Hofmann (*Hofmann* process); finally, sodium hyposulphite with cuprous hyposulphite was first applied by Russell in 1884, who included in his process the acidulation of the first wash-water (to neutralize any harmful alkaline reaction), and the separation of lead with sodium carbonate from the silver solution previous to precipitating with sodium sulphide. In all processes the silver ore is finely crushed, usually by rolls, as, because making few fines, they leave the ore in the best condition for leaching. As a rule the ore is subjected to a preliminary chlorodizing roast, though occasionally it may be leached raw. The vats in common use are circular wooden tanks, 16–20 feet in diameter and 8–9 feet deep if the leached ore is to be removed by sluicing, 5 feet if by shovelling. They have a false bottom, with cloth or gravel filters. The basis of the following outline is the Patera process. The ore, supposed to have been salt-roasted, is charged loosely into the leaching vat and treated with water (to which sulphuric acid or blue vitriol may have been added), to remove soluble salts, which might later on be precipitated with the silver (base-metal chlorides), or overcharge the solution (sodium chloride and sulphate), or interfere with the solvent power (sodium sulphate). The vat is filled with water from above or below, in-and out-flow are then so regulated as to keep the ore covered with water. Any silver dissolved by the first wash-water is recovered by a separate treatment. After the wash-water has been drained off, the ore is ready for the silver solvent. This is a solution containing up to 2 per cent. of sodium hyposulphite ($Na_2S_2O_3 +$ 5 aq.), of which one part dissolves 0·485 parts silver chloride, = 0·365 parts metallic silver ($2AgCl + 3Na_2S_2O_3 = Ag_2S_2O_3, 2Na_2S_2O_3 + 2NaCl$). Silver arsenate and antimoniate are also readily soluble, metallic silver slightly so, silver sulphide not at all. (In the Russell process double salts: $4Na_2S_2O_3 \cdot 3Cu_2S_2O_3$, and $3Na_2S_2O_3$ $3Cu_2S_2O_3$ metallic silver and silver sulphide are readily soluble; thus it supplements that of Patera). After the silver has been dissolved by percolation, the last of the solvent still in contact with the ore is replaced by a second wash-water. The silver solution, collected in a circular precipitating vat (10 feet in diameter and 10 feet deep), is treated with sodium sulphide (or calcium polysulphide), unless sodium carbonate was first added to throw down any lead, present in the ore as sulphate, that had gone into solution. Silver sulphide falls out as a black mud, namely, $2Ag_2S_2O_3 + Na_2S_2 = Ag_2S + Na_4S_2O_6$ and $Na_4S_2O_6 + Na_2S_2 =$

$2Na_2S_2O_3 + 2S$ (or $Ag_2S_2O_3 + CaS_5 = Ag_2S + CaS_2O_3 + S_4$, and in part $CaS_2O_3 + Na_2SO_4 = CaSO_4 + Na_2S_2O_3$), with about 50 per cent. silver, and the solvent will be regenerated. If the sodium cuprous hyposulphite was used as a solvent in addition to the simple sodium hyposulphite, cuprous sulphide will be precipitated with the silver sulphide, and the precipitate will be of lower grade. At some works the silver is precipitated with sodium sulphide, and the liquor, after having been separated from the silver sulphide, is treated with calcium polysulphide, that by the precipitation of calcium sulphate the accumulation of sodium sulphate may be prevented. The precipitated silver (copper) sulphide is filtered, dried, and usually shipped to silver-lead works to be refined; sometimes it is converted into metallic silver at the works. The solution, freed from silver, is used again as solvent. Lixiviation has many advantages over amalgamation. It permits coarser crushing of the ore, the cost of plant is lower, the power required is nominal, the cost of chemicals is lower than that of quicksilver, less water is necessary, and the extraction is often higher, as silver arsenate and antimoniate are readily soluble, while they are not decomposed in amalgamation. On the other hand, silver and silver sulphide are readily amalgamated; and while they are not dissolved in the Patera process, they are in the Russell process.

Statistics.—The world's production of silver in 1900 was, according to *The Mineral Industry*, vol. ix. p. 315, in troy oz.: United States, 59,561,797; Canada, 4,446,505; Mexico, 55,804,420; Central America, 1,446,795; Argentina, 383,561; Bolivia, 10,432,685; Chile, 5,772,791; Colombia, 2,800,000; Ecuador, 81,000; Peru, 6,590,955; Austria, 1,272,022; Hungary, 675,750; France, 466,189; Germany, 6,243,326; Greece, 1,294,917; Italy, 1,081,707; Norway, 154,389; Russia, 163,960; Servia, 18,386; Spain, 5,909,418; Sweden, 73,626; Turkey, 65,363; United Kingdom, 191,927; Dutch East Indies, 1447; Japan, 1,810,375; Australasia, 14,063,244; other countries, 48,226; total, 180,854,781.

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(H. O. H.)

Silves, a town of the district of Faro, Portugal, on the right bank of the Silves, 30 miles west-north-west from Faro. It is surrounded with walls and possesses a castle. Its manufactures include corks and soap. It produces corn, vegetables, and fruits, especially oranges, carob beans, and almonds (all three exported). Pigs are bred, and fishing is carried on in the river and at sea. Alfonso III. wrested Silves from the Moors. Population (1890), 8363; (1900), 9688.

Simbirsk, a government of East Russia, on the right bank of the Middle Volga, with an area of 19,110 square miles. Its geology has been carefully investigated, and it appears that all systems, beginning with the Carboniferous, are represented. The "Variegated Marls," which have been the subject of animated polemics among the Russian geologists, continue to remain problematic as to their exact age, but the thorough inquiries of Professor Pavloff have permitted the geological age of the Jurassic formations to be definitely settled. Triassic deposits appear in the north; Carboniferous and Cretaceous are spread in the eastern part of the province, where they are covered in many places by Tertiary deposits; Chalk and Eocene deposits chiefly crop up in the west, and the Chalk in the south. Post-Pliocene deposits containing bones of the mammoth and other extinct mammals cover the older formations. Sulphur, asphalt, salt, ochre, and iron-ore are extracted, as well as various building stones. The domiciled population, which was estimated at 1,655,500 in 1891, proved to be only 1,549,461 in 1897, when there were 799,660 women, and the urban population numbered 109,175. Nearly all the inhabitants either belong to the Russian Orthodox Church or are Nonconformists, there being only 144,440 Mussulmans. The government is divided into eight districts, the chief towns of which are Simbirsk (43,300), Alatyr (11,086), Ardatoff (4838), Buinsk (4216), Karsuñ (4613), Kurmysh (3484), Senghilei (5735), and Syzrañ (32,377). The number of schools in 1899 was 944, with 39,000 boys and 11,000 girls. School gardens and school farms have been widely introduced, and no fewer than 240 schools were provided with such facilities for practical instruction, while bee culture was taught in 55 schools, and various trades in 14 schools. Owing to the efforts of the *zemstvos* (local councils), sanitation is well looked after, and there are 32 hospitals and 91 infirmaries. Out of a total area of 7,502,500 acres of cultivated land in 1898, the peasant village communities held 4,495,800 acres, private owners 2,330,300 acres, the Imperial domains 602,500 acres, and the towns and the Crown 73,400 acres. In 1898 the forests covered 3,437,000 acres. The peasants are rapidly buying considerable quantities of land. Most of their allotments (more than 76 per cent.) are under fields, and besides what they own they rent 501,500 acres from the private owners. No fewer than 3,483,500 acres were under cereal crops in 1900, and the average yield in 1895–99 was: wheat, 884,000 cwt.; rye, 9,945,000 cwt.; oats, 4,402,000 cwt.; barley, 50,000 cwt.; all cereal crops, 17,436,000 cwt.; also potatoes, 3,311,000 cwt.

In 1898 there were 288,890 horses, 326,000 horned cattle, and 916,820 sheep. Good breeds of horses are kept, and a considerable export trade in them is carried on. Domestic trades give employment to nearly 15,300 persons; carts, sledges, wheels, and all sorts of wooden ware are made in the villages, as also are felt goods, boots, gloves, caps, handkerchiefs, ropes, and fishing-nets, all of which are widely exported. Large establishments, however, are not very numerous; factories, indeed, employ only 18,710 workers, and their aggregate annual returns do not amount to more than 10,640,000 roubles. They mainly comprise wool cloth mills (4,575,000 roubles), flour-mills (18 provided with rollers), and distilleries; there are also tanneries, glass, and starch works. The internal trade is chiefly carried on at 82 fairs, the chief of which are held at Simbirsk, Syzrañ, and Karsuñ. There is a considerable export trade in grain, mostly rye and flour. (P. A. K.)

Simbirsk, the capital of the above government, 576 miles by rail east-south-east of Moscow, between the Volga and the Sviaga, which here closely approach each other. It is one of the best built provincial towns of Russia. It has gymnasia for boys and girls, with a summer sanatorium for the pupils, numbers of other town and industrial schools for boys and girls alike, two public libraries, one of which has 44,000 volumes, three daily papers, a good theatre, and more than the usual number of philanthropic institutions. Its factories are of no importance, but its trade is considerable, especially that connected with its great fair in horses. In 1897 the population was 43,300.

Simla, a town and district of British India, in the Delhi division of the Punjab; the summer residence of the Viceroy and of the staff of the supreme Government. The town is 7075 feet above the sea; 58 miles by cart-road from the railway station of Kalka, which is 1116 miles from Calcutta. Population (1881), 12,258; (1891), 13,836; municipal income (1897–98), Rs.3,22,280; death-rate (1897), 23 per thousand. The sanitarium of Simla occupies a spur of the lower Himalaya, running east and west for about 6 miles. Three miles west is the cantonment of Jutogh. The minor sanitaria of Kasauli, Sabathu, Dagshai, and Solon lie some distance to the south. The hills all round are clothed with rhododendron and deodar. In 1897 the total rainfall was 51 inches, of which 38 inches fell from June to September; the maximum temperature was 82° F. in May, the minimum 32° in December; the prevailing winds are northerly.

Simla is gradually becoming the permanent headquarters of many of the official establishments. A vice-regal lodge, foreign office, secretariat buildings, army headquarters, public works office, and clerks' quarters have been built at imperial expense. The municipality has provided water and sewerage works and a fine town-hall, out of a loan of Rs.8,15,890. There are several hotels and banks. Simla is the headquarters of a volunteer rifle corps, 400 strong. Two breweries have a yearly out-turn of 39,000 gallons, with larger breweries at Kasauli and Solon. There are 11 printing-presses, issuing 5 newspapers and periodicals; and there are numerous libraries and institutes, of which the chief is the United Service Institution, with a subsidy of Rs.3,000 from Government. The Ripon hospital receives Rs.10,000 from endowment and Rs.1,500 from Government. Educational institutions include Bishop Cotton's school for boys, the Mayo industrial school for girls, several aided schools for European boys and girls, and two Anglo-vernacular schools for natives. The Lawrence military asylums are at Sonawar, near Kasauli.

The district of SIMLA has an area of 102 square miles. Population (1891), 44,642; (1901), 40,353; average density, 395 persons per square mile. The land revenue and rates in 1897–98 were Rs.21,151; cultivated area, 13,045 acres, of which 52 were under tea; number of police, 307; number of schools, 41, attended by 1864 boys, being 40 per cent. of the boys of school-going age; death-rate (1897), 22 per thousand. A railway on the metre gauge is under construction from Kalka to Simla, 68 miles, with several tunnels.

Simon, Sir John (1816– ——), English surgeon and sanitary reformer, was born in London 10th October 1816. His father, Louis Michael Simon, was for many years a leading member of the London Stock Exchange. Both his grandfathers were French emigrants, who carried on business in London and Bath respectively. His father died at the advanced age of almost ninety-eight, and his mother, after sixty-seven years of happy wedlock, when she had almost attained ninety-five years of age. Simon was educated at a preparatory school in Pentonville, spent seven years at Dr Burney's school in Greenwich, and then ten months with a German Pfarrer in Rhenish Prussia. His father intended him for surgery, and he began the study of medicine on 1st October 1833, when he was a few days short of seventeen. After the fashion of the time, he became an apprentice of Joseph Henry Green, the distinguished surgeon at St Thomas's, well known for his friendship for Samuel Taylor Coleridge, whose literary executor Green became. He qualified in due course, became a demonstrator of anatomy, and was assistant surgeon to King's College Hospital for several years; and in the autumn of 1847 he was appointed surgeon and lecturer on pathology at his old school, St Thomas's, where, with progressive changes, he continued to remain an officer. His life was divided between two great pursuits—the career of a surgeon, and the mastery and solution of many of the great problems of sanitary science and reform. In the spring of 1844 he gained the first Astley Cooper prize by a physiological essay on the thymus gland, and the following year was elected a fellow of the Royal Society. In 1847 he gave his first lecture at St Thomas's Hospital, on the "Aims and Philosophic Method of Pathological Research"; followed a little later by lectures on general pathology in relation to the principles of diagnosis, and the treatment of disease. These lectures were of great importance at the time, and of the utmost value in directing energy into new and profitable channels of work. Simon published many clinical surgical lectures of the greatest importance, and contributed a masterly article on "Inflammation" to Holmes's *System of Surgery*, which has become a classic of its kind. It was, however, on his appointment in 1848 as medical officer of health to the City of London, and afterwards to the Government, that Simon's great abilities found scope for congenial exercise. His first report to the City Commissioners was characterized by *The Times* of 8th November 1849 as of extraordinary interest, and the ablest, most lucid, and most temperate statement of modern sanitary condition and wants. His work in sanitary science has stimulated and guided its development, until it has reached in England the highest degree of excellence, and affords an example to the civilized world. He himself defined it as "proposing the physical, social, and, indirectly, the moral improvement of what is an immense majority of our fellow creatures. It transcends the importance of all other sciences, and seems in its beneficent operations most nearly to embody the spirit, and to fulfil the intentions, of practical Christianity." It is impossible to overestimate the value of Sir John Simon's work, or the importance of his influence in the furtherance of the public health, and the prevention of disease, and in inculcating right methods of medical government. In 1878, after filling other offices in the Royal College of Surgeons, he became its president, and in 1887 was created K.C.B. It was largely due to his advocacy that the new St Thomas's Hospital was rebuilt on its present site after it was compelled to leave its old habitation near London Bridge. As a surgeon, Simon's work came second to his interest in sanitary science, but he claimed priority over Cock in the operation of perineal puncture of the urethra in cases of retention from stricture. (W. MACC.)

Simon, Jules François (1814–1896), French statesman and philosopher, was born at Lorient in December 1814. His parents were of Jewish extraction, and the family name was Suisse, which he dropped, making a surname out of the prenomen Simon. He became a schoolmaster, and after holding various appointments at public schools in the provinces, was called to Paris by Victor Cousin, then omnipotent in all educationl matters, to lecture on the history of philosophy at the École Normale. In 1839 he became professor of philosophy at the Sorbonne; in the following year he published his *Études sur la Théodicée de Platon et d'Aristote*; and in 1844–45 his history of the philosophical school of Alexandria. These works, as well as the brilliancy of his lectures, gave him a high reputation, and after the revolution of 1848 he was elected to the National Assembly, which he quitted in the following year to serve on the Council of State, from which he was soon removed as too much of a Republican. His Republicanism was in fact most moderate, but thoroughly sincere, as he proved by refusing to take the oath of allegiance to Louis Napoleon's Government after the *coup d'état* of December 1851. Deprived of his professorship, he set, together with his wife, a splendid example of honourable poverty, living with the utmost frugality, and occupying himself with the production of a series of valuable treatises, written for general readers in a popular style, on religion, morals, and politics in their most practical aspects. *Le Devoir* appeared in 1854, *La Religion Naturelle* in 1856, *La Liberté de Conscience* in 1857, *La Liberté Politique* and *La Liberté Civile* in 1859, *L'Ouvrière* in 1861. In 1863 M. Simon was again elected to the legislature, and until 1869 worked with the group of five, headed by M. Émile Ollivier, who constituted the Republican parliamentary Opposition. He has given in his memoirs an entertaining account of this diminutive but by no means insignificant party. After the downfall of the Empire, M. Simon was made minister of public instruction by the Provisional Government, and after the

capitulation of Paris he became minister of the interior *ad interim*, and was sent to Bordeaux to put down the apprehended resistance of Gambetta to the peace concluded with Germany and the elections ordered by the Government. He successfully acquitted himself of this difficult task, and although defeated at Paris, was elected for the Marne. Upon the definitive reconstitution of the Ministry he resumed the portfolio of public instruction, and retained it until Thiers's fall in May 1873. Throughout his tenure of office his course was most conciliatory, especially towards the clergy, whose distrust of him he succeeded in greatly mitigating. In pursuance of this policy he directed the repair of the chapel founded as an expiation for the death of Louis XVI. on the one hand, and the restoration of Napoleon's statue in the Place Vendôme on the other. His ministry was also memorable for the organization of the French School of Archæology at Athens. In 1875 he was elected a member of the Academy and a life senator; and in December 1876, upon the resignation of M. Dufaure, was summoned by Marshal MacMahon to form a Cabinet, in which he was premier and minister of the interior. Here, as previously, his policy was one of conciliation, and he and the President would probably have worked together in harmony could they have been left to themselves. The constant pressure of the more advanced Republicans, however, alarmed the Conservative President, who on his part was worked upon by the anti-Republican conspirators about him, until, on 16th May 1877, he addressed M. Simon a letter which, although not openly demanding his resignation, left him no alternative but to tender it, unless he was prepared to resist and appeal to the Chambers. It was a very general opinion that he ought to have done so; and although he has vindicated himself by alleging his fear of provoking the Marshal to a *coup d'état*, it is certain that the transference of the Government of the Republic to its enemies might well have been its ruin but for their timidity and the extraordinary exertions of Gambetta. M. Simon never again held office, but frequently took an active part in the debates of the Senate, and proved himself one of the first orators of his time in the resistance which his conciliatory temper led him to offer to the sweeping educational reforms of M. Jules Ferry, and in his advocacy of free trade in 1891. On both occasions, however, he failed to convince his audience. He wrote in 1878 the history of M. Thiers's Government, and in 1887 published a most vivid personal sketch of Victor Cousin, the author of his fortune, but from whose despotism he had had much to endure. In his latter years he wrote two volumes of autobiographical memoirs, *Premiers Mémoires*, and *Le Soir de ma Journée*. They have many gaps, but contain much interesting matter. He died in Paris, 8th June 1896. No man prominently connected with French politics in the 19th century has left a higher reputation for moderation and patriotic disinterestedness; it is impossible to find a fault with his public conduct, unless his failure to resist Marshal MacMahon be accounted one. As a moral philosopher he ranks high, and his treatises have enjoyed a very wide circulation; in speculative philosophy he is less distinguished as a thinker than as a historian. (R. G.)

Simon's Town, a town and naval station in Cape Colony on Simon's Bay, an inlet on the west side of False Bay, 20 miles south of Cape Town, with which it is connected by rail. It occupies one of the finest sites in South Africa under the sickle-shaped headland, at the southern extremity of which stands the lighthouse of the Cape of Good Hope. The Imperial Parliament voted a sum of £2,500,000 for enlarging and strengthening the fortifications, docks, arsenal, and approaches of this station; and, in course of time, Simon's Town will be the strongest and most convenient naval station in the southern hemisphere. False Bay, which corresponds on the south to Table Bay on the north side of Table Mountain, is a spacious inlet which has an average depth of from 15 to 20 fathoms, and is completely sheltered on all sides except towards the south. Here a whole fleet of the largest vessels can ride safely at anchor under the formidable batteries by which it is proposed to guard the southern entrance between the Cape headland and Cape Hangklip, facing it on the opposite (east) side. The Cape headland forms the divide between the cold Antarctic current which passes to the west and the warm Mozambique current which sweeps round from the Indian Ocean and penetrates into False Bay, thus raising the temperature of Simon's Town 4° or 5° F. above that of Cape Town. Population (1887), 3000; (1900), 5000.

Simson, Martin Eduard von (1810–1899), German jurist and politician, was born at Königsberg, in Prussia, on 10th November 1810, of Jewish parentage. After the usual course at the gymnasium of his native town, he entered its university in 1826 as a student of jurisprudence, and devoted himself specially to the study of Roman law. He continued his studies at Berlin and Bonn, and, having graduated *doctor juris*, attended lectures at the École de Droit in Paris. Returning to Königsberg in 1831 he established himself as a *privat-docent* in Roman law, becoming two years later extraordinary, and in 1836 ordinary, professor in that faculty at the university. Like many other distinguished German jurists, *pari passu* with his professorial activity, Simson followed the judicial branch of the legal profession, and, passing rapidly through the subordinate stages of auscultator and assessor, became adviser (Rath) to the Landgericht in 1846. In this year he stood for the representation of Königsberg in the National Assembly at Frankfort-on-Main, and on his election was immediately appointed secretary, and in the course of the same year became successively its vice-president and president. The office to which he was called required in those days of storm and stress an unusual amount of nerve, tact, and calm judgment, and these qualities the young lawyer displayed to a remarkable degree. He controlled the sittings of the assembly during the revolutionary period with a dignity that would have done honour to a Speaker of ripe experience in any house of legislature in the world. In his capacity of president he appeared, on 3rd April 1849, in Berlin at the head of a deputation of the Frankfort Parliament to announce to King Frederick William IV. his election as German Emperor by the representatives of the people. The king, either apprehensive of a rupture with Austria on this account, or fearing detriment to the prerogatives of the Prussian crown should he accept this dignity at the hands of a democracy which he had alternately flouted and cajoled, refused the offer. Simson, bitterly disappointed at the outcome of his mission, resigned his seat in the Frankfort Parliament, but in the summer of the same year accepted a mandate as deputy for Königsberg in the popular chamber of the Prussian Landtag. Here he had at length an opportunity of displaying his skill in debate, and soon made his mark as one of the best orators in that assembly. A member of the shortlived Erfurt Parliament of 1850, he was again summoned to the presidential chair, and it was while acting in that capacity that he administered to Bismarck a well-merited rebuke. Bismarck, sitting as an ordinary deputy and being called to order by the president, made a loud aside to a colleague to the effect that they, being of noble birth, knew far better than the president

what licence to permit themselves. To this Simson replied, "What? You dare say that to me, a descendant in the direct line from Aaron!" Bismarck, to his honour be it said, immediately rose and bowed profuse apologies to his rebuker.

On the dissolution of the Erfurt assembly, Simson retired from politics, and for the next few years devoted himself exclusively to his academical and judicial duties. It was not until 1859 that he re-entered public life, when he was elected deputy for Königsberg in the lower chamber of the Prussian Landtag, of which he was president in 1860 and 1861. In the first of these years he attained high judicial office as president of the court of appeal at Frankfort on the Oder. In 1867, having been elected a member of the constituent assembly of the North German Federation, he again occupied the presidential chair, as he did also in the first regular Diet and the Zoll-parliament which succeeded it. On 3rd October of that year he presented on behalf of this body an address to King William I. of Prussia in the castle of Hohenzollern, the ancestral home of that royal house. On 18th December 1870 Simson arrived at the head of a deputation in the German headquarters at Versailles to offer the imperial crown to the King of Prussia in the name of the newly-elected Reichstag. The conditions under which Prussia might justly aspire to the hegemony in Germany at last appeared to have been accomplished. German unity had been cemented on the field of battle, and no obstacles, as in 1849, were in the way of the acceptance of the crown by the leading sovereign of the confederation. Thus the mission of the tribune of the people, who had the unique experience of twice offering a crown, was successful, and on 18th January 1871 King William of Prussia was proclaimed with all pomp German Emperor in the Salle des Glaces at Versailles. Simson continued as president of the Reichstag until 1874, when he retired from the chair, and in 1877 resigned his seat in the Diet, but at Bismarck's urging, "You owe it to your children, they will be proud of you," accepted, though reluctantly, the presidency of the supreme court of justice (Reichsgericht), and this high office he filled with great distinction until his final retirement from public life in 1891. In 1888 the Emperor Frederick bestowed upon Simson the order of the Black Eagle, which confers a patent of hereditary nobility, but it is characteristic of the modesty of this man that he never cared to adopt the title, but continued to sign himself simply "Dr Eduard Simson."

His political career coincides with the era of German struggles towards unity. As a politician he was one of the leaders of modern Liberalism, and though always loyal when appeals were made to patriotism, such as Government demands for the army, he remained obdurate on constitutional questions and refused to sacrifice a jot or tittle of popular rights; and he resolutely opposed the reactionary policy of the Prussian Conservatives. As president of the popular assembly, he conducted the proceedings with dignity and good feeling. He was a profound lawyer, but owing to the composition of the chambers in the supreme court not much scope was afforded for the display of individual talent. On his retirement from the presidency of the Reichsgericht, he left Leipzig and made his home in Berlin, where he died on 2nd May 1899. His Life has been published by his son, Bernard von Simson, under the title *Eduard von Simson, Erinnerungen aus seinem Leben*, 1900. (P. A. A.)

Sinaïa, a small town in Rumania, picturesquely situated in the Transylvanian Alps at about 15 miles from the Austro-Hungarian frontier at Predeal. It has become the fashionable summer resort of Bucharest society since the construction of the royal residence of Peles, "Castle Peles," called after the little mountain on which it is built. The building is of a mixed style of architecture, principally Old German, and the interior is fitted with magnificent wood carvings, and stained-glass windows illustrating the principal scenes of Carmen Sylva's writings. The town is lighted throughout by electricity. Population (1900), 2210.

The monastery of Sinaia, founded by Michel Cantacuzene in 1695, was the residence of the royal family until the present château was built. It consists of two courts surrounded by low buildings, the residence of the monks. In the centre of each court is a small church built in the Byzantine style, which has been renovated. The monks possess a library, in which are kept the valuable jewels, belonging to the Cantacuzene family.

Sinaloa, a state of Mexico, bounded on the N. by Sonora and Chihuahua, on the E. by Chihuahua and Durango, on the S. by the territory of Tepic and the Pacific, on the W. by the Gulf of California. Area, 33,681 square miles. Population (1879), 186,491; (1895), 258,865. It is the best watered state of the republic. The western hot belt or maritime zone is devoted to agriculture, the eastern or cold belt to mining. The yield of cereals, cotton, tobacco, sugar-cane, coffee, and fruits is valued at about $8,000,000 a year. It is claimed that Sinaloa is the richest mining region in Mexico, gold, silver, copper, iron, lead, being the principal products; there are also salt deposits, mineral springs, &c. An active trade is carried on through the port of Mazatlan, valued at about $18,000,000 a year. The state is divided into ten districts. The capital, Culiacan Rosales, with 10,487 inhabitants, is an important commercial centre, and has fine public buildings, manufactures, and a mint, and is connected with the port of Altata by rail. The principal towns are Mazatlan (15,852 inhab.), Mocorito (9971), Sinaloa, El Fuerte, Rosario, and San Ignacio.

Sind, or SCINDE, an historic region of India, now forming a division of the Bombay presidency. It comprises the four British districts of Karachi, Haidarabad, Shikarpur, Thar and Parkar, and Upper Sind Frontier, together with the native state of Khairpur. Total area, 53,898 square miles. Population (1891), 3,003,711; (1901), 3,412,373. The administrative headquarters are at Karachi, the seaport for all the Indus valley.

Excluding the native state of Khairpur, the area of British territory is 47,789 square miles. Population (1881), 2,413,823; (1891), 2,871,774, showing an increase of 19 per cent., due to the extension of cultivation by means of canals; average density, 60 persons per square mile, ranging from 100 in the irrigated districts of Haidarabad and Shikarpur to only 23 in the desert tract of Thar and Parkar. Classified according to religion, in 1891 Mahommedans numbered 2,215,147; Hindus, 567,536; Christians, 7764, of whom more than half were Europeans; "others," 81,327. The great majority of the inhabitants are undoubtedly of Hindu descent, converted to Islam a thousand years ago. They speak a language of their own, which is of special interest as being more nearly akin to the ancient Prakrit than any other of the modern tongues. In 1901 the population was 3,212,808, showing a further increase of 12 per cent.

Agriculture is almost entirely dependent upon irrigation from the Indus, the average annual rainfall not exceeding 8 inches. In 1897–98, out of a total cultivated area of 3,802,482 acres, no fewer than 2,917,624 acres, or 77 per cent., were irrigated, mainly from Government canals. The principal crops are millet, rice, wheat, oil-seeds, pulse, and cotton. In 1897–98 the receipts from 8 "major" irrigation works (of which only 4 were in operation) amounted to Rs.13,24,256, and the working expenses to Rs.3,81,653, showing a profit of Rs.9,42,603, or 6·65 per cent. on a capital expenditure of Rs.1,41,83,196. In addition, on 7 "minor" works there was a profit of Rs.10,14,301, or 28·6 per cent. on a capital expenditure of Rs.38,67,927. The revenue and rates in 1897–98 was Rs.1,10,25,351; number of police,

4195; pupils at school, 58,980, being 2·4 per cent. of the population, the same proportion as for the whole of Bombay.

Sind is traversed by the North-Western Railway, which follows the Indus from the Punjab to the sea at Karachi. The Indus is twice bridged: at Rohri, where the main line crosses the river, and a branch goes off to Quetta; and at Kotri, opposite Haidarabad, whence a line was opened into Rajputana in 1900. The sea-borne trade of Sind is concentrated at the port of Karachi, which ranks as the fifth port in India, with an aggregate of imports and exports (foreign and coasting) valued at about 15 crores of rupees (say ten millions sterling) a year. A little trade is carried on at the two petty ports of Sirgonda and Keti Bander. Navigation on the Indus by native boats is kept open by the Indus conservancy department. In 1897–98 the river-borne traffic between Sind and the Punjab amounted to 1,055,297 maunds, compared with 1,437,321 maunds in the preceding year. The external land trade of Sind with Afghanistan and Baluchistan was valued at Rs.52,18,329 for imports and Rs.29,06,489 for exports. The trade with Kandahar is declining, but that with Kalat and Las Beyla is increasing.

See A. W. Hughes. *Gazetteer of the Province of Sind.* London, 1876. (J. S. CO.)

Sindhia (Ali Jah Jaiaji Rao), Maharaja (1835–1886). The strength of loyal purpose which enabled Maharaja Ali Jah Jaiaji Rao to remain steadfast to his allegiance to the British Crown and faithful to his engagements, entitles him to a conspicuous place in the history of the 19th century. The full measure of credit which the Maharaja deserved for his behaviour in 1858 can only be appreciated by considering the past traditions of his family, the conditions of misrule which preceded his succession, and the circumstances of his own accession to ruling powers. The important state of Gwalior, now filling an area of 29,067 square miles in the centre of India, was at the commencement of the 18th century not only the first Maratha state, but a competitor for imperial rule. At the battle of Panipat, 1761, a Sindhia measured himself against Ahmad Shah Durani. The Emperor Shah Alam was restored by the Marathas to Delhi, and from 1788 was practically a prisoner in Sindhia's charge. Mahadaji Sindhia's influence reached to Mysore, for it was through his influence, in 1793, that the proposal of Lord Cornwallis to unite the Peshwa and the Nizam against Tipu was defeated. Daulat Rao Sindhia succeeded Mahadaji in 1794, and aided by French officers, he trained and collected a formidable army. His predecessor had in 1782 guaranteed the British treaty with the Marathas concluded at Salbai. But the growing power of Daulat Rao induced him to join with Berar in supporting Baji Rao against the British. Daulat Rao Sindhia secured Ahmednagar, seized most of Indore, and at the head of the strongest native army in India aspired to imperial rule. But the British victories of Assaye, Laswari, and Delhi broke his power, and before the outbreak of the Pindari war, Gwalior was reduced to the position of a protected principality. When Daulat Rao died in 1827, a distant relative succeeded, under the name of Jankoji Rao. The Regent, Baiza Bai, widow of the last Maharaja, quarrelled with the young chief, and the army took sides in the palace disputes which followed. Disorder prevailed without, and intrigues within the capital. The army was without pay or discipline, and turbulent classes, intolerant of British justice, sought an asylum in Gwalior, relying upon its past traditions to give them an opportunity for pursuing their lawless occupations.

The weak Jankoji died in 1843, and a lad of eight years named Bhagirat Rao, a very distant relative, was adopted by the child-widow of the late Maharaja. He took the name of Ali Jah Jaiaji Rao, and Mama Saheb was appointed Regent. The Regent was ousted by Dada Khasgiwalla, who, being hostile to the British, won the support of the army. War was imminent in the Punjab, and these proceedings at Gwalior could not be ignored. The surrender of Dada Khasgiwalla was obtained, and Lord Ellenborough demanded an interview with the young Maharaja on 16th December 1843. Sindhia's troops prevented the meeting, and on 29th December they attacked Sir Hugh Gough at Maharajpur, losing 56 guns and sustaining a decisive defeat. The victory of Panniar was won on the same day, and the army of Sindhia was scattered. By a treaty dated 13th January 1844 lands were ceded for the maintenance of a contingent force, the army was reduced, and the affairs of Gwalior were settled. But beneath the surface the embers of further disorder smouldered, until the outbreak of the Mutiny in 1857 again revived the hopes of Maratha supremacy. The Contingent mutinied in June, and the British agent withdrew. Every effort was made to induce the Maharaja to place himself at the head of a national movement. But Sindhia and his minister Dinkar Rao resisted all overtures. They resorted to presents and various expedients for keeping the troops of the state quiet, while Delhi was being recaptured and Cawnpore avenged. At last Tantia Topi appeared near Gwalior, and the Maharaja marched out to give him battle. His troops, however, went over to the mutineers and seized the fortress, and Sindhia, with his minister, escaped to Agra. On 19th June 1858 Sir Hugh Rose retook Gwalior and restored the Maharaja to his capital. Sindhia's name and influence would have been of incalculable value to the mutineers. His loyal conduct therefore received the grateful acknowledgment of the Government. The decorations of G.C.B., G.C.S.I., and C.I.E., the rank of an honorary general in the British Army, considerable grants of territory, and in 1886 the restoration of the fort of Gwalior, expressed the gratitude of the British for his services. Jhansi was received from Gwalior, and various territorial exchanges were effected. In the matter of railways, salt, and postal arrangements, the Maharaja readily co-operated with the Government of India. He died on 20th June 1886, leaving large accumulations of treasure, and was succeeded by his son Madho Rao. (W. L.-W.)

Singapore, an island and town situated at the southernmost extremity of the Malayan Peninsula in 1° 20′ N. and 103° 50′ E. The island is the most important portion of the Crown Colony of the Straits Settlements, and the town, which is the administrative centre of the colony, is the principal emporium of the trade of Southern Asia. Singapore is one of the most valuable of the minor possessions of Great Britain. It is very strongly fortified by guns and works of a modern type, upon which large sums have been expended by the Imperial Government, aided by a heavy military contribution from the colony. Its geographical position gives it strategic value as a naval base, whence the routes to and from the Far East can be commanded. It possesses a good harbour, docks, extensive coaling wharves, an admiralty dockyard, and considerable facilities for shipping. As a commercial centre it is unrivalled in that part of the world. The total value of the imports in 1898 was £16,416,831, and the exports in the same year valued £13,583,146. The ships using the port during 1898 numbered 10,013, with an aggregate tonnage of 9,086,556, of which 5768 were British, with an aggregate tonnage of 5,402,032. The revenue of Singapore for 1898 amounted to $2,963,550, exclusive of $46,150 received for land sales, and the expenditure was $2,427,061. On the island of Pulau Brani stand the largest tin-smelting works in the world, which annually pass through their furnaces more than half the tin produced. Singapore has also establishments for tinning pine-apples and a large biscuit factory. The city possesses few fine buildings,

but Government House, the new law courts, the gaol, the lunatic asylum, and the Hong Kong and Shanghai Bank are exceptions, as also is the cathedral of St Andrew's. There are three Roman Catholic churches, a Free church, an American mission, and several chapels belonging to other Nonconformist sects. There is a good racecourse and polo-ground, fine cricket and football fields, two golf links, and innumerable lawn-tennis courts. There is a town and a country club, as well as a German club, and both the latter have good bowling-alleys attached. Singapore is governed by its own municipality, under the supervision of the Colonial Government.

The atmospheric pressure registered in Singapore for 1898 showed 30·017 inches to be the highest on 28th January, and 29·711 inches to be the lowest on 9th November; the range for the year was 0·104 inches, and the mean for the year 29·870 inches. The temperature of Singapore registered 91·9° F. in the shade on 18th March 1898, that being the highest for the year. The lowest was 70·2° F., registered on 29th January. The range for the year was 12·7° F., and the mean was 79·7°. Temperature of solar radiation for 1898 was: highest 163·2° F. on 24th March; lowest 81·0° F. on 12th February; mean for 1898, 142·3° F. The temperature of nocturnal radiation on grass was: highest 75·1° F. on 30th June; lowest 66·9° F. on 24th March; mean of 1898, 71·2° F. Relative humidity: highest 98 per cent. on 7th September; lowest 53 per cent. on 10th November; mean for 1898, 81 per cent. Northerly and north-east winds prevail from the middle of October to the end of April, southerly and south-westerly winds from the beginning of May to the middle of October. The mean velocity of winds for the year 1898 was 177 miles, the greatest velocity recorded in 24 hours was 351 miles on 15th October. Rainfall: mean for 1898, 106·19 inches; maximum, 158·68 inches; maximum monthly fall, 23·94 inches in October; minimum monthly fall, 2·96 inches; greatest fall in 24 hours, 4·12 inches on 14th October.

The following shows the composition of the population, which numbered in all 228,555 in 1901: Europeans 3824, Eurasians 4120, Chinese 164,041, Malays 36,080, Indians 17,823, other nationalities 2667. The births registered in Singapore during 1898 numbered 3751, namely, 1960 males and 1791 females, being a ratio of 16·55 per mille. The deaths registered during the same period numbered 7602, namely, 5894 males and 1708 females, a ratio of 33·54 per mille. The excess of deaths over births is due to the fact that there are comparatively few women among the Chinese; the steady increase of the population in the face of this fact is to be attributed entirely to immigration, mainly from China, but to a minor extent from India also. The persons classed above under "other nationalities" are representatives of almost every Asiatic nation of importance, and of many African races, Singapore being one of the most cosmopolitan cities in the world. (H. CL.)

Singhbhum, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Chaibassa.

Area, 3375 square miles. Population (1881), 453,775; (1891), 545,488, showing an increase of 20 per cent., which must be partly due to more accurate enumeration; average density, 145 persons per square mile. Classified according to religion, in 1891 Hindus numbered 230,999; Mahommedans, 3215; Christians, 4864, of whom 129 were Europeans; aborigines, 306,410. In 1901 the population was 608,826, showing an increase of 12 per cent. The land revenue and rates in 1897–98 were Rs.1,47,907; number of police, 184; boys at school (1896–97), 12,842, being 31·5 per cent. of the male population of school-going age; registered death-rate (1897), 23·9 per thousand. The isolation of Singhbhum has been broken by the opening of the Bengal-Nagpur Railway, which has protected it from the danger of famine, and at the same time given a value to its jungle products. In 1896-97 no less than 538,767 cubic feet of sleepers were exported for a railway beyond Benares; and the net receipts of the forest department in that year were Rs.2,40,000, or twice the land revenue. There are three missions in the district—S.P.G., Lutheran, and Roman Catholic—which have been very successful among the aboriginal tribes, especially in the spread of education.

Singora, or SUNGKLA, the Sangore of early navigators, the most important port on the east coast of the Malay Peninsula, situated in 7° 12′ N. and 100° 35′ E. It was settled at the beginning of the 19th century by Chinese from Amoy, who placed themselves under the protection of the kings of Siam. Chinese influence is evident in the architecture of the walls of the town, as well as in many of the houses, and practically the whole of the commerce is in Chinese hands. The population numbers about 10,000, the greater part consisting of Siamese, and of Malays who reside in a settlement on the north side of the harbour, and have mostly adopted the Siamese language. The channel to the inland sea or great lake of Patalung, which makes the harbour one of the most picturesque in the Far East, affords a safe and commodious anchorage, but is rendered difficult of access by a dangerous bar. A good road across the peninsula connects the port with Keddah on the west coast. A concession was granted for a railway along this route, but no work has been done upon it. The chief products of the province are paddy, tin, dried and salted fish and fruit. It is included in the munton or circle named after the historic and once powerful province of Nakawn Si Tamaraj, north of the lake, and is the residence of the chief commissioner. The rainy season is much later than in Upper Siam, commencing towards the end of the south-west monsoon. When the north-east monsoon breaks in the China Sea in October the coast becomes a leeshore, and receives the full force of the gales which sweep against it. A high sea and heavy rains then prevail.

Sing Sing. The name of the village of Ossining (*q.v.*), Westchester county, New York, U.S.A., previous to 1901.

Sinkat. See EGYPT: *Military Operations.*

Sinnah. See KURDISTAN.

Sinope, now SINÚB, the chief town of a sanjak of the same name in the Kastamúni vilayet of Asia Minor, situated on the south shore of the Black Sea, on a low sandy isthmus which connects the promontory of Boz Tepe with the mainland. It has the only safe roadstead between the Bosphorus and Batum, but is shut off from the Anatolian plateau by high forest-clad mountains, over which there is no good road. It has little trade. The population consists of 5000 Moslems and 4000 Christians. The exports are about £80,000, and the imports £50,000.

Sion, or SITTEN, the capital of the Swiss canton of the Valais. It is on the railway between St Maurice (25½ miles distant) and Brieg (33 miles distant). Sion is one of the most picturesque little cities in Switzerland, being built around two prominent hillocks that rise from the level valley of the Rhône. The north hillock is crowned by the castle of Tourbillon (built 1294, burnt 1788), which was long the residence of the bishops. The south hillock bears the castle of Valeria, long the residence of the canons, with the interesting 13th-century church of St Catherine. In the town below is the 15th-century cathedral, and the majoria (burnt in 1788), the former residence of the "major" (or mayor of the city). There are various other curious objects in the city, which is built on the banks of the Sionne torrent, and is at a height of 1680 feet above the sea. In 1888 Sion contained 5424 (in 1900, 6095) inhabitants (mainly Roman Catholics), of whom 1969 were German-speaking and 3271 French-speaking.

Sion dates from Roman times (*Sedunum*), and the bishop's see was removed thither from Martigny (*Octodurum*) about 580. In 999 the bishop received from Rudolf III., King of Burgundy, the dignity of Count of the Valais, and henceforward was the temporal as well as spiritual lord of the Valais, retaining this position, at least in part, till 1798.

See J. GREMAUD. Introduction to vol. v. (Lausanne, 1884) of his *Documents relatifs à l'histoire du Vallais.*—R. R. HOPPELER. *Beiträge zur Geschichte des Wallis im Mittelalter*, Zürich, 1897. —B. RAMEAU. *Le Vallais Historique.* Sion, 1886.

(W. A. B. C.)

Sioux City, a city of Iowa, U.S.A., capital of Woodbury county. It is on the river Missouri, at the mouth of the Big Sioux, in the north-western part of the state, at an altitude of 1103 feet. The business portion of the city is in the bottom lands, while the residences are built upon the slope and summit of the cliffs. It has excellent water-supply and sewerage systems, is well paved, mainly with wood, and is divided into eight wards. It is a railway point of great importance, five railways meeting here—the Chicago, Milwaukee, and St Paul, the Chicago, St Paul, Minneapolis, and Omaha, the Illinois Central, the Great Northern, and the Sioux City and Pacific. These, with boats on the Missouri, give it a very large trade. In 1900 it had 329 manufacturing establishments, with a total capital of \$5,691,644. These employed 3104 hands, and the production was valued at \$15,469,702. Of this more than one-half was the product of slaughtering and meat-packing houses. Sioux City is the seat of Morningside College, a Methodist Episcopal institution, opened in 1890, which in 1899 had a faculty of 18 and was attended by 217 students. The assessed valuation of real and personal property was, in 1900, \$5,341,959, the net debt was \$2,176,013, and the rate of taxation 69·00 per \$1000, indicating a very low rate of assessment. Population (1890), 37,806; (1895), 27,371, showing a decided loss in the five years; (1900), 33,111, of whom 6592 were foreign-born and 280 negroes. Of 10,082 males 21 years of age and over, 117 were illiterate (could not write).

Sioux Falls, a city of South Dakota, U.S.A., capital of Minnehaha county. It is situated on the west bank of the Big Sioux, in the south-eastern part of the state, at an altitude of 1390 feet. The city has a regular plan, is divided into six wards, has good water-supply and sewerage systems, and is well paved. It is in a rich farming region, producing mainly wheat, for which this city is the shipping point. It has five railways, the Burlington, Cedar Rapids, and Northern, the Chicago, Milwaukee, and St Paul, the Chicago, St Paul, Minneapolis, and Omaha, the Wilmar and Sioux Falls branch of the Great Northern, and the Illinois Central. It has an excellent water-power in the Falls, which descend 100 feet in half a mile, and which have been utilized in flour-mills. Sioux City was incorporated as a town in 1877, and received a city charter in 1883. Population (1880), 2164; (1890), 10,177; (1900), 10,266, of whom 1858 were foreign-born.

Sipunculoidea.—The Sipunculoidea, formerly associated with the Echiuroidea (*q.v.*) in the group Gephyrea, are marine animals of uncertain affinities. Externally, the body of a Sipunculoid presents no projections: its surface is as a rule even, and often glistening, and the colour varies from whitish through yellow to dark brown. The anterior one-quarter or one-third of the body is capable of being retracted into the remainder, as the tip of a glove-finger may be pushed into the rest, and this retractile part is termed the introvert. At the tip of the introvert the mouth opens, and is surrounded in *Sipunculus* by a funnel-shaped, ciliated lophophore (Figs. 1 and 2). In *Phascolosoma* and *Phascolion* this funnel-shaped structure has broken up into a more or less definite group of tentacles, which in *Dendrostoma* are arranged in four groups. In *Aspidosiphon* and *Physcosoma* the tentacles are usually arranged in a horse-shoe, which may be double, overhanging the mouth dorsally. On the surface of the funnel-shaped lophophore are numerous ciliated grooves, and each of the tentacles in the tentaculated forms has a similar groove directed towards the mouth. These grooves doubtless serve to direct currents of water, carrying with them small organisms towards the mouth.

The skin consists of a layer of cuticle, easily stripped off, secreted by an ectodermal layer one cell thick. Within this is usually a sheath of connective tissue, which surrounds a layer of circular muscles; the latter may be split up into separate bundles, but more usually form a uniform sheet. Within the circular muscles is a layer of longitudinal muscles, very often broken into bundles, the number of which is often of specific importance. Oblique muscles sometimes lie between the circular and longitudinal sheaths. On the inner surface is a layer of peritoneal epithelium, which is frequently ciliated, and at the bases of the retractor muscles is heaped up and modified into the reproductive organs. The ectoderm is in some genera modified to form certain excretory glands, which usually take the form of papillæ with an apical opening. These papillæ give the surface a roughened aspect; the use of their secretion is unknown. They are best developed in *Physcosoma*.

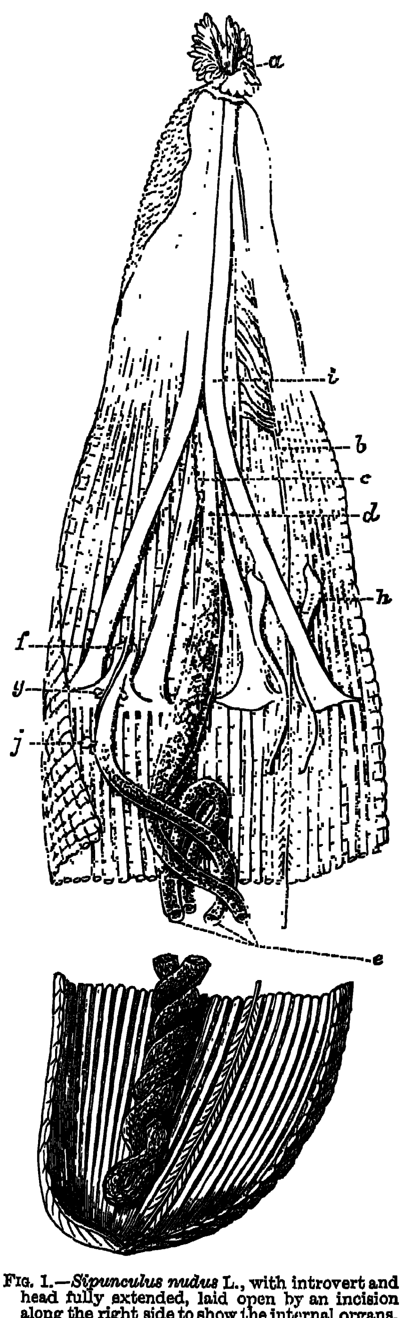

Fig. 1.—*Sipunculus nudus* L., with introvert and head fully extended, laid open by an incision along the right side to show the internal organs, ×2. *a*, mouth; *b*, ventral nerve-cord; *c*, "heart"; *d*, œsophagus; *e*, intestine; *f*, position of anus; *g*, tuft-like organs; *h*, right nephridium; *i*, retractor muscles; *j*, diverticulum on rectum. The spindle-muscle is seen overlying the rectum.

When the body of a Sipunculoid is opened, it is seen that the body-cavity is spacious and full of a corpusculated fluid, in which the various organs of the body float. The most conspicuous of these is the long, white alimentary canal, crowded with mud. The mouth is devoid of armature, and passes without break into the œsophagus; this is surrounded by the retractor muscles, which are inserted into the skin around the mouth, and have their origin in the body-wall, usually about one-third or one-half of the body-length from the anterior end (Figs. 1 and 2). Their function is to retract the introvert, which is protruded again by the contraction of the circular muscles of the skin; these, compressing the fluid of the body-cavity, force forward the anterior edge of the introvert, which in Lankester's

phraseology is pleurecbolic, acrembolic. The number of muscles varies from one (*Onchnesoma* and *Tylosoma*) to four, the latter being very common. The alimentary canal is U-shaped, the dorsal limb of the U terminating in the anus, situated not very far from the level of the origin of the retractor muscles. The limbs of the U are further twisted together in a looser or tighter coil, the axis of which may be traversed by a "spindle" muscle arising from the posterior end of the body. No glands open into the alimentary canal, but a diverticulum, which varies enormously in size, opens into the rectum. As is so often the case with animals which eat mud and sand, and extract what little nutriment is afforded by the organic débris therein, the walls of the alimentary canal are thin and apparently weak. All along one side is a microscopic ciliated groove, into which the mud does not seem to enter, and along which a continuous stream of water may be kept up. Possibly this is respiratory—there are no special respira-

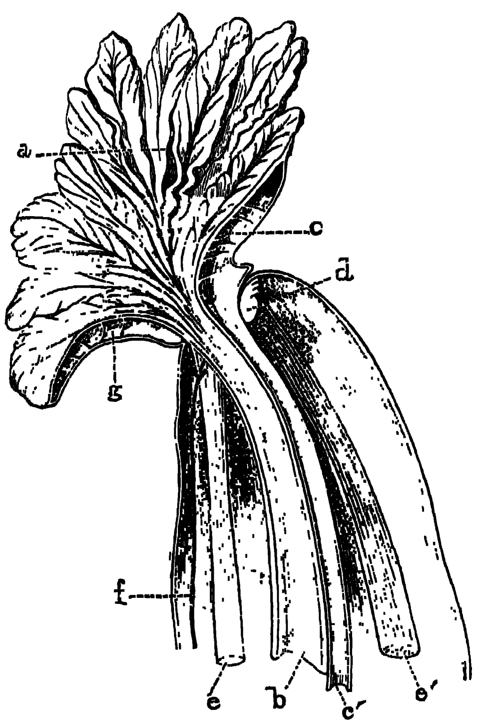

FIG. 2.—Right half of the anterior end of *Sipunculus nudus*, L., seen from the inner side and magnified. *a*, funnel-shaped grooved tentacular crown leading to the mouth; *b*, œsophagus; *c*, strands breaking up the cavity of the tentacular crown into vascular spaces; *c′*, "heart"; *d*, brain; *e*, ventral, and *e′*, dorsal retractor muscles; *f*, ventral nerve-cord; *g*, vascular spaces in tentacular crown.

tory organs. A so-called heart lies on the dorsal surface of the œsophagus; it is closed behind, but in front it opens into a circumœsophageal ring, which gives off vessels into the lophophore and tentacles. The contraction of this heart, which is not rhythmic, brings about the expansion of the tentacles and lophophore. This system is in no true sense a vascular system: there are no capillaries, and the fluid it contains, which is corpusculated, can hardly have a respiratory or nutritive function. It is simply a hydrostatic mechanism for expanding the tentacles. The excretory organs are typical nephridia, with an internal ciliated opening into the body-cavity, and an external pore. One surface of the tube is prolonged into a large sac lined with glandular, excretory cells. The organs are typically two, though one is often absent, *e.g.*, in *Phascolion*. They serve as channels by which the reproductive cells leave the body, and they are sometimes spoken of as "brown tubes." There is a well-developed brain dorsal to the mouth; this gives off a pair of œsophageal commissures, which surround the œsophagus and unite in a median ventral nerve-cord which runs between the longitudinal muscles to the posterior end of the body. From time to time it gives off minute circular nerves, which run round the body in the skin and break up into a very fine nerve plexus. There are no distinct ganglia, but ganglion cells are uniformly distributed along the ventral side of the cord. The whole is anteriorly somewhat loosely slung to the skin, so as to allow free play when the animal is extending or retracting its introvert. A pit or depression, known as "the cerebral organ," opens into the brain just above the mouth; this usually divides into two limbs, which are deeply pigmented and have been called eyes.

Sipunculoids are diœcious, and the ova and spermatozoa are formed from the modified cells lining the body-cavity, which are heaped up into a low ridge running along the line of origin of the retractor muscles. The ova and the mother-cells of the spermatozoa break off from this ridge, and increase in size considerably in the fluid of the body-cavity. Fertilization is external; and in about three days a small ciliated larva, not unlike that of the Echiuroids, but with no trace of segmentation, emerges from the egg-shell. This little creature, which has many of the features of a Trochosphere larva, swims about at the surface of the sea for about a month, and grows rapidly. At the end of this time it undergoes a rapid metamorphosis: it loses many of its larval organs, cilia, takes in a quantity of water into its body-cavity, sinks to the bottom of the sea, and begins life in its final form.

The following genera of Sipunculoids are recognized:—(i.) *Sipunculus*. This, with *Physcosoma*, has its longitudinal muscles divided up into some 17–41 bundles. It has no skin papillæ. The members of this genus attain a larger size than any other species, and the genus contains some 16–17 species. (ii.) *Physcosoma* (Fig. 3) has its body covered with papillæ, and usually numerous rows of minute hooks encircling the introvert. It is the most numerous genus, and consists for the most part of shallow-water (less than 50 fathoms) tropical and subtropical forms. They often live in tubular burrowings in coral-rock. The following three genera have their longitudinal muscles in a continuous sheath:—(iii.) *Phascolosoma*, with some 25 species, mostly small, with numerous tentacles. (iv.) *Phascolion*, 10 species, small, living in mollusc-shells and usually adopting the coiled shape of their house; only one kidney, the right, persists. (v.) *Dendrostoma*, with 4–6 tentacles, a small genus found in tropical shallow water. (vi.) *Aspidosiphon*, with 19 species, is easily distinguished by a calcareous deposit and thickened shield at the posterior end and at the base of the introvert, which is eccentric. (vii.) *Clœosiphon* has a calcareous ring, made up of lozenge-shaped plates, round the base of its centric introvert. (viii.) *Petalostoma*, a minute form with two leaf-like tentacles, is found in the English Channel. (ix.) *Onchnesoma*, with 2 species, and (x.) *Tylosoma*, with 1 species, have no tentacles, only one brown tube, and only one retractor muscle. Both genera are found off the Norwegian coast. The last named is said to have numerous papillæ and no introvert.

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The *Priapuloidea*, a peculiar group of only three genera, *Priapulus*, *Priapuloides*, and *Halicryptus*, are usually placed in the neighbourhood of the Gephyrea, though there is little in their structure to warrant this classification. They are cylindrical worm-like animals, with a median anterior mouth quite devoid of any armature or tentacles. The body is ringed, and often has circles of spines, which are continued into the slightly protrusible pharynx. The alimentary canal is straight, the anus terminal, though in *Priapulus* one or two hollow ventral diverticula of the body-wall stretch out behind it. The

nervous system, composed of a ring and a ventral cord, retains its primitive connexion with the ectoderm. There are no specialized sense-organs or vascular or respiratory

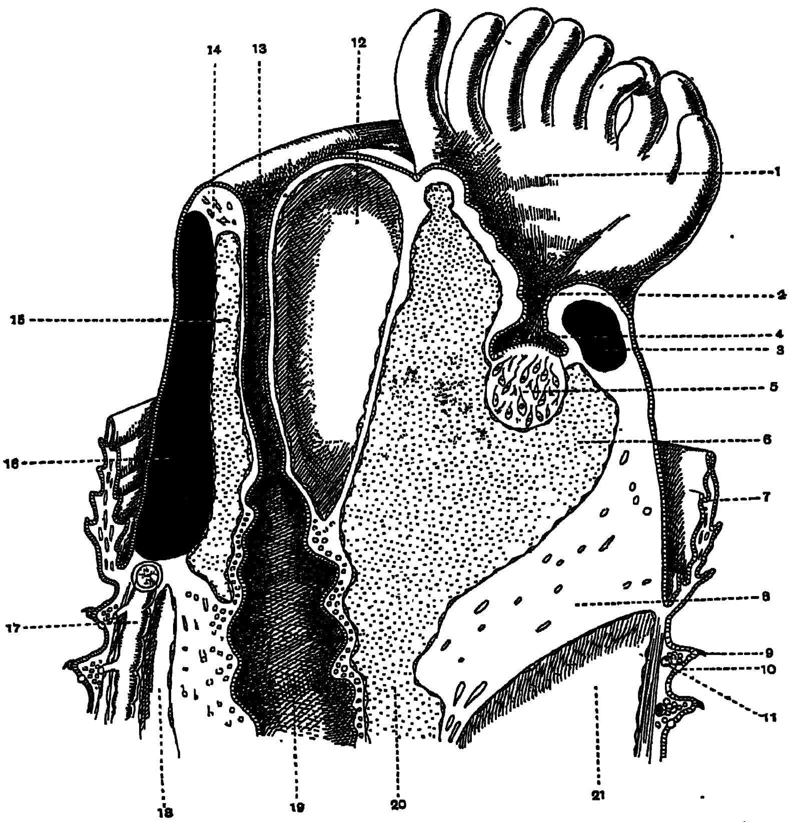

FIG. 3.—A semi-diagrammatic figure of the anterior end of half a *Physcosoma*, seen from the inner side. The introvert is fully everted and the lophophore expanded. The collar which surrounds the head is not fully extended. Two rows only of hooks are shown. 1, lophophore; 2, pigmented pit leading to brain; 3, section of dorsal portion of mesoblastic "skeleton"; 4, pit ending in eye; 5, the brain; 6, blood-sinus of dorsal side surrounding brain and giving off branches to the tentacles; 7, collar; 8, retractor muscle of head; 9, hook; 10, sense-organ; 11, nerve-ring; 12, cœlom of upper lip, it is continuous with 21; 13, mouth; 14, lower lip; 15, blood-sinus of ventral side, continuous with 6; 16, ventral portion of mesoblastic "skeleton"; 17, ventral nerve-cord; 18, cœlom, continuous with 12 and 21; 19, œsophagus; 20, dorsal vessel arising from the blood-sinus 6; 21, cœlom.

systems. The Priapuloidea are diœcious, and their male and female organs, which are one with the excretory organs, consist of a pair of branching tufts, each of which opens to the exterior on one side of the anus. The tips of these tufts enclose a flame-cell similar to those found in Platyhelminths, &c., and these probably function as excretory organs. As the animals become adult, diverticula arise on the tubes of these organs, which develop either spermatozoa or ova. These pass out through the ducts. Nothing is known of the development. The much-needed investigation of this point would probably throw some light on the affinities of the group. There are three genera: (i.) *Priapulus*, with the species *P. caudatus*, Lam., of the Arctic and Antarctic and neighbouring cold seas (Fig. 4), and *P. bicaudatus*, Dan., of the north Atlantic and Arctic seas; (ii.) *Priapuloides australis*, de Guerne, of the circum-polar waters of the south; and (iii.) *Halicryptus*, with the species

FIG. 4.—*Priapulus caudatus* Lam. Natural size. *a*, mouth, surrounded by spines.

H. spinulosus, v. Sieb., of northern seas. They live in the mud, which they eat, in comparatively shallow waters up to 50 fathoms.

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Sirajganj, a town of British India, in the Pabna district of Bengal, on the right bank of the Jamuna or main stream of the Brahmaputra; 6 hours by steamer from the railway terminus at Goalundo. It is the chief river mart for jute in northern Bengal, with several jute presses and a jute mill. Population (1881), 21,037; (1891), 23,267.

Sirmur, or SARMOR (also called Nahan, after the chief town), a native state of India, within the Punjab. It occupies the lower ranges of the Himalaya, between Simla and Mussoorie. Area, 1108 square miles. Population (1881), 112,763; (1891), 124,134; (1901), 135,626, showing a continuous increase of about 10 per cent. in each decade. Estimated gross revenue, Rs.5,12,000; military force, 604 men. The chief, whose title is Raja, is a Rajput of high lineage. The Raja Shamsher Perkash, G.C.S.I., who died in 1898, ruled with remarkable ability and success. A younger son commanded the Imperial Service sappers in the Tirah campaign of 1896–97, and was rewarded with the rank of honorary captain in the Indian army and the distinction of C.I.E. Attempts have been made to establish an iron foundry, and to develop mines of slate and mica. The town of NAHAN is situated about 40 miles south of Simla, 3057 feet above the sea. The palace of the Raja and several other houses are built of stone in European style. Population (1881), 5253.

Sirohi, a native state of India, in the Rajputana agency. Area, 1966 square miles. Population (1881), 142,903; (1891), 188,977; (1901), 154,350, showing an increase of 30 per cent. in the earlier, but a decrease of 17 per cent. in the later period, due to the results of famine. Gross revenue (1896–97), Rs.4,21,587; tribute, Rs.6880. The chief, whose title is Maharao, is a Deora Rajput of the Chauhan clan, and claims descent from the last Hindu king of Delhi. The state is traversed by the Rajputana Railway. The town of SIROHI is 28 miles north of Abu-road station. Population (1881), 5699. It has manufactures of sword-blades and other weapons. The Crosthwaite Hospital, called after the late agent, which is built and equipped on modern principles, was opened by Sir Robert Crosthwaite in December 1897.

Sirsa, a town of British India, in the Hissar district of the Punjab, situated on a dry bed of the river Ghaggar; station on a branch of the Rajputana Railway, half-way between Rewari and Ferozepore. Population (1881), 12,292; (1891), 16,415; municipal income (1897–98), Rs.19,942. It occupies an ancient site, and was re-founded in 1837 as the headquarters of a British district, which was subdivided in 1884 between Hissar and Ferozepore. It is an important centre of trade with Rajputana, and has manufactures of cotton cloth and pottery.

Sis, the ancient *Sision*, the chief town of the Khozan sanjak of the Adana vilayet of Asiatic Turkey, situated on the left bank of the Girgen Su, a tributary of the Jihún, Pyramus, and at the south end of the important pass across Mount Taurus, which is followed by the road from Geuksún (*Kokusos*), to the Cilician plain and Adana. It was besieged by the Arabs in 704, and rebuilt in 1086 by Leo II., king of Lesser Armenia, who made it his capital. In 1374 it was taken and demolished by the sultan of Egypt, and it has never recovered its prosperity. It is the seat of an Armenian Katholikos, and the monastery and church built by Leo II. are interesting.

Sisterhoods (Modern Anglican).—The dissolution of religious houses in England (1536–1540) under Henry VIII. swept away more than 140 nunneries, and the Anglican Church was left without sisterhoods for three centuries. But as these had for 900 years formed part of her system, there were protests from time to time and attempts at restoration. Amongst such protests, which generally dwelt a good deal on the want of provision for unmarried women, may be mentioned three in successive centuries. The historian Fuller would have been glad "if such feminine foundations had still continued," those "good shee-schools," only without vows (Bk. vi.). Richardson the novelist, in *Sir Charles Grandison*, wishes there could be a Protestant nunnery in every county, "with a truly worthy divine, at the appointment of the bishop of the diocese, to direct and animate the devotion of such a society"; in 1829 the poet Southey, in his *Colloquies* (cxiii.), trusts that "thirty years hence this reproach also may be effaced, and England may have its Béguines and its sisters of mercy. It is grievously in need of them." Also small practical efforts were made in the religious households of Nicholas Ferrar at Little Gidding, 1625, and of William Law at King's Cliffe, 1743; and under Charles II., says Fr. Bede, *Autob.*, "about 12 Protestant ladies of gentle birth and considerable means" founded a shortlived convent, with Sancroft, then Dean of St Paul's, for director.

Southey's appeal had weight, and before the thirty years had passed, compassion for the needs of the destitute in great cities, and the impulse of a strong Church revival, aroused a body of laymen, among whom were included Mr Gladstone, Sir T. D. Acland, Mr A. J. Beresford-Hope, Lord Lyttelton, and Lord John Manners (chairman), to exertions which restored sisterhoods to the Church of England. On 26th March 1845 the Park Village Community was set on foot in Regent's Park, London, to minister to the poor population of St Pancras. The "Rule" was compiled by Dr Pusey, who also gave spiritual supervision. In the Crimean war the superior and other sisters went out as nurses with Florence Nightingale. The community afterwards united with the Devonport Sisters, founded by Miss Sellon in 1849, and together they form what is known as Ascot Priory. The St Thomas's sisterhood at Oxford commenced in 1847; and the present mother-superior of the Holy Trinity Convent at Oxford, Marian Hughes, dedicated herself before witnesses to such a life as early as 1841 (Liddon's *Life of Dr Pusey*, iii.).

Four sisterhoods stand together as the largest: those of Clewer, Wantage, All Saints, and East Grinstead; and the work of the first may stand as a specimen of that of others. The "Community of St John the Baptist" at Clewer, near Windsor, arose in 1849 through the efforts of Mrs Tennant and the vicar, afterwards warden of the society, the Rev. T. T. Carter, to save fallen women. Under the first superior, Harriet Monsell, the numbers grew apace, and are now above 200. Their services to society and the Church include 6 houses for fallen women, 7 orphanages, 9 elementary and high schools and colleges, 5 hospitals, mission work in 13 parishes, and visiting in several "married quarters" of barracks. Many of these are important institutions, and their labours extend over a wide area; two of the settlements are in India, and two in the United States. A list of 26 sisterhoods is given in the *Official Year-Book of the C.E.*, 1900, to which may be added 10 institutions of deaconesses, many of whom live in community under rule. The Episcopal Church of Scotland has 3 sisterhoods; and they are found also at Toronto, "Saint John the Divine"; Brisbane, "Sacred Advent"; Grahamstown, "Resurrection"; Bloemfontein, "St Michael and All Angels"; Maritzburg, "Saint John the Divine." The *Year-Book* of the Protestant Episcopal Church of America (Anglican) mentions 17 American sisterhoods and 7 deaconess homes and training colleges.

Practically all Anglican sisterhoods originated in works of mercy, and this fact largely accounts for the rapidity with which they have won their way to the good-will and confidence of the Church. Their number is believed to exceed 3000, and the demand for their services is greater than the supply. Bishops are often their visitors, and Church Congresses, Convocation, and Lambeth Conferences have given them encouragement and regulation. This change in sympathy, again, has gained a hearing from modern historians, who tend more and more to discredit the wholesale defamation of the dissolution period. This charitable activity, however, distinguishes the modern sister from the nuns of primitive and mediæval times, who were cloistered and contemplative, and left external works to deaconesses, or to laywomen of a "third order," or to the freeer societies like the Béguines. St Vincent de Paul is considered to have begun the new era with his institution of "Sisters of Charity" in 1634. Another modern feature is the fuller recognition of family ties: Rule 29 of the Clewer sisters directs that "the sisters shall have free intercourse with relations, who may visit them at any time." But in most essential respects modern sisterhoods follow the ancient traditions. They devote themselves to the celibate life, have property in common, and observe a common rule of prayer, fellowship, and work. Government is by a sister-superior, assisted by various officers. The warden and chaplain are clergy, and the visitor is commonly a bishop. In one important regard there has been hesitation, and authorities like Dr Littledale and Bishop Grafton contend strongly for the primitive ideal of the convent as family, with a constitutional government, as against the later and widespread Jesuit ideal of the convent as regiment, with a theory of despotic rule and absolute obedience. If some early mistakes in the restoration of sisterhoods were due to this exaggerated doctrine of obedience, the doctrine itself may be trusted to disappear among a Church and people accustomed to free institutions and to respect for individuality.

Authorities.—T. T. Carter. *Memoir of Harriet Monsell.*—Dr R. F. Littledale. Papers on "Sisterhoods" in the *Monthly Packet*, July 1874–November 1879.—Parl. Report on *Convent. and Monast. Inst.*, 1870.—Lina Eckenstein. *Woman under Monasticism.*—Bishop Grafton. *Vocation.* (J. O. N.)

Sistova, or Sistow, chief town of a department of Bulgaria, on the right bank of the Danube, 40 miles above Rustchuk. It has improved considerably in prosperity since the Russian war of 1878, notwithstanding a large migration of the Turkish population, and has a considerable trade in corn and wine. A Russian petroleum depôt has been established. The exports in 1897 amounted to 30,261 tons, valued at £132,961, and the imports to 26,296 tons, valued at £207,601; and in 1900 the exports and imports amounted respectively to only 17,295 tons, valued at £94,520, and 15,065 tons, valued at £91,691. Population (1892), 13,212.

Sitapur, a town and district of British India, in the Lucknow division of Oudh. The town is on the river Sarayan, half-way between Lucknow and Shahjahanpur; railway station, 55 miles north-west from Lucknow. Population (1881), 18,544; (1891), 21,380; municipal

income (1897–98), Rs.30,592, less than half from octroi; incidence of taxation, R.0.12.6 per head; registered death-rate (1897), 61·5 per thousand. It is still a cantonment, with a European regiment. It has a high school and printing-press.

The district of SITAPUR has an area of 2255 square miles. Population (1881), 958,251; (1891), 1,075,413, showing an increase of 12 per cent.; average density, 477 per square mile. In 1901 the population was 1,175,579, showing an increase of 9 per cent. The land revenue and rates are Rs.15,34,427, the incidence of assessment being just R.1 per acre; cultivated area (1896–97), 874,472 acres, of which 121,608 were irrigated from wells and tanks; number of police, 1490; vernacular schools, 159, with 5811 pupils; registered death-rate (1897), 36·6 per thousand. The principal crops are rice, pulse, wheat, barley, sugar-cane, and opium. The district is traversed by the Lucknow–Bareilly section of the Rohilkhand and Kumaon Railway. There are no Government canals.

Sitka, formerly Novo Arkhangelsk, the most notable town of S.E. Alaska, situated on Sitka Sound on Baranoff Island, in 57° 03′ N. and 135° 20′ W. Founded in 1804 by Lisianski and Baranoff, after the destruction of an earlier trading post (1800–04) in a less defensible situation, it was until 1867 the chief port and seat of government of Russian America, a fortified trading-post, with churches, a seminary, library, shipyard, foundries, and all the belongings of a great mercantile corporation under military discipline. Since the purchase of Alaska it has continued to be the seat of government and of the United States courts, though its commercial importance has diminished relatively to other towns in Alaska. The transfer of the territory took place at Sitka (18th October 1867). The settlement, besides Government buildings, comprises a large Indian village of frame houses, as well as numerous magazines, shops and dwellings of the white population, a saw-mill, a Greek church and mission school, a large Presbyterian school and mission, and an ethnological museum. In the vicinity are numerous mines of gold and silver. The extinct volcano Mount Edgecumbe is a conspicuous landmark across the Sound. The population in 1890 was 300 whites and 893 natives; in 1900 the total population was 1396. The mean annual temperature of Sitka is 43·3° F.; rainfall 81·7 inches. The prevailing winds are from the south and east.

Sittingbourne, a market-town in the Faversham parliamentary division of Kent, England, on a creek of the Swale, 16 miles by rail west by north of Canterbury. Modern buildings are a free library, a Masonic hall, and public baths. Area of parish (an urban district), 1004 acres. Population (1881), 7856; (1901), 8944.

Siut. See ASSIUT.

Sivaganga, a town of British India, in the Madura district of Madras; situated in 9° 51′ N. and 78° 32′ E., 25 miles east of Madura. Population (1891), 8800. It contains the residence of a *zamindar*, whose estate covers an area of 1220 square miles and pays a permanent land revenue of £25,864. The succession has been the subject of prolonged litigation. There is a high school.

Sivas.—(1) One of the largest and most important vilayets of Asia Minor, lying between 38° 30′ and 41° N. and 35° 30′ and 39° E. It is divided into four sanjaks—Sivas, Tokat, Amásia, and Shabin Kara-hissar; has an area of 32,300 square miles, and a population of 1,090,000 (Moslems, 840,000, of whom one-third are Kizilbash; Armenians, 172,000; Greeks, 78,000). The vilayet is rich in mineral wealth—silver, lead, copper, iron, manganese, arsenic, alum, salt, and coal; has several hot and cold mineral springs; and large forests of fir, pine, beech, and oak. The climate is good, and the soil fertile. Wheat and barley are largely grown on the plateau, and in the lower districts there are extensive fruit orchards and vineyards. The port of the vilayet is Samsún, whence a *chaussée* runs through Amasia, Tokat, and Sivas to Kharpút. The exports in 1900 amounted to £422,175, and the imports to £502,506; the principal items in the former being grain and flour, opium, textiles, tobacco, wool, live stock, and carpets, while cotton goods represent 28 per cent. of the imports.

(2) The chief town of the vilayet and of a sanjak of the same name, the ancient *Sebasteia*, altitude 4420 feet, situated in the broad valley of the Kizil Irmak, on one of its tributaries, the Murdan Su. The climate is healthy, but severe in winter. Coarse cotton cloth and woollen socks are manufactured. The *medresses*, or colleges, built in the 13th century by the Seljúk sultans of Rúm, are amongst the finest remains of Seljúk art in Asia Minor. In one of them is the tomb of its founder, Izz-ed-dín Kai Káús I. (1210–19). Near the town is the Armenian Monastery of the Holy Cross, in which are kept the throne of Senekherim and other relics. There are several Armenian churches of interest, a flourishing American mission with church and schools, and a Jesuit mission. Population, Moslems, 33,000; Armenians, 9000; Greeks, 2000. Sebasteia was the name given under the early empire to an unknown place, which had been called Megalopolis by Pompey. Under Diocletian it became the capital of Armenia Minor, and in the 7th century that of the Sebasteia Theme. Justinian rebuilt the walls and, under the Byzantine emperors, it was second only to Cæsarea in size and wealth. In 1021 Senekherim, king of the Armenian province of Vaspuragan (Van), ceded his dominions to Basil II., and became the Byzantine viceroy of Sebasteia and the surrounding country. This position was held by his successors until the town fell into the hands of the Turkomans after the defeat, 1071, of Romanus II. by the Seljúks. After having been ruled for nearly a century by the Danishmand Emirs, it was taken, 1172, by the Seljúk sultan of Rúm, and in 1224 was rebuilt by Sultan Ala-ed-dín Kai Kubad I. In 1400, when captured by Timúr, the city is said to have had 100,000 inhabitants. On this occasion the bravest defenders were massacred, and 4000 Armenians were buried alive. From this disaster Sivas never recovered. In November 1895 most of the Armenians of wealth and influence were massacred. Mekhitar, the founder of the Mekhitarist Order and of the famous monastery at Venice, was born (1676) at Sivas. (C. W. W.)

Sivori, Ernesto Camillo (1815–1894), Italian violinist, was born at Genoa 25th October 1815, and was taught by Restano and Costa until, when he was about six years old, Paganini heard him play, and was so impressed that he wrote a concertino for violin, guitar, viola, and violoncello, in which the composer used to play the guitar part. From 1827 Sivori began the career of a travelling virtuoso, which lasted almost without interruption until 1864. He played Mendelssohn's concerto for the first time in England, in 1846, and was in England again in the seasons of 1851 and 1864. He lived for many years in Paris, and died at Genoa 18th February 1894. He was the recognized successor of Paganini, and his playing possessed all the qualities that distinguish the virtuoso.

Sivri-Hissar, the ancient *Justinianopolis-Palia*, a town of Asia Minor, in the Angora vilayet, situated 8 miles north of the site of Pessinus. It is a road and commercial centre, with a trade in opium and mohair. The population includes a large Armenian community. Justinianopolis was one of the strong places on the Byzantine military road, and became the chief city of Galatia Salutaris, and the seat of a metropolitan who held the title of archbishop of Pessinus.

Skagerrack, an arm of the North Sea giving access to the Cattegat, whilst northwards it forms Christiania Fjord. (For the currents, temperature, and salinity of the water, &c., see NORTH SEA.)

Skagway, a town in S.E. Alaska at the mouth of the river of the same name, in 59° 27′ N. and 135° 16′ W., on an indentation of Taiya Inlet, a branch of Chilkoot Inlet, leading out of Lynn Canal. This settlement was made in 1895, though individuals had squatted there earlier. It originated in the rush for the Klondike gold-fields, for which Skagway is the most convenient entrance, by the trail over the lower of the two passes to the head-waters of the Yukon. After a stormy beginning, due to the usual mixed population of a community of diggers, Skagway has steadily grown in population, business, and good order. It has water-works, churches, schools, &c., and being the seaward termination of the Yukon and White Pass Railway, by which goods and passengers reach the Klondike, its prosperity seems assured. In 1900 the population was 3117. It is connected with Dawson by telegraph, and with the outside world by frequent steamers.

Skating.—Development in both branches of skating, speed and figure, was great in the later years of the 19th century. The pastime profited both by increasing devotion to athletics and by increased facilities of communication, which led to international competitions, interchange of ideas, and the institution of skating clubs in Switzerland and elsewhere, especially those of Davos, St Moritz, and Grindelwald, where ice is available every winter. Although skating instruments are so simple, the evolution of the skate has advanced considerably, contributing to marked improvement in the skater's skill. In *speed-skating* an epoch was marked, first, by the almost universal adoption of the Norwegian type of racing skate; and, secondly, by the institution in 1892, at an international congress held in Holland, of annual races for the championships of Europe and of the world.

(i.) The Norwegian skate, introduced and perfected (1887–1902) by Axel Paulsen and Harald Hagen, is constructed with a view to lightness, strength, and diminution of friction. The blade, of specially hardened steel, is set in a hollow horizontal tube of aluminium, and connected by similar vertical tubes with foot-plates riveted to a closely-fitting boot with thin leather sole. It is 16–17¾ inches long and ½–2 millimetres thick (*i.e.*, ·019–·078 inch), the average employed for hard ice being ¾ mm., often thinner towards the heel. This thickness is suitable for good English ice, but for softer ice $\frac{1}{16}$ or $\frac{3}{32}$ inch is preferable. The blade is flat on the ice throughout, except for an inch in front; this flatness distributes the weight, and with the extreme thinness of blade reduces friction to a minimum. The edges are right-angled and sharp.

The skater's style has been modified. The blade, when planted on the ice with weight upon it, describes a nearly straight line, the last few feet only curving slightly outwards as the skate leaves the ice. Hence the stroke of the best modern skaters is almost, if not entirely, on the inside edge, a gain in directness and speed, the outside edge being used for curves only. The length of stroke has tended to diminish. Contrasted with the 12–18 yards' stroke attributed to the old English champion, W. "Turkey" Smart, which was partly on the outside edge, the modern racing stroke rarely exceeds 10 yards, and is usually nearer 6 or 7. Particular instances vary with conditions of ice, &c., but at St Petersburg, in 1896, Eden's stroke in the 10,000 metre race averaged about 7½ yards, that of P. Oestlund at Davos in 1900, the same (for one lap, 8 yards). J. F. Donoghue's stride in 1891 was computed at about 6 yards. The general effect has been vastly increased speed, and a conjoint cause is the stricter training undergone before important races.

(ii.) The races held annually since 1892–93 for the championships of Europe and of the world, under the auspices of the International Skating Union, have assembled representatives from the skating countries of Europe and from America; but up to 1902, after the victorious career of Mr J. F. Donoghue through Europe in 1890–91, Americans rarely competed in Europe, though America has produced some remarkably fine skaters, such as J. L. Johnson and Nilsson; while England, through lack of ice for practice, has fallen somewhat behind in skill, and up to 1902 entered but a single representative for the world's championship, Mr C. Edgington (Oxford University), who from 1899 held successfully against the foreigners the only world's record made in recent years by an Englishman, viz., 19 miles 348 yards in an hour. Hence the struggle lies usually between Norway, Sweden, Germany, Austria, Hungary, Holland, Finland, and Russia. France has produced no speed-skater of note except M. G. de Stoppani.

The professional championship was held in 1893–94 at Zwolle, in Holland, and was won by H. Hagen (Norway), but since then has lapsed. The winners of the world's amateur championship are as follow:—

Date.	Place.	Name.	Nationality.
1892–93 .	Amsterdam	J. Eden	Holland
1893–94 .	Stockholm	Not decided	...
1894–95 .	Hamar	J. Eden	Holland
1895–96 .	St Petersburg	J. Eden	„
1896–97 .	Montreal	J. K. McCulloch	Canada
1897–98 .	Davos	P. Oestlund	Norway
1898–99 .	Berlin	P. Oestlund	„
1899–1900 .	Christiania	E. Engelsaas	„
1900–01 .	Stockholm	F. Wathén	Finland
1901–02 .	Helsingfors	Not decided *	...

* R. Gundersen (Norway) won two races only.

The races are four in number, over distances of 500, 1500, 5000, and 10,000 metres, and to obtain the title of champion a skater must win three races and finish in the fourth. In addition, each country, when possible, holds its own championship races. The English champions for 1899–1900 were A. E. Tebbit (amateur) and F. Ward (professional); and for 1901–2, A. E. Tebbit and J. Bates; but the National Skating Association was prevented by unsuitable weather from holding the races from 1895–1900.

In England races are still skated, with rare exceptions, on straight courses, with a sharp turn round a post or barrel, the distance prescribed for N.S.A. championships being 1½ miles with three turns. The Continental and international system involves a course with straight sides and curved ends of such a radius that no slackening of speed is necessary. In both instances the competitors race two at a time on a double track, and the time test is used. Each skater must keep his own course, to prevent either from using the other as pacemaker or wind-shield. The international regulations (*Eiswettlauf Ordnung*) prescribe that, if a single track be used, the hindmost skater must keep at a minimum distance of 5 metres from the other, on pain of disqualification. The advantage of inner curve on a Continental course is given alternately, and a space left open between the tracks at one point for the skaters to cross.

The curves are skated with a step-over-step action, and the direction is always from right to left. Hence, on entering the curve the right foot is brought across in front and set down on the inside edge, the left passing behind on the outside edge, and being in its turn set down on an outside edge in front. The strokes thus form a series of tangents to the curve, and are little shorter than in the straight. With a radius of 25 and 30 metres, as at Davos, the curves can be skated with safety at full speed. Skating records are somewhat confused, varying widely with conditions and form of track. The world's records for the four championship distances up to 1902 were:—

Distance.	Time.		Holder and Nationality.	Place and Date.
Metres.	min.	secs.		
500 (=547 yds.) . .	0	45⅕	P. Oestlund (Norway)	Davos, 1900
1500 (=1640 yds.) . .	2	22⅗	„ „	„ „
5000 (=3 miles 188 yds.)	8	37⅗	J. Eden (Holland)	Hamar, 1894
10,000 (=6 miles 376 yds.)	17	50⅗	P. Oestlund (Norway)	Davos, 1900

For other distances and times, cf. *The Field* (*passim*); *Sporting*

and Athletic Records, by H. Morgan-Browne (1897); *The Sportsman's Year-Book*, 1899; *The Spirit of the Times*, W. Curtis (New York); *The Badminton Magazine*, January 1900; *Whitaker's Almanac.*

Figure-skating has received a great impetus—

(i.) In England, (*a*) from the multiplication of clubs, *e.g.*, Wimbledon (founded 1870), Thames Valley, Crystal Palace, &c., in addition to the original "Skating Club" and those in Switzerland already mentioned; and from the construction of numerous artificial rinks, such as "Niagara" and the "National Skating Palace"; (*b*) from the encouragement afforded by the National Skating Association, which offers 1st, 2nd, and 3rd class badges (and a special or "Diamond" badge for figure-skating) for figure tests, as well as for speed; and in 1893 founded a "London Skating Council," while in 1898 and in 1902 it held the figure-skating championship of the world in London. The N.S.A. has, however, occupied an anomalous position, holding international competitions in Continental style, while encouraging a style which in itself disqualifies Englishmen from competing.

(ii.) Abroad, from increased organization and the institution of rinks and minor competitions in every important town, in addition to the amateur championships of Europe and of the world held by the International Skating Union.

Thus figure-skating also has developed on international lines, and two separate styles or schools have been evolved, English and Continental, based no doubt on variety of national temperament; the distinctive features of the latter being use of arms and "unemployed" leg, and the bending of the knee, which in the English school are rigidly forbidden. The foreign school was founded by Jackson Haynes, an American professional and accomplished dancer, and is the more showy and seemingly the more graceful, the English being the more severe and the more self-restrained, but bolder and stronger, having for its object not an individual display, but perfect skating in combination. There are, of course, local modifications, the strictest exponents of the English school being the Davos and St Moritz skaters, while the Continental varies from the complete *abandon* of the French to the more restrained style of the Germans; Canadians cultivate also grape-vines and other two-footed figures. The essential features are, however, identical. Thus Englishmen consider of secondary importance loops, cross-cuts, continuous and hand-in-hand skating, though such figures are included in the 1st class test of the N.S.A., and devote themselves mainly to "combined figures." Combined figures have been defined as "symmetrical execution of a figure by one or more pairs of skaters." Originally known as the "skating club figures," they have been gradually developed, and in 1891 delegates from the principal clubs established a regular terminology. The ideal number of skaters for a combined figure is four, though sixes and eights are seen, one being chosen "caller" of the movement to be skated. Various sets of "calls" are arranged at the discretion of different clubs, and consist ordinarily of "turns" and "changes." The N.S.A. offer a challenge shield for an annual competition in combined figure-skating. There has of late, however, been a marked tendency towards unification of style, through Englishmen adopting Continental methods, rendered almost a necessity by the circumscribed area of artificial rinks. In 1901 the Figure Skating Club was established for this purpose, and its members attained such success that an English lady, Mrs Syers, gained the second place in the world's championship competition in 1902, and with her husband won the International Pair Skating.

Continental skating culminates in the annual meeting for the amateur championship of the world, which was won by Herr Grenander (Stockholm), 1898, Herr G. Hügel (Vienna), 1899 and 1900, and Herr U. Salchow (Stockholm), 1901 and 1902. The competition consists of two parts, (*a*) compulsory figures, (*b*) free skating, the latter affording scope for the performance of dance steps and brilliant individual figures, such as the "sitting pirouette," of which Herr Hugel is master, and the "star," consisting of four crosses (forward rocker, back loop, back counter), invented by Herr Engelmann and splendidly rendered by Herr Salchow.

As in speed-skating, important professional meetings are almost non-existent.

The skates used for the English and Continental styles differ in radius, though both are of the same type, *i.e.*, a blade fastened to the boot by sole-plates, the "Mount Charles" pattern being the one generally adopted by Englishmen. The English radius is 7 ft., or now more usually 6 ft.; the foreign, 5½ or even 5 ft., and the result is seen in the larger curves skated on the former, and the greater pace obtained owing to decreased friction; at the same time, the difficulty of making a turn is greater. The English skate has generally right-angled edges and blade of same thickness throughout, except in the "Dowler" variety, which is thicker towards the extremities. The foreign skate is sometimes thicker in the middle than at the ends.

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Skeat, Walter William (1835——), English philologist, was born in London, 21st November 1835, and educated at King's College, Highgate Grammar School, and Christ's College, Cambridge, of which he became a fellow in July 1860. In 1878 he was elected Ellington and Bosworth Professor of Anglo-Saxon at Cambridge. He completed Mitchell Kemble's edition of the Anglo-Saxon Gospels, and did much other work both in Anglo-Saxon and in Gothic, but is perhaps most generally known for his labours in Middle English, and for his standard editions of Chaucer and Piers Plowman. As he himself generously declared, he was at first mainly guided in the study of Chaucer by Henry Bradshaw, with whom he was to have participated in the edition of Chaucer planned in 1870 by the University of Oxford, having declined in Bradshaw's favour an offer of the editorship made to himself. Bradshaw's perseverance was not equal to his genius, and the scheme came to nothing for the time, but was eventually resumed and carried into effect by Professor Skeat in an edition of seven volumes, the last of which was published in 1897. He also issued an edition of Chaucer in one volume for general readers, and a separate edition of his *Treatise on the Astrolabe*, with a learned commentary. His standard edition of Piers Plowman was published in 1886, and, besides the *Treatise on the Astrolabe*, he edited numerous books for the Early English Text Society, including Barbour's *Bruce* and the romances of *Havelock the Dane* and *William of Palerne.* For the Scottish Text Society he edited *The King's Quair*, usually ascribed to James the First of Scotland, and he published an edition of Chatterton, with an investigation of the sources of the obsolete words employed by him. In pure philology Professor Skeat's principal achievement is his *Etymological English Dictionary*, the most important of all his works, which must be considered in connexion with the numerous publications of the English Dialect Society, in all of which, even when not edited by himself, he had a hand as the society's director and afterwards its president. He is also the author of a work on the principles of English etymology, and of a volume of essays entitled *A Student's Pastime*, besides minor matters too numerous to mention. No modern scholar has laboured more assiduously, or produced a larger amount of first-class work.

Skegness, a popular bathing-resort in the South Lindsey, or Horncastle, parliamentary division of Lincolnshire, England, 20 miles north-east of Boston. Since 1873,

when railway connexion was given with Firsby on the Lincolnshire loop line, the place has undergone a complete transformation, and possesses now broad tree-shaded streets, a marine promenade, public gardens, good hotels, a cricket ground, golf links covering 400 acres, and a long pier, opened in 1881. There are broad, firm sands, on which account Skegness is much visited. On bank holidays and similar holidays several thousands of excursionists are poured over the sands from the manufacturing towns of Yorkshire, Nottinghamshire, Derbyshire, Leicestershire, and Lancashire. Since 1894 it has been governed by an urban district council. Population of the urban district (1891), 1488; (1901), 2140.

Skien, a seaport town of Norway, county of Bratsberg, on the south coast, on the river Skien, 5 miles below its issue from Lake Nord, and 6 miles above its outflow into Frier Fjord. It has been mostly rebuilt since a fire in 1886. Here Henrik Ibsen, the dramatist, was born in 1828. In 1892 a canal, nearly 50 miles long and ascending 189 feet by means of 15 lochs, was made between Lakes Bandak and Nord. In the town and district are numerous saw-mills, planing-, cotton-spinning-, and flour-mills, factories for wood-pulp, furniture, ironmongery, paper, bleaching-powder, calcium carbide, tobacco, hosiery, shoes, butter, candles and soap, also a copper mine (at Omdal). The total trade approximates to half a million sterling (£173,000 in 1887); the exports being ice, timber (telegraph poles for the British Government), wood-pulp, and copper, and the imports coal and china-clay. In 1898 the port was entered and cleared by vessels of an aggregate of 123,100 tons. Population (1891), 8979; (1900) 11,343.

Skin. See PATHOLOGY: *Skin*.

Skipton, a parish and market-town in the Skipton parliamentary division of Yorkshire, England, on the Aire, 18 miles north-east of Bradford by rail. Science and art schools have been erected. There are extensive woollen and cotton factories, and, in the neighbourhood, a large limestone quarry. Area of township (an urban district), 4245 acres. Population (1891), 10,376; (1901), 11,986.

Skobeleff, Michael Dimitriévitch (1843–1882), Russian general, was born near Moscow on 29th September 1843. After graduating as a staff officer at St Petersburg he was sent to Turkestan in 1868 and, with the exception of an interval of two years, during which he was on the staff of the Grand Duke Michael in the Caucasus, remained in Central Asia until 1877. He commanded the advanced guard of General Lomakine's column from Kinderly Bay, in the Caspian, to join General Verefkin, from Orenburg, in the expedition to Khiva in 1874, and, after great suffering on the desert march, took a prominent part in the capture of the Khivan capital. Dressed as a Turkoman, he intrepidly explored in a hostile country the route from Khiva to Igdy, and also the old bed of the Oxus. In 1875 he was given an important command in the expedition against Khokand under General Kaufmann, showing great capacity in the action of Makram, where he outmanœuvred a greatly superior force and captured 58 guns, and in a brilliant night attack in the retreat from Andijan, when he routed a large force with a handful of cavalry. He was promoted to be major-general, decorated with the order of St George, and appointed the first Governor of Fergana. In the Turkish war of 1877 he seized the bridge over the Sereth at Barborchi in April, and in June crossed the Danube with the 8th Corps. He commanded the Caucasian Cossack Brigade in the attack of the Green Hills at the second battle of Plevna. He captured Lovtcha on 3rd September, and distinguished himself again in the desperate fighting on the Green Hills in the third battle of Plevna. Promoted to be a lieutenant-general, and given the command of the 16th Division, he took part in the investment of Plevna and also in the fight of 9th December, when Osman Pasha surrendered, with his army. In January 1878 he crossed the Balkans in a severe snowstorm, defeating the Turks at Senova, near Schipka, and capturing 36,000 men and 90 guns. Dressed with care in white uniform and mounted on a white horse, and always in the thickest of the fray, he was known and adored by his soldiers as the "White General." He returned to Turkestan after the war, and in 1880 and 1881 further distinguished himself in retrieving the disasters inflicted by the Tekke Turkomans, captured Geok-Tepe, and, after much slaughter, reduced the Akhal-Teke country to submission. He was advancing on Askabad and Kalat i-Nadiri when he was disavowed and recalled. He was given the command at Minsk. In the last years of his short life he engaged actively in politics, and made speeches in Paris and in Moscow in the beginning of 1882 in favour of a militant Panslavism, predicting a desperate strife between Teuton and Slav. He was at once recalled to St Petersburg. He was staying at a Moscow hotel, on his way from Minsk to his estate close by, when he died suddenly of heart disease on 7th July 1882. (R. H. V.)

Skopin, a district town of Russia, in the government of Ryazañ, 23 miles by rail from Ryazhsk junction. It is a very old town, which is now a great centre for trade in corn, hemp, oil, meat, cattle, and salt exported to Moscow, and in hardware goods imported both from the capital and from Nijni-Novogorod. It has several flour-mills, oil-mills, tanneries, and soap-works. Population (1897), 14,737.

Skowhegan, a town of Maine, U.S.A., capital of Somerset county. It is on the river Kennebec 35 miles above Augusta, and on a line of the Maine Central Railroad. Using the ample water-power furnished by the river, it has manufactures of varied character. Population (1880), 3869; (1900), 4266, of whom 480 were foreign-born.

Skram, Erik. See DANISH LITERATURE.

Skye, the largest island of the Inner Hebrides, Scotland, lying between 57° 1′ 12″ and 57° 42′ 39″ N. and 5° 38′ 50″ and 6° 47′ 8″ W. The sheep farms include some of the finest in Scotland, carrying famous stocks. The crofters succeed best with turnips and potatoes. Since the passing of the Crofters Act in 1886, the old black huts have been largely replaced by well-built houses in those parishes where stone is obtainable, and more attention is being paid to cleanliness in the home. The opening of an extension of the Highland Railway has brought the fishing grounds somewhat closer to the markets. In 1899 the value of the fish caught in the Skye district was £159,988. Diatomite is found in the island, and is used for the manufacture of explosives. A stone pier has been built at Broadford. There is a fever hospital, a court house and resident sheriff-substitute, and a tweed factory, at Portree, near which town stands the combination poorhouse of the island. Population of the island (1891), 15,705; (1901), 14,608.

Slagelse, a town of Denmark, county Sorö, island of Zealand, 58 miles by rail west-south-west of Copenhagen. It is one of the oldest towns of the kingdom, and was mentioned in the 12th century. In the vicinity are the ruins of the Knights Hospitallers' monastery of Antvorskov. Population, (1880), 6076; (1901), 8958.

Slatina, chief town of the district of Olt, Rumania, 87 miles west of Bucharest, on the river Olt or Alutha.

It has nine churches, of which the most remarkable is that of St Jonascu. The town is very ancient. Population (1895), 6500; (1900), 8028.

Slaughter-House, or ABATTOIR.—In the United Kingdom slaughter-houses are of two kinds, those which belong to individual butchers and those which belong to public authorities; the former are usually called private slaughter-houses, the latter public slaughter-houses. Private slaughter-houses in existence in England before the passing of the Public Health Act, 1875, were established without licence by the local authority, except in those towns to which the provisions of the Towns Improvement Clauses Act, 1847, relating to slaughter-houses, were applied by special Act. By the Act of 1875 these provisions were extended to all urban districts. Subsequently to 1890 urban authorities adopting Part III. of the Public Health (Amendment) Act of that year could license for limited periods of not less than one year all slaughter-houses coming into existence after such adoption. In London, slaughter-houses have been licensed since 1855. Private slaughter-houses are frequently situated at the rear of the shop in which the meat is sold. Each consists of a compartment in which the animals are killed, and in association with this are the pounds in which a few animals can be kept pending slaughter. These buildings are regulated by by-laws made under the Public Health Act by the several urban sanitary authorities. The by-laws usually provide for the floor to be made of jointless paving, to ensure that the earth shall not be fouled in the process of slaughtering; for the walls to be cemented to a certain height above the floor, to provide a surface which can be easily cleaned; for the doors to be of sufficient width to enable cattle to enter the slaughter-house without difficulty; and for the poundage to have floor-space sufficient for each animal. These by-laws also provide for water-supply to the slaughter-house for cleansing, and to the pounds for the use of the animals, for the periodical lime-whiting of the premises, and for the observance of care to prevent the blood escaping into the drains. Private slaughter-houses, especially those which were established without licence, are often in too close proximity to inhabited buildings. In towns in which by-laws are not strictly enforced they are often sources of nuisance. Private slaughter-houses are also objectionable on other grounds. They lead to the driving of cattle through the towns on the way to the slaughter-house, sometimes to the danger of the inhabitants, and they render impossible any systematic inspection of meat. It is in connexion with the increasing demand for such meat-inspection that the objections to private slaughter-houses are most manifested; and hence, in countries in which the law provides for the obligatory inspection of meat, private slaughter-houses are ceasing to exist, and public abattoirs are being substituted for them.

Private.

Public slaughter-houses are of great antiquity and owe their beginnings to Roman civilization. In 300 B.C. animals were slaughtered in the open air in the Forum in Rome. Later, to meet the convenience of butchers, a house on the river Tiber was given to them for the purposes of their trade. This house had been occupied by a Roman citizen named Macellus. The building appears to have retained his name, and hence the *macellum* of Livy's time subsequently erected in the Forum, which, *inter alia*, is believed to have contained rooms for the slaughter of animals. The rooms actually used for slaughter were *lanienæ*, from *laniare*, but the word *macellum* has been preserved in the Italian *macellare*, to slaughter, and in the German *metzgen* or *metzgeln*, and in the English *massacre*.

Public.

Public slaughter-houses existed in many large towns of Germany in mediæval times under the name of *Kuttelhöfe*; they were mostly situated on the rivers, which provided an ample supply of water, and afforded means for the removal of the blood which drained into them. Some of these Kuttelhöfe continued to exist within recent years. No law other than a town law governed their establishment and management. They were owned or controlled by the butchers' corporations or gilds, but all butchers were not members of the gilds; and this appears to have led to a ministerial order in Prussia in 1826, which made it inadmissible to require every butcher to slaughter in them. Shortly after the middle of the 19th century the prevalence of trichinosis compelled a return to the use of public slaughter-houses; and the enactment of laws in 1868 and 1881 in Prussia, and similar laws in other German states, empowered urban authorities to require that all animals killed in towns should be slaughtered in public slaughter-houses. (Schwarz, *Bau, Einrichtung und Betrieb öffentlicher Schlacht- und Viehhöfe.*)

In France, in the 15th and 16th centuries, numerous towns were provided with public slaughter-houses. It was required that they should be used by all persons killing animals the flesh of which was to be sold; but their position and the conditions they created were such as urgently to demand amelioration, and some effort was made in this direction in 1567. It was not, however, until the time of Napoleon I. that it was decided that the atrocious nuisance which these slaughter-houses created should be removed. By decrees passed in 1807 and 1810 public slaughter-houses were required to be provided in all large towns in France, the needs of Paris being determined by a Commission, which recommended the establishment of five abattoirs or public slaughter-houses. In 1838 the requirement that public slaughter-houses should be provided in large centres was extended to all towns in France, and it was further required that the slaughter-houses should be situated at a distance from dwelling-houses. In 1867 the large abattoir of La Villette was constructed to meet the needs of Paris, two of the five constructed under the decrees of Napoleon being closed. In 1898 the additional abattoir of Vaugirard was opened, and the remainder of the five were closed except Villejuif, which was restricted in its use to the slaughter of horses for human food.

For other countries the position may be more briefly stated. In Belgium public slaughter-houses have been provided in all the large and many of the small towns. In Switzerland there are public slaughter-houses in nearly all places having more than two thousand inhabitants. In Italy a law of 1890 required that public slaughter-houses should be erected in all communities of more than six thousand inhabitants. In Austria a law of 1850 required the provision of such places in all the large and medium-sized towns. In Norway and Sweden a law of 1892 required the provision of public slaughter-houses; but in Norway there is as yet only one, at Christiansund, and in Sweden there are none, though they are proposed at Stockholm, Gothenburg, and a few smaller towns. In Denmark there are public slaughter-houses in a few towns, including Copenhagen. In Russia, Spain, and Portugal some have existed for a number of years. It is in Germany, however, that the greatest progress has been made, and especially in Prussia, where Professor Ostertag, of Berlin, states they have "literally grown out of the ground" (*Handbuch der Fleischbeschau*); so much so that in 1897 there were 321 public slaughter-houses in the kingdom, 40 of which were provided in the period 1895–97.

In England the power to provide public slaughter-houses

was given by the Public Health Act, 1848, to the local authorities of cities, towns, boroughs, &c., to which the Act was applied by Order; and later, was given to all urban sanitary authorities by section 169 of the Public Health Act, 1875. These authorities have, however, suffered from the disadvantage that they have had no power to control the continuance of private slaughter-houses (except in so far as these were annually licensed), and they have therefore been unable to ensure that the public provision would be used by the butchers. In Ireland and Scotland much the same powers exist; but in Scotland, if the burgh commissioners provide a public slaughter-house, no other slaughter-house can be used. Some English local authorities have obtained in local Acts powers similar to those possessed by the burgh commissioners in Scotland. The need for still wider control is, however, manifest. Belfast may be cited as an illustration of a town in which a public slaughter-house has been provided, and in which there are no private slaughter-houses, but which receives a quantity of meat from private slaughter-houses erected beyond the boundaries of the city.

Regulations.

The outcome of these difficulties is that the power of local authorities to provide public slaughter-houses has been but sparingly used. There is no law requiring that meat shall be inspected before sale for human food, hence there is no obligation upon butchers to make use of public establishments for the slaughter of their cattle. This, indeed, is the position of some of the Continental slaughter-houses; but the increasing strictness of the laws as to meat-inspection, and especially in requiring that all animals shall be inspected at the time of slaughter, is making the use of public slaughter-houses obligatory. Such a law now exists in Belgium, where it has served as a model to other countries. An Imperial German law of 1900 extends to all parts of that country the same requirement, and enacts that "neat cattle, swine, sheep, goats, horses, and dogs, the meat of which is intended to be used for food for man, shall be subjected to an official inspection both before and after slaughter." Antecedent to that year it was in force in southern Germany, in Brunswick, and Saxony, but only in some parts of northern, western, and central Germany. A similar law exists in Norway and Sweden, but, as already stated, provision of public slaughter-houses is still wanting; in Austria-Hungary there is a similar requirement, but Ostertag states that the administration is lacking in uniformity; in Italy, he writes, the regulation of meat-inspection having been left to provincial authorities, thorough reform is impossible. In the British colonies advance is being made. The Meat Supervision Act of Victoria empowers the Board of Health to make regulations for ensuring the wholesomeness of meat supplies. Regulations have been made for Melbourne. Cattle are killed in public slaughter-houses and the carcases are stamped, thus showing in which slaughter-house they have been killed.

Construction.

The planning and construction of public slaughter-houses have been the subject of excellent treatises by German writers, among whom may be mentioned Dr Oscar Schwarz, of Stolp, and the late Herr Osthoff, city architect, Berlin, to whose works the author of this article is largely indebted for information. After inspection of the public slaughter-houses in England and in a number of Continental cities, the writer considers that those of Germany are most deserving of description.

The slaughter-house should be situated outside the town, or so placed as to be isolated, and approached by wide roads, so that if cattle are driven through them there should not be interference with the traffic. If possible, the slaughter-house should be connected with the railway system by a branch line, with a platform which has an impervious surface capable of being readily cleansed and disinfected. The most convenient shape of the site is a rectangle or square, having one side abutting on the principal road and another side bounded by the railway. A cattle-market is usually provided in connexion with the slaughter-house, and the position should be such that cattle brought by train can be taken immediately into the cattle-market and from the market or the railway to the slaughter-house. The cattle-market should be entirely separate from the slaughter-house area. Osthoff states (*Schlachthöfe für kleine und mittelgrosse Städte*) that the area of the slaughter-house should be as follows :—

		Sq. Metres.
Towns of 5,000– 7,000 inhabitants	.	0·40 per inhabitant.
,, 7,000–10,000 ,,	.	0·35 ,, ,,
,, 10,000–50,000 ,,	.	0·30 ,, ,,
,, over 50,000 ,,	.	0·25 ,, ,,

It is of course assumed that the population derives the whole of its meat-supply from this source.

The parts required, according to Dr Oscar Schwarz, are: (1) an administrative block; (2) a slaughtering-hall, with a special room for scalding swine; (3) cattle lairs; (4) room for scalding and cleansing tripe and intestines; (5) an engine-house; (6) separate slaughtering-room, with lairs for animals suffering from, or suspected to be suffering from, contagious disease.

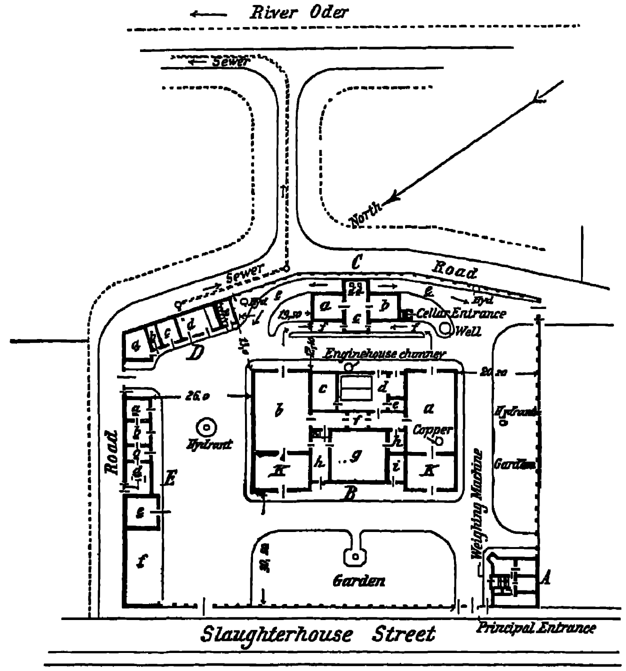
In small towns the slaughtering-hall and room for cleansing intestines may, to save cost of construction, be under the same roof. A necessary adjunct is a cold chamber, to which carcases can be removed from the slaughtering-hall. The actual slaughtering compartment has been built on two plans—one, providing a separate slaughtering-room for each butcher; the other, a common slaughtering-hall. The latter is greatly to be preferred, inasmuch as it is the only arrangement which gives adequate opportunity for inspection by the officials whose duty it is to examine the meat. The slaughter-house in Berlin was constructed on the separate-room system; but the writer was informed, when visiting it a few years ago, that it was intended to reconstruct it, on account of the difficulties of inspection of which it was the cause. During recent years in Germany the practice has been to construct slaughter-houses with common halls. The part occupied by each butcher at the time of slaughtering is, however, sufficiently distinguishable, and at Hamburg the position of the hooks hanging from above divides the hall into separate areas, each of which has an entrance from without. Schwarz gives the following as the most convenient arrangement of the buildings :—The administrative building (with the house of the superintendent) at the entrance, so that from it the entrance and whole place can be seen. In the vicinity should be a weighing-machine for cattle. The centre of the area is occupied by the slaughtering-halls, and the lairs belonging to them only separated from them by a road or passage way. The manure-house and tripe-house must be easily accessible from all the slaughtering-halls, but not in direct communication with them, or smell from them may enter the hall.

The manure-house must abut upon a road, to enable its contents to be removed without passing through the premises. Next to the tripe and pig-scalding houses is the engine-house. The building for diseased animals, with the slaughter-house for them, must be isolated from all other buildings. All buildings should be so arranged that they may be capable of extension as the population of the town increases. By the provision of grass plots and trees every effort should be made to relieve the premises of the dreary appearance they will otherwise present.

Cold chambers, although not included among the absolute essentials for small slaughter-houses, are an almost necessary adjunct, for they serve for the preservation of the meat after slaughter, and are indeed absolutely necessary when the slaughter-house is of large size. The cold chamber should be situated opposite the slaughtering-halls, so that carcases can be conveyed by overhead carriers directly from those halls to it. Within the cold chamber are separate compartments or cages of different sizes, rented by butchers, who are thus able to preserve their meat and draw upon their supply as their business may require. The cold chamber is therefore a great convenience to the butchers, and is a source of profit to the authority owning the slaughter-house. A frequent adjunct to large German slaughter-houses is the "Freibank," at which is sold at low price cooked meat of quality which renders it unfit to be sold under ordinary conditions.

Much depends upon the design and details of construction of the several component parts of a public slaughter-house, upon the provision of adequate lighting and ventilation of the buildings, upon the construction of walls, floors, and fittings which are impermeable and can be readily cleansed, and upon the provision of an abundant water-supply. It is essential that the buildings should be well lighted, especially those which are used for the slaughtering operations, or for any detailed examination of meat which may be needed—such, for instance, as for trichinæ. The material generally used for the floor of the slaughtering-hall is cement or granolithic pavement, which must not present so smooth a surface as to be slippery. The floor must have an adequate fall, so that the washings may discharge into a system of drainage.

The plans of the public slaughter-house of Neusalz on the Oder and of Düsseldorf well illustrate the provision which is now made respectively for a small and for a large town. The writer is indebted to Dr Schwarz for the plan and a description of the slaughter-house at Neusalz. It was completed in October 1899,



The figures give measurements in metres.

FIG. 1.—Plan of Public Slaughter-House at Neusalz on the Oder (1899).

and is erected on the Oder below the town, on land of an area of 8500 square metres. The building has been carefully planned by the town architect, Herr Brannaschk, so as to admit of increase within the next 10–20 years. Brickwork is used for the construction of the buildings, and the roofs are wood and cement. The walls of all the rooms except those of the administrative block are lined partly with polished stone, partly with cement, to a height of two metres above the floor. The floors consist of stone slabs set in cement (Fig. 1).

The administrative block (*A*) is situated at the entrance and is a three-storey building, containing an office, a room for examination of meat for trichinæ, and dwelling-rooms for the superintendent. In the central block (*B*) two slaughter-halls are provided (*a*) for swine and (*b*) for cattle and sheep. With these are associated (*c*) an engine-house, (*d*) a boiler and fuel room, (*e*) a workshop, (*f*) a passage communicating with the two slaughter-halls, (*g*) a cold chamber, (*h*) ante-rooms to the cold chamber, (*i*) dressing-rooms for assistants, and (*k*) stabling. The cold chamber has an area of 169 square metres and contains 28 cells of various sizes. In order to attain an even temperature of 2° C. to 4° C., air rendered cold by the ammonia process is conveyed to the room by channels. In the engine-house (*c*) are a 48-horse-power engine, the cooling machines, and the water-pump, which pumps water from a well into two cisterns situated in a water-tower over the passage between the two slaughter-halls. In the outbuilding (*C*) are (*a*) and (*b*), the gut-washing rooms for cattle and swine respectively, (*c*) an ante-room with (*d*) openings for manure to be thrown into carts. The road (*e*) slopes downwards, so as to enable a cart to be driven below the openings through which the manure is discharged. In the outbuilding (*D*) are (*a*) a horse slaughtering-room, (*b*) a stable, (*c*) a bathroom, (*d*) a room in which the floor washings are treated chemically or by filtration before discharge into the river, and (*e*) a urinal. In the outbuilding (*E*) are (*a*) a stable for sick animals, (*b*) a slaughter-house for diseased animals, (*c*) a sterilizing-room for meat to be subsequently sold in (*d*) the "Freibank," (*e*) a stable for horses, and (*f*) a cart-shed. The slaughter-house is to be lighted with electric light. The cost of the buildings is about £19,000, and provides for a population of from 20,000 to 25,000 inhabitants.

The slaughter-house at Düsseldorf is on a more extensive scale.

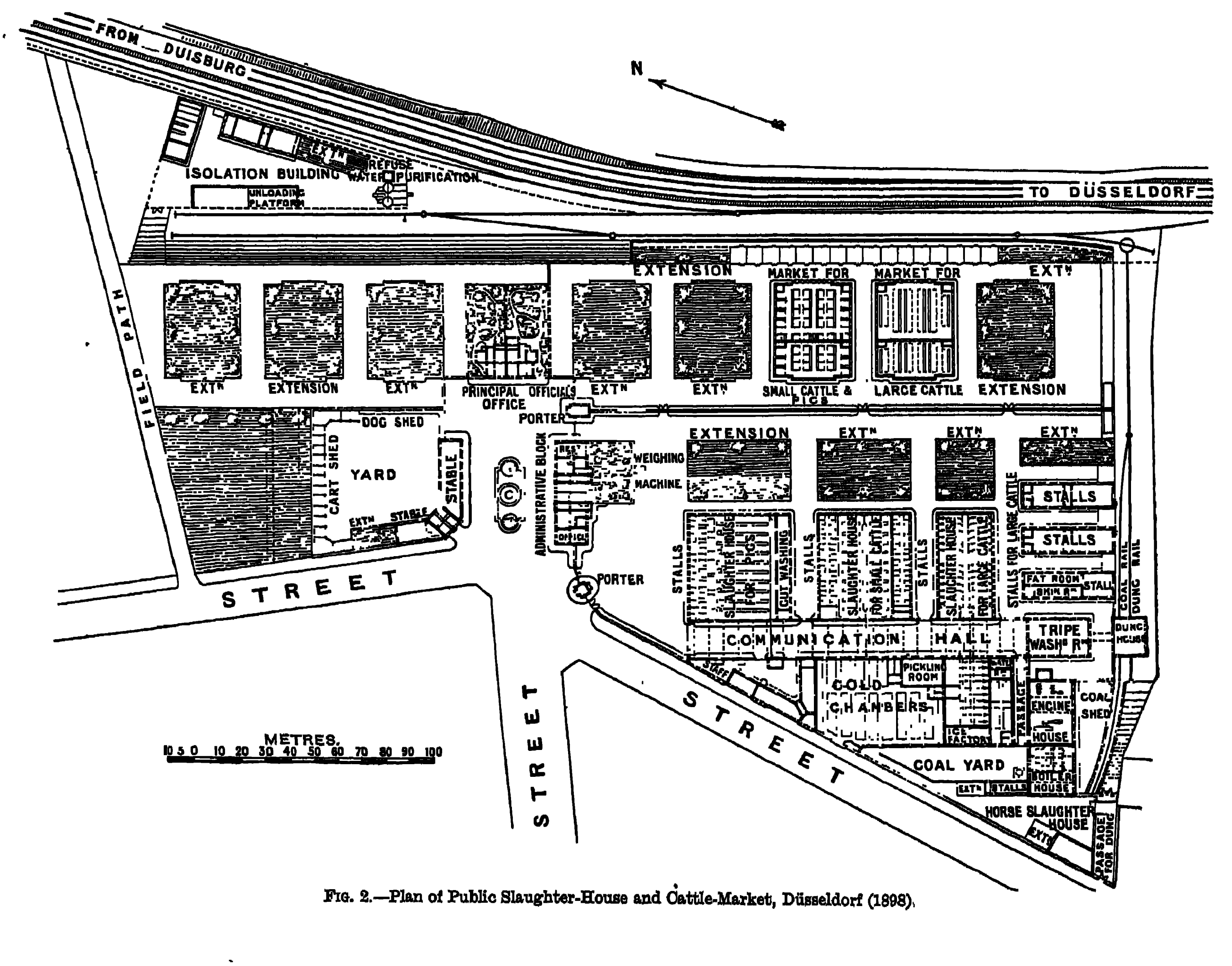


FIG. 2.—Plan of Public Slaughter-House and Cattle-Market, Düsseldorf (1898).

It was erected at an estimated cost of from £162,000 to £175,000, and covers an area of about 23·2 acres. Provision is made for each department to be practically doubled in size. It is unnecessary to describe it in any detail, but it may be noted that it has a market associated with it, and that separate slaughter-halls are provided for large cattle, for small cattle (sheep and calves), and for swine (Fig. 2). The population of Dusseldorf was 212,949 in 1900.

The average cost of slaughter-houses in Germany is given by Osthoff, of Berlin (*Handbuch der Hygiene*), as 7 to 8 marks per inhabitant if no cold chamber is provided, and from 10 to 12 marks per inhabitant if there is a cold chamber, or, in more detail, as follows :—

Number of Inhabitants.	Cost of Slaughter-house per Inhabitant, in Marks.	
	Without Cold Chamber.	With Cold Chamber.
5,000– 6,000 . .	8	12
6,000– 8,000 . .	7	10
8,000–15,000 . .	6	9
15,000–20,000 . .	7	10
Over 20,000 . .	8	10

Slaughter-houses in Germany pay their own expenses, the fees received for the use of the slaughter-house, and for examination of meat and stamping after examination, providing a sufficient sum for this purpose. The fees vary in different places. From the works of Osthoff and Schwarz it would appear that these fees average about one pfennig per kilogramme of the living animal, or about half a farthing per ℔ of meat.

In Chicago and certain other western American cities large numbers of cattle are slaughtered and the meat prepared for transmission to all parts of the world. The important feature of these slaughter-houses is their adaptation for rapidly dealing with the animals which they receive. At the Chicago slaughter-houses the cattle to be slaughtered are driven up a winding viaduct, by which, in certain of the houses, they eventually reach the roof. Each animal now passes into a narrow pen, where it is at once stunned by a blow on the head. It then falls through a trap-door in the pen into an immense slaughtering-room, where the hind legs are secured, and the animal hoisted by a wire rope suspended from a trolley-line. A knife is then plunged into its throat and the carcase made to travel along the line. The carcase is next lowered to the floor, the hide taken off, the head and feet cut off and the internal parts removed. The carcase again travels along the trolley-line to a place where it is divided into halves, which then, after washing, travel to the refrigeration-room, being trimmed while on the way. The extent of the business may be judged by the fact that over 400 cattle are killed per hour in the slaughtering-room. The cooling-rooms are so large that 13,000 halves of beef hang there at one time. The method of dealing with sheep is very similar. The animals are driven into narrow alleys, then into the slaughter-room, where their throats are cut. They next travel along a route where their skins and the internal organs are removed, and finally pass into the cooling-rooms. Swine are raised in the slaughter-room on to the trolley-line by a chain attached to the animals' feet and to a solid disc or wheel, which in revolving carries them until a mechanical contrivance throws the chain upon the trolley-line where a knife is plunged into their throat. In its subsequent passage the carcase is scalded, scraped by a machine through which it passes, later decapitated, the internal parts removed, and the interior washed. The carcase then travels to the cooling-room.

The use of public slaughter-houses has not been found to affect the price of meat, although one of the numerous arguments used by butchers against being required to slaughter in public slaughter-houses was that they would have this effect. The increasing recognition in European countries of the need for inspection, at the time of slaughter, of the flesh of all cattle intended to supply food for man, the necessity for the provision of public slaughter-houses to make such inspection practicable, the convenience which these slaughter-houses afford to those engaged in the business of butcher, combine to ensure that, at any rate in all populous places, they will in time entirely supersede private slaughter-houses, which offer none of these advantages.

No doubt the provision of public slaughter-houses will continue to be opposed by the butchers' trade so long as private slaughter-houses are permitted, and, as already stated, local authorities in England are discouraged from making public provision by their inability to prevent the continuance of the use of all existing private slaughter-houses. Probably the extension to English local authorities of the power which the law of Scotland gives to the commissioners of Scottish burghs of closing private slaughter-houses when a public slaughter-house has been provided, would facilitate the much-needed substitution of public for private slaughter-houses. (S. F. M.)

Sligo, a maritime county of Ireland, province of Connaught.

Population.—The area of the administrative county in 1900 was 442,205 acres, of which 73,364 were tillage, 236,818 pasture, 82 fallow, 7123 plantation, 35,716 turf bog, 6517 marsh, 65,382 barren mountain, and 17,203 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, comprises the whole of the old judicial county except 3 electoral divisions now added to Mayo. The population in 1881 was 111,578; in 1891, 98,013; and in 1901, 84,022, of whom 41,760 were males and 42,262 females, divided as follows among the different religions: Roman Catholics 76,194, Protestant Episcopalians 6362, Presbyterians 648, Methodists 529, and other denominations 289. The decrease of population between 1881 and 1891 was 12·16 per cent., and between 1891 and 1901, 11 per cent. The average number of persons to an acre in 1891 was ·21, and of the total population, 86,545 persons inhabited the rural districts, being an average of 178 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891 :—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr. Ep.	Presb.	Meth.
Read and write .	29,729	29,387	59,116	64·7	88·8	92·5	94·4
Read only	4,458	4,989	9,447	11·2	5·5	3·6	2·9
Illiterate	9,615	10,131	19,746	24·1	5·7	3·9	2·7

The percentage of illiterates among Roman Catholics in 1881 was 33·3. In 1891 there were 8 superior schools, with 296 pupils (Roman Catholics 189 and Protestants 107), and 226 primary schools, with 15,061 pupils (Roman Catholics 13,629 and Protestants 1432). The number of pupils on the rolls of the national schools on 31st December 1900 was 15,776, of whom 14,407 were Roman Catholics and 1369 Protestants. The following table gives the number of births, deaths, and marriages in various years :—

Year.	Births.	Deaths.	Marriages.
1881 . .	1999	1157	281
1891 . .	2011	1394	316
1900 . .	689	350	286

In 1900 the birth-rate per 1000 was 20·1 and the death-rate 16·1; the rate of illegitimacy was ·4 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 74,658, of whom 35,413 were males and 39,245 females. The only town of any importance in the county is Sligo, which in 1891 had a population of 10,274, and in 1901 of 10,862.

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 8281 and 7570. The rateable value in 1900 was £213,457. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 1 urban and 4 rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount

of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county:—

Year.	Wheat.	Oats.	Barley, Rye, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	324	25,907	1091	22,485	3362	1736	34,959	89,864
1891	387	17,892	726	16,382	2959	2225	33,534	74,105
1895	290	17,753	747	16,557	3184	2041	38,702	79,274
1900	288	14,388	697	14,658	2492	2859	37,982	73,364

For 1900 the total value of the cereal and other crops was estimated at £488,295. The number of acres under pasture in 1881 was 225,099; in 1891, 240,301; and in 1900, 236,818.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	8638	7806	89,238	59,837	18,934	4074	345,071
1891	9024	8835	93,376	88,228	24,748	6980	359,244
1895	9438	9045	94,460	75,474	27,441	6393	402,447
1900	7720	9727	96,351	72,572	29,042	6785	434,844

The number of milch cows in 1891 was 31,298, and in 1900, 31,374. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £1,383,087. In 1900 the number of holdings not exceeding 1 acre was 824; between 1 and 5, 1381; between 5 and 15, 5589; between 15 and 30, 4337; between 30 and 50, 1597; between 50 and 100, 781; between 100 and 200, 298; between 200 and 500, 129; and above 500, 35—total, 14,971. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 683, amounting to £128,957. The number of loans for agricultural improvements sanctioned under sec. 31 of the Land Act, 1881, between 1882 and 1901 was 512, and the amount issued £34,633. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £139,932.

Fisheries.—In 1900, 159 persons were employed in the salmon fishery district of Sligo.

Sligo, a maritime town, capital of the above county, on the river Garavogue, 137 miles north-west of Dublin by rail. Under the Local Government (Ireland) Act, 1898, it retains its mayor and corporation, but has practically the status of an urban district council. In all 740 vessels, of 107,060 tons, entered in 1900, and 607, of 66,012 tons, cleared. Population (1891), 10,274; (1901), 10,862.

Sliven, or Slivno, the chief town of a department in Eastern Rumelia, Bulgaria, near an important defile of the Balkans called the Iron Gate, 100 miles east-north-east of Philippopolis. Its black wine is still famous. Thoroughly modern machinery has been introduced into the Government factory, which employs about 300 hands; and the cloth manufacture for the army equals that of any other European country. Bulgarian home-spuns ("shayak") are also manufactured, and there is a small trade in silk. The general trade in staple articles is large. There is an important higher class school, with 40 professors and attended by about 800 pupils. Population (1892), 23,210; (1900), 24,542, of whom nine-tenths are Bulgarians.

Slobodskoi, a district town of Russia, in the government and 20 miles to the north-west of Vyatka, on the river Vyatka. It was founded in 1546 and is now a growing town. It has distilleries, match and glue works, tanneries and breweries, and carries on a brisk trade, chiefly in oats, flax, linseed, and wooden ware. Population (1897), 10,052.

Slocum, Henry Warner (1827–1894), American soldier, was born in Onondaga county, New York, 24th September 1827, and graduated at the United States Military Academy in 1852. He resigned in 1856 to practise law at Syracuse, N.Y. When the Civil War broke out he became a colonel (May 1861) of the 27th New York volunteers. He fought through the Virginia campaigns (1861–63), as brigadier and then as major-general of volunteers. In the west, in 1864, he occupied Atlanta in September, and led the left wing through Sherman's march of invasion. He resigned from the army, September 1865, resumed professional practice at Brooklyn, and was chosen to Congress, 1868, serving three terms. He died at Brooklyn 14th April 1894.

Slough, a market-town in the Wycombe parliamentary division of Buckinghamshire, England, 18 miles west of London by rail, and 2 miles north of Windsor. The Leopold Institute is a memorial of the Duke of Albany. The town has been formed into a civil parish (an urban district), comprising the parish of Upton-cum-Chalvey and part of Stoke Poges. Area, 1639 acres. Population (1891), 8713; (1901), 11,461.

Smaldeel. See Orange River Colony.

Small Arms.—British and Foreign.—For a table of the rifles in use up to 1880, a short history of the development of firearms, and a general description of manufacture (the last being much the same at the present time), the reader is referred to the article "Gunmaking" in vol. xi. of the *Ency. Brit.*, 9th edition. The rifle, however, now in the hands of the soldier, whether British or foreign, differs very greatly from that of 1880, being superior to the latter in velocity, range, penetration, and accuracy; while the cartridges, with which it is loaded, are charged with a smokeless explosive and contained in a magazine from which they are automatically fed, ready to be at once pushed home into the breech.

Repeating rifles.

The repeating or magazine system, now universally adopted, may be said to date back to about 1840, when the first repeating rifle was brought out by Colt in America. The Henry, Spencer, and Winchester (all American) systems followed, the last-named still holding the field, and being perhaps the proximate cause of the general adoption of the magazine in all military rifles; for in the Russo-Turkish war of 1877–78 some of the Turkish troops were armed with this rifle, and the rapidity of fire obtainable with it brought the repeating system prominently forward, with the result that by 1886 all the important Powers, with the exception of the United States, Great Britain, and Russia, had armed their troops with magazine rifles.

These earlier patterns were all of large calibre (that is, not less than ·45 inch), being frequently conversions of the single-loaders previously used to avoid the heavy outlay on a completely new armament; but the advantages of a smaller calibre were soon discovered, the earliest experiments in this direction having apparently been originated by Major Rubin in Switzerland in 1883. The smaller calibre brings with it certain distinct advantages, viz., a lighter bullet and smaller charge, and as a consequence a lighter cartridge; and a higher velocity without undue recoil, since the recoil varies directly as the weight of the bullet and charge. As a consequence of the lighter bullet, the soldier can carry many more

cartridges than formerly, while the absence of recoil combined with a flat trajectory enables him to shoot with far more accuracy and greater prospect of striking his foe. Owing to the trajectory of the British ·303-inch magazine rifle, when firing at an object 500 yards distant, never rising more than $4\frac{1}{2}$ feet above the direct line of sight, the British soldier is taught always to aim at the feet of his enemy when once he has come within that range, and not to alter his sights as the range decreases, since, if his aim be moderately correct, though he will hit the objective higher and higher up, he will still hit it somewhere. At a range of 350 yards the bayonet is usually fixed, and this always tends to cause low shooting at a time when excitement is apt to make men shoot high. The 500-yards sight is therefore termed the "fixed sight."[1]

Small calibre: advantages.

On the other hand, the small calibre has some very definite disadvantages. In order to get the requisite weight, a small-calibre bullet must be much longer proportionately than the larger-calibre bullet. The ·303-inch bullet, for instance, weighing only 215 grains, is 1·25 inches long, while the Martini-Henry bullet, ·45 inch in diameter and weighing 480 grains, is only 1·27 inches in length; and this greater length, as compared to diameter, necessitates a much sharper pitch of rifling in order to revolve the bullet sufficiently rapidly to keep it point first. The pitch in the British ·303 rifle is one turn in 10 inches, and in the Martini-Henry one turn in 22 inches.

Its disadvantages.

Bullets of the hardest lead when fired from barrels with this high-pitched rifling were found to "strip," that is, they were forced through the barrel without rotation being impressed on them, their surfaces being torn off. To remedy this, the lead bullet must be encased in an envelope of harder material (the envelope of the British bullet is made of cupro-nickel), and this hard envelope produces some exceedingly important effects. The enveloped bullet has a much higher penetrative power than one of lead only; but on the other hand there is no doubt that, unless it should happen to strike a large bone (more especially if it should do so when it first enters the body, as it then drives the splinters forwards), it does not inflict nearly such severe wounds, nor has it such a stunning effect as the old lead bullet. The cause is obvious: it cuts a small clean hole and does not deform. This fact is of great military importance, especially in warfare with savages, in which the chief danger is usually a rush of enormous numbers at close quarters.

A minor disadvantage arises from the fact that the hard envelope wears away the rifling of the barrel more rapidly than lead does; the latest pattern, British rifle, will, however, fire at least 8000 rounds before being sufficiently worn materially to impair its accuracy, and in ordinary circumstances any rifle will become unserviceable from other causes long before that number is fired. The advantages, however, of the small calibre have been judged to outweigh the disadvantages, and it has been universally adopted. (See the table at the end of this section.)

Smokeless powder.

As already stated, a smokeless explosive has been adopted universally. It is the natural concomitant of the magazine system, and without it the advantages of the latter would be enormously reduced, since in the case of a rapid fire with the old smoky powders the firer is quickly enveloped in a cloud of smoke, which, besides betraying his position to his enemy, prevents him from seeing to take aim. France was the first to recognize and take action in this matter, and in 1886 armed her troops with a small-bore magazine rifle firing a smokeless propellant.

Most nations arm their cavalry with carbines. The carbine generally has the same breech mechanism and fires the same cartridge as the rifle used by the infantry, but is much shorter and is rarely fitted for a bayonet. Italy is an exception, her carbine having a bayonet which folds under the carbine on a hinge. The carbine usually has a wooden hand-guard extending nearly to the muzzle, to enable it to be grasped, when heated by rapid firing, in almost any position, so that the trooper may not be hampered in hurried mounting. The bolt knob is also made to fold down more closely, to be convenient for carrying slung on the back, or in the leather sheath or carbine "bucket" on the saddle. (See Figs. 12 and 16.)

Automatic rifles.

Although no nation has yet armed her forces with an automatic rifle—that is, a rifle in which the recoil, or a portion of the gases of explosion, is used to do the work of opening and closing the breech which is now done by hand—it is not because such weapons have not been made to work practically. There are already some rifles, and more pistols, of this class before the world, notably the Maxim, Woodgate, Mannlicher, Bergmann, and Mauser. A perusal of the article on MACHINE GUNS in this work will show the principles on which automatic mechanism can be provided. So far the recoiling barrel has been mainly utilized. Of course, automatic rifles could not of necessity be so simple or so free from liability to damage as the existing rifles, and they would also probably be slightly heavier. Complication is, however, merely comparative, and many weapons of war which, with reasonable care, are now found to be perfectly serviceable for the roughest campaigning, would have been scouted as wholly unsuitable in the 'seventies. The gain in rapidity of fire with an automatic rifle should be out of all proportion to that due to merely getting rid of the time taken in working the bolt; for, with the slight recoil given by the light bullet of the modern rifle (especially if that recoil be largely absorbed in working the mechanism), it would appear possible with an automatic weapon to keep the eye continually on the sights and to maintain the aim, the recovery of aim being at present one of the great factors in the rate of fire, if accuracy be combined with rapidity. On the other hand, the potential waste of ammunition would be equally increased, and the rifles would be considerably more costly. Looking, however, to the past, it certainly appears more than probable that the adoption by any one great Power of the automatic system would force it on all.

British Rifles.—The Lee-Metford or Lee-Enfield magazine rifles or carbines, with which the British army and navy are armed, have the Lee breech and magazine mechanism and the Metford or Enfield system of rifling. The latter has superseded the former, as it stands the wear caused by the enveloped bullet more successfully. Compare Figs. 1 and 2. The various patterns (see General Table) differ only in details; the principle of the mechanism is the same in all, and they take the same cartridge and bayonet.

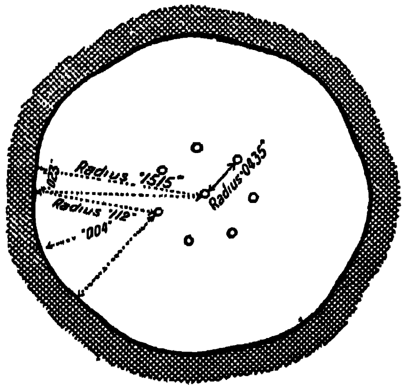


Fig. 1.

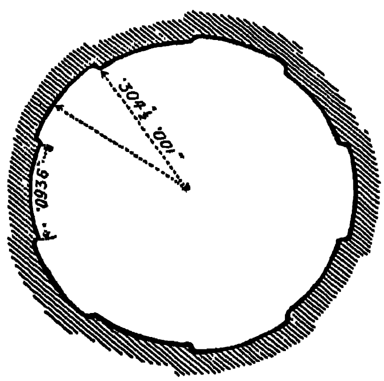


Fig. 2.

The breech (see Figs. 3 to 9) is closed by a bolt I, with bolt-head O, which slides in a "bolt-way" cut for it in the body B, much as does an ordinary door bolt. When pushed home, and the bolt knob turned down, the bolt is locked, the bolt-head O

[1] This applies especially when accurate range-finding is practically impossible. Of course there are occasions when alteration of sights should be made for short ranges.

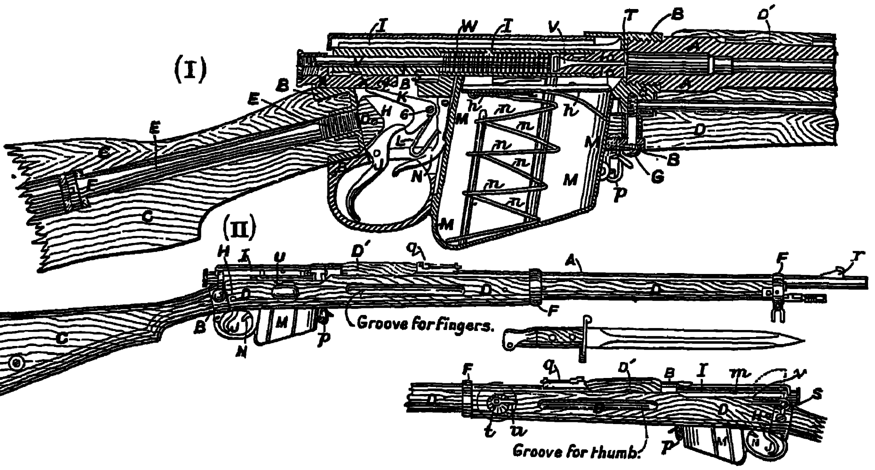


Fig. 3.

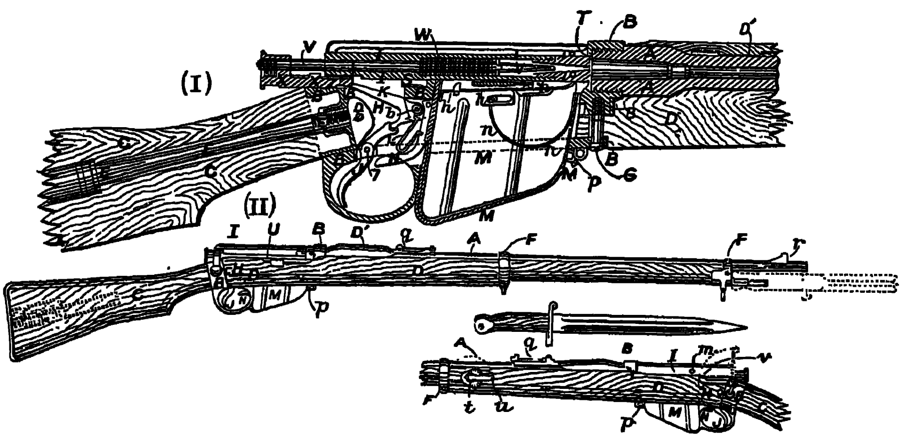


Fig. 4.

abutting against the base of the cartridge. Movement backwards is prevented by the rib P being brought in front of the lug Q on the body B, and a projection R (Fig. 6) being turned into the groove S in the interior of the bolt-way. Upward movement is prevented by the bolt being partially enveloped by the bolt-way and the bolt-head fitting into the recess T just in rear of the breech. The bolt contains the striker V and main spring W. The former is attached to the cocking-piece X. Supposing the bolt fully withdrawn (see Fig. 6) it is clear that as it is pushed forward the toe Y of the cocking-piece X will encounter the nose Z of the trigger sear K; and if the bolt be then pushed home, the spring W will be compressed, owing to the cocking-piece and striker being held back. If now the trigger J be pulled, the nose of sear K is depressed and the striker flies forward and fires the cartridge. When released, the striker can be cocked by pulling out the cocking-piece by hand. If placed on half-cock, the shape of the half-cock notch Z′ causes the sear nose to be locked and the trigger cannot be pulled. In the later patterns a safety catch is provided (see Fig. 10). This is a prolongation (d) of the cocking-piece X carrying a thumb-piece (f). When the latter is turned up, a half-round axis-pin (e) can be turned into either of the semicircular slots (b) or (c) on a prolongation (a) of the bolt I, and the cocking-piece is then locked to the bolt.

The magazine M is a detachable sheet steel box (see Figs. 3, 4, and 9). It is provided with a platform (h) pushed upwards by a spring (n). On this platform the cartridges (ten, in two parallel but overlapping columns of five, in the later patterns) rest, the spring (n) being compressed as the magazine is filled. The tops of the side walls of the magazine are bent inwards, and, while permitting the magazine to be filled with cartridges one by one, will not allow them to escape until pushed forward about an inch. Pivoted in the body is the "cut-off" or lid (g) (see Figs. 7 and 8). When this is closed, the cartridges in the magazine are kept down clear of the bolt-way.

When using the rifle as a single-loader the cut-off is closed, the bolt is withdrawn, and a cartridge placed on the cut-off and partially in the breech. It is then pushed home by the bolt, and as this is done the claw (k) of the extractor rides up over, and hooks on to, the cartridge's rim; consequently, when the bolt is withdrawn, the cartridge (fired or unfired) is pulled out with it, and is ejected, its base, on the side opposite to that held by the extractor claw, striking against the ejector screw (m) and being thus canted to the right and thrown clear of the rifle (see Fig. 7). It should be noted that, as the bolt is turned for opening, the projection R working in the cam groove S causes the bolt to recede very slightly and to draw back the cartridge correspondingly. Owing to leverage, this first shift can be effected with considerable power in case a cartridge should stick. Once shifted the cartridge case can be readily extracted, as it is coned. This action is termed "primary extraction."

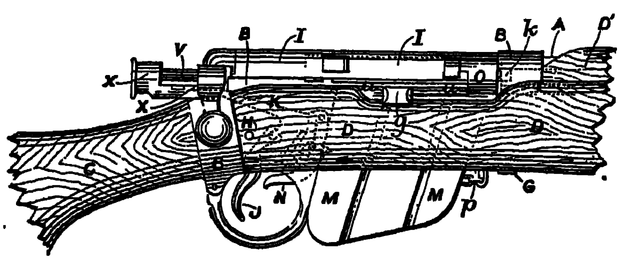


Fig. 5.

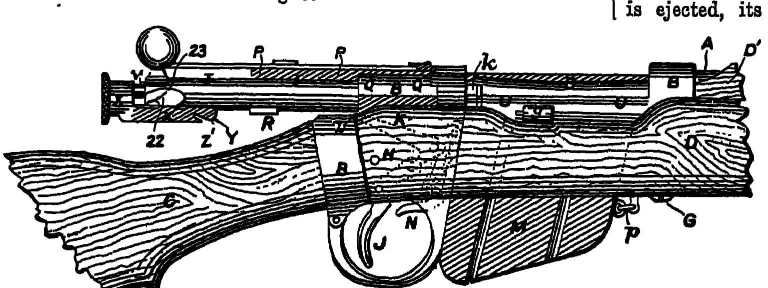


Fig. 6.

The forward part of the cocking-piece X has a stud X′, which, in combination with the cam groove 22 and projection 23 on the under side of the bolt I, performs the function of preventing the rifle from being fired when the breech is not properly closed, and also causes a slight withdrawal of the point of the striker when the bolt is opened. It should be observed in this connexion that the cocking-piece X, though it can move longitudinally, cannot *turn* with the bolt.

To load from the magazine (see Figs. 8 and 9) the cut-off (g) is opened. The cartridges immediately rise and a portion of the base of the top cartridge (o1) can be engaged by the bolt-head O and pushed into the breech. Immediately

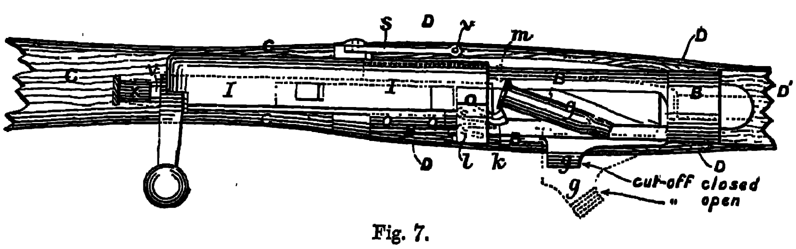
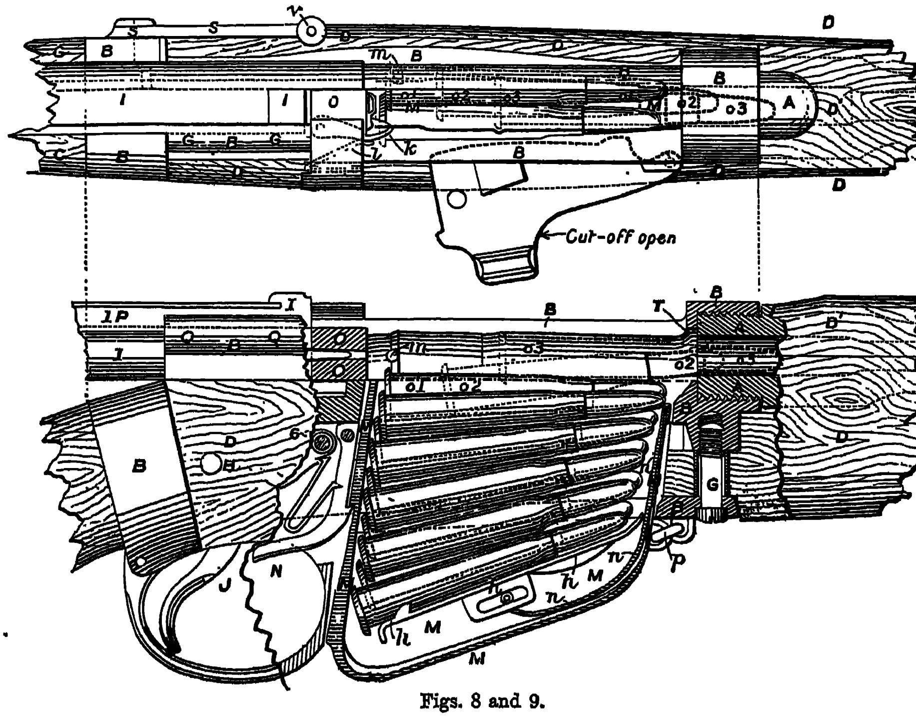


Fig. 7.

this cartridge is fired, extracted, and ejected, another cartridge rises in front of the bolt ready to be pushed home; (*o*1) (*o*2) (*o*3) represent the different positions of the cartridge, (*o*1), as it is pushed from the magazine into the breech.

The bolt, extractor, ejector, safety, and magazine actions, described above, are much the same in principle in all magazine rifles with box magazines, but the diversity of detail is considerable. The principal feature in which the British rifle differs from others is in the method of filling the magazine. The underlying principle of the British magazine is that the rifle shall be normally used as a single-loader, and exceptionally as a magazine weapon, the store of cartridges in the magazine being retained intact for emergencies. Continental Powers, on the other hand, with a few exceptions, have adopted rifles without cut-off, and always load from the magazine. To fill the latter rapidly the cartridges are carried packed in bundles of from three to six, in sheet metal or cardboard receptacles. These receptacles are of two kinds, "clips" or "chargers."

The clip, employed in the Mannlicher system, is used with a magazine with parallel walls, being held down in the magazine against the pressure of the magazine platform spring by means of a spring catch. It has its sides turned over at top and bottom to retain the cartridges until pushed forward some distance by the bolt; but openings are left through which the magazine platform spring can act on the cartridges, and also to permit the clip to fall out past the platform spring, through a hole in the bottom of the magazine, when empty (see Figs. 13 and 15). The charger, used in the Mauser system, does not enter the magazine, but is placed



Figs. 8 and 9.

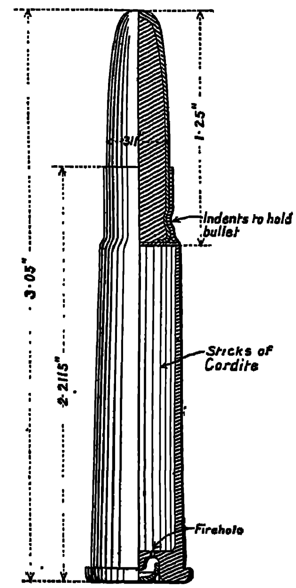


Fig. 11.

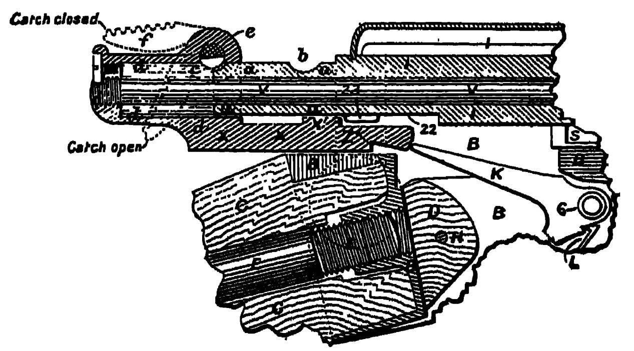


Fig. 10.

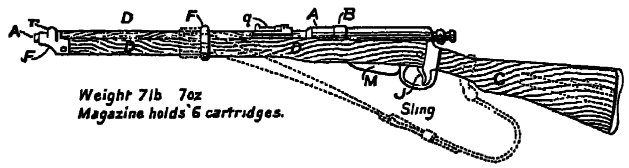


Fig. 12.

over the top of the magazine, and all the cartridges in it pushed by *one* motion into the magazine. A magazine with overlapping walls allowing entry but not exit (except, of course, by the push of the bolt) is necessary with a charger. The British rifle could be adapted easily for loading by charger, if this were considered desirable.

Besides the vertical box magazine systems there are the horizontal box and tube systems. The former, the Krag-Jörgensen, is described under the section *United States* below. The latter, the oldest European magazine system and termed the Kropatschek, consists of a tube under the fore end in which the cartridges lie base to point, being pushed backwards to the breech by means of a long spiral spring. By an extremely neat though intricate mechanism the cartridges are placed one by one on a pivoted carrier (*h*) and presented in front of the bolt (see Figs. 18 and 19). It is highly improbable that France would again adopt the tube system in any new pattern of rifle, as it has the following objections when compared with the box system, whether vertical or horizontal:—It is exceedingly cumbrous for an equal number of cartridges; its feed and cut-off mechanism is very complicated; the balance of the rifle is much more altered as the magazine empties; the placing of the cartridges base to point, even when the bullet has a flat point, is not unattended with danger, especially when the magazine is full and the spiral spring strongly compressed; lastly, loading by any form of charger is practically impossible.

As regards the foreign rifles and cartridges shown in Figs. 13 to 19, their principal features are as follows:—

Austria-Hungary.—Both the 1890 and 1895 patterns have "straight-pull" bolts; that is, bolts which are not turned for locking. The bolts are in two parts which "telescope" into each other. In the 1890 pattern (see Fig. 13) when the bolt I is home against the cartridge and the "lever cylinder" I′, which carries the bolt knob, is further pushed forward, the hinged block R is caused to drop in front of the resistance piece Q, and so locks the bolt I against the cartridge. In the 1895 pattern (see Fig. 14) the final pushing forward of the lever cylinder causes the head of the bolt I to turn and projections on its head to lock into recesses SS just in rear of the breech. The turning is due to helical feathers (20) on the inside of the lever cylinder I′ working in grooves in the rear of the bolt I. The trigger mechanism in the 1890 pattern is the "double pull," much used in Continental arms. It will be seen from the figure that as the trigger is pulled the bearing is taken first at (8) and then at (9). This gives, owing to the change of leverage, power at the commencement and rapidity at the end of the pull; and by this means a heavy pull, to give

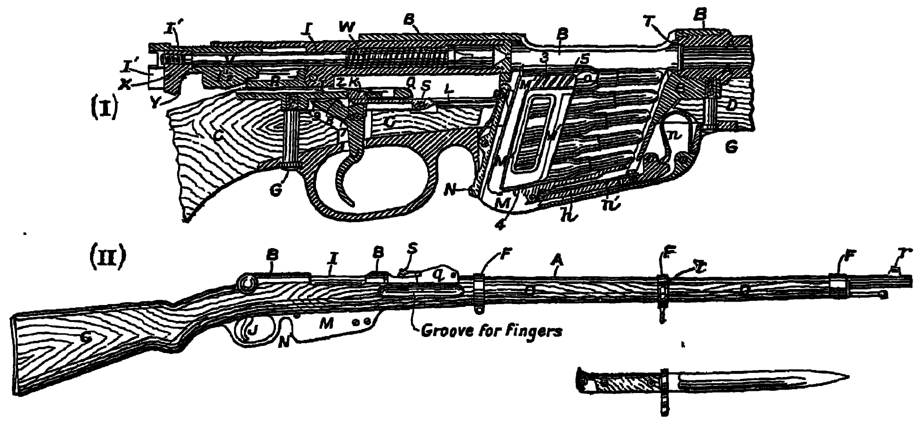


Fig. 13.

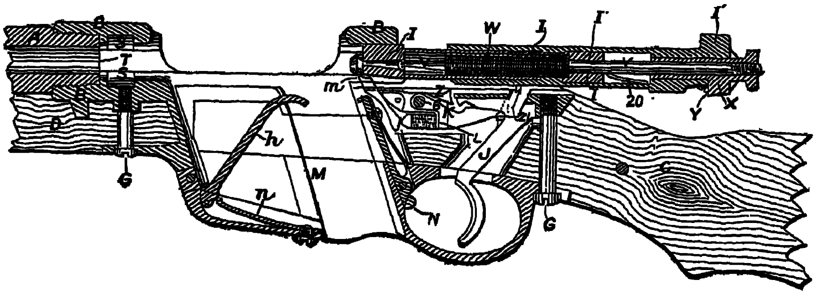


Fig. 14.

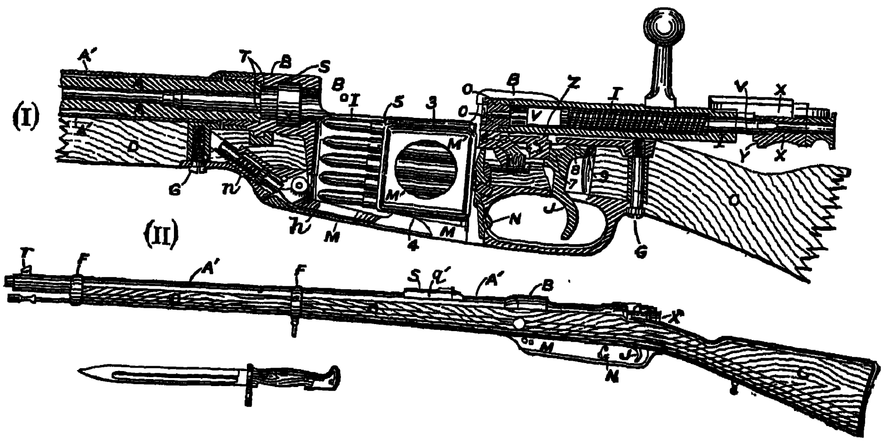


Fig. 15.

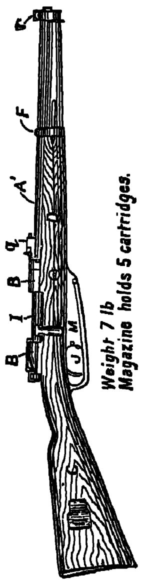


Fig. 16.

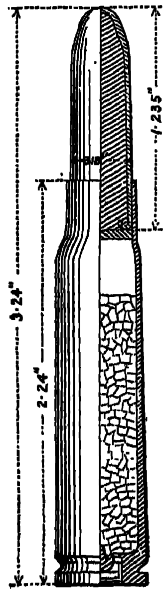


Fig. 17.

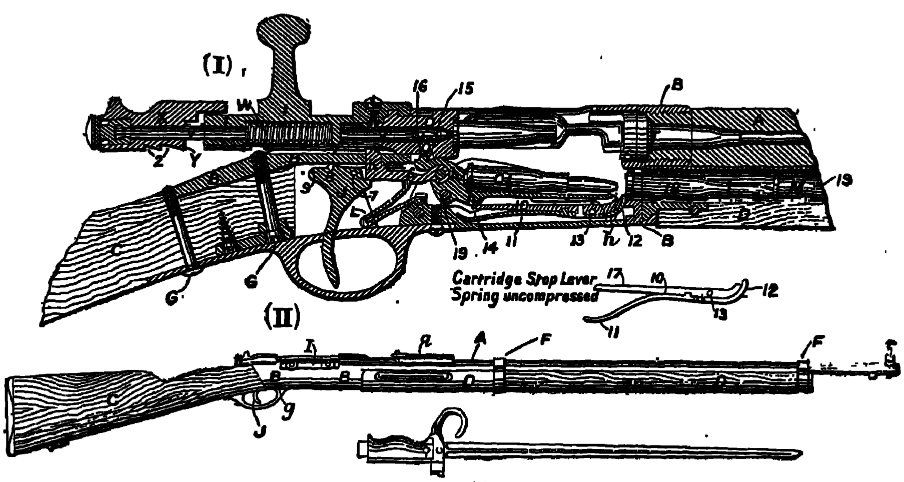


Fig. 18.

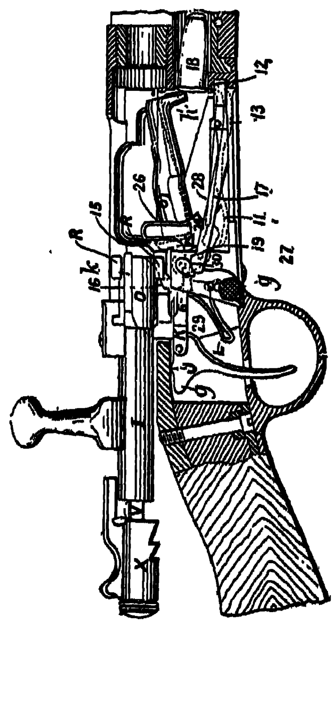


Fig. 19.

Details of Modern Military Rifles

Country	Austria-Hungary		Belgium	Denmark	France	Germany **	Great Britain		
Date of Pattern / Designation	1890 Mannlicher	1895 Mannlicher	1889 Mauser	1889 Krag-Jörgensen	1886 Lebel	1888 Pattern 1888	1888–92 Lee-Metford Mark I.*	1892–95 Lee-Metford Marks II. and II.*	1895–99 Lee-Enfield † Marks I. and I.*
Magazine System	Fixed vertical box	Fixed vertical box	Detachable vertical box	Fixed horizontal box	Tube in fore-end	Fixed vertical box	Detachable vertical box	Detachable vertical box	
Number of cartridges in magazine	5	5	5	5	8	5	8	10	
Charger or Clip	Clip	Clip	Charger	Charger §	Neither	Clip	Neither	Neither	
Out-off	No	No	No	Yes	Yes	No	Yes	Yes	
Safety catch	Yes	Yes	Yes	No	No	Yes	No	Mark II. no; Mark II.* yes	Yes
Weight of Rifle without Bayonet (lb oz.)	9 11	7 14	8 9	9 12	9 3½	8 6	9 8	9 lb 4 oz.	
Weight of Rifle with Bayonet (lb oz.)	10 8	8 9	9 9	10 4½	10 1½	9 4	10 7½	10 lb 3½ oz.	
Length of Rifle without Bayonet (ft. in.)	4 2	4 2	4 3	4 5	4 3	4 1¼	4 ft. 1·85 in.		
Length of Rifle with Bayonet (ft. in.)	5 0	5 0	5 0	5 3	5 11·8	4 9¼	5 ft. 1·45 in.		
Barrel: Calibre in inches	·315		·301	·315	·315	·311	·303		
Barrel: Number of grooves	4	Same as 1890 pattern	4	6	4	4	7		5
Barrel: Depth of grooves	·003		·0065	·0075	·0059	·0047	·004		·005
Barrel: Twist of rifling 1 turn in..inches	9·8		9·8	11·8	9·4	9·4	10		
Sights: Lowest for...yds.	246	246	547	436	278	273	200		
Sights: Highest for...yds.	2460	2132	2187	2078	2187	2242	2800; 2900 (mark I.*)		
Cartridge: Length in inches	3		3	3	2·95	3·24	3·05		
Cartridge: Total weight in grs.	455		441	404	447	421	415		
Bullet: Material of core	Hard lead		Lead	Lead	Hard lead	Hard lead	Hard lead		
Bullet: Material of envelope	Steel lubricated	Same as 1890 pattern	Cupro-nickel	Cupro-nickel	Cupro-nickel	Cupro-nickel	Cupro-nickel		
Bullet: Maximum diameter in inches	·323		·311	·323	·318	·3189	·311		
Bullet: Length in inches	1·262		1·205	1·181	1·26	1·235	1·25		
Bullet: Weight in grains	244		215	237	232	227	215		
Approximate muzzle velocity (M.V.) or observed velocity at 90 feet from the muzzle (O.V.) in feet per second	2034 (M.V.)		2034 (M.V.)	1968 (M.V.)	2074 (M.V.)	2034 (M.V.)	2000 (M.V.)		

Country	Holland	Italy	Japan §§	Portugal	Rumania	Russia	Spain	Sweden and Norway	Switzerland	Turkey	United States Army	United States Navy ‡
Date of Pattern / Designation	1895 Mannlicher	1891 Mannlicher-Carcano	1893 Murata	1886 Kropatschek	1893 Mannlicher	1894 "3-line" (Mauser)	1896 Mauser	1897 Krag-Jörgensen	1893 Schmidt-Rubin	1893 Mauser	1894 Krag-Jorgensen	1898 Lee "straight pull"
Magazine System	Fixed vertical box	Fixed vertical box	Tube in fore-end	Tube in fore-end	Fixed vertical box	Fixed vertical box	Fixed vertical box	Fixed horizontal box	Detachable vertical box	Fixed vertical box	Fixed horizontal box	Fixed vertical box
Number of cartridges in magazine	5	6	5	9	5	5	5	5	12	5	5	5
Charger or Clip	Clip	Clip	Neither	Neither	Clip	Charger	Charger	Neither §	Charger	Charger	Neither §	Charger
Out-off	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No
Safety catch	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Weight of Rifle without Bayonet (lb oz.)	9 11	8 6	9 2¼	10 3	8 12¾	9 0	9 7¼	9 5	9 13¼	9 1	9 8¾	8 7
Weight of Rifle with Bayonet (lb oz.)	10 8¾	9 2	9 12½	11 6	9 9½	9 12½	10 6¼	9 13	10 13¾	10 7¾	10 8½	9 3
Length of Rifle without Bayonet (ft. in.)	4 3	4 2½	3 11¾	4 4	4 0¼	4 3¼	4 1	4 2	4 3¼	4 0¾	4 1	3 11½
Length of Rifle with Bayonet (ft. in.)	5 5	5 2½	4 10¼	5 10½	4 10	5 8¼	4 11	5 0¾	5 3	5 6¼	5 0¾	4 7¾
Barrel: Calibre in inches	·2569	·2569	·315	·315	·2569	·3	·276	·254	·295	·302	·3	·236
Barrel: Number of grooves	4	4	4	4	4	4	4	4	3	4	4	6
Barrel: Depth of grooves	·0065	·006	·012	·0075	·0065	·006	·0055	·0055	·0055	·0055	·0045	·005
Barrel: Twist of rifling 1 turn in..inches	8	8·25 ‖	9·5	11	7·8	9·5	8·7	8	10·6	10	10	7½
Sights: Lowest for...yds.	436	437	328	328	437	310	437	109	328	273	300	300
Sights: Highest for...yds.	2187	2187	2187	2406	2187	2096	2187	2407	2187	2187	1900	2000
Cartridge: Length in inches	3	3·26	3	3·19	3	3	3	3·13	3	3	3	3·11
Cartridge: Total weight in grs.	351	332	474 (about)	546	350	307	377	372	430	416	444	311
Bullet: Material of core	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead	Hard lead
Bullet: Material of envelope	Steel coated with cupro-nickel	Cupro-nickel	Copper	Steel	Cupro-nickel	Cupro-nickel	Cupro-nickel	Steel coated with cupro-nickel	Steel (only covers head of bullet)	Steel coated with cupro-nickel	Steel coated with cupro-nickel	Copper nickel plated
Bullet: Maximum diameter in inches	·263	·267	·3295	·3228	·264	·308	·284	·263	·310	·311	·307	·243
Bullet: Length in inches	1·225	1·24	1·185	1·279	1·236	1·194	1·21	1·3	1·18	1·2	1·26	1·035
Bullet: Weight in grains	156	160	240	248	162	211	172	156	213	211	219	111
Approximate muzzle velocity (M.V.) or observed velocity at 90 feet from the muzzle (O.V.) in feet per second	2433 (O.V.)	2257 (O.V.)	2000 (M.V.)	1750 (M.V.) with black powder	2400 (M.V.)	1927 (O.V.)	2239 (O.V.)	2309 (O.V.)	1968 (M.V.)	2004 (O.V.)	1869 (O.V.)	2489 (O.V.)

† The Mark I.* only differs from Mark I. in not being fitted with a clearing rod.
§ A charger can be used with the Krag-Jörgensen system if desired.
‖ Increasing twist from 1 turn in 19¾ inches at breech to 1 turn in 8·25 inches at muzzle.
** Germany is re-arming with a new rifle (Pattern 1898) with charger loading on the latest Mauser system. This rifle has no barrel casing (see text); but it has the same calibre and muzzle velocity and takes the same cartridge as the 1888 pattern.
§§ Japan is re-arming with a new rifle (pattern 1900) on the Mauser system. It has a calibre of ·256 inches, O.V. of 2286 f.s., and is about 1 lb lighter than the 1893 pattern.
‡ The United States have decided to re-arm the navy with a rifle of the same calibre as that used by the army.

safety against accidental discharge, is combined with a light pull at the moment of firing. The loading by clip has been explained.

Germany.—The rifle (see Fig. 15) has a turning bolt, projections on the bolt-head being turned into recesses SS in rear of the breech to lock the bolt. The special feature of this rifle is the steel barrel casing A′, which permits the use of a lighter and cheaper barrel, since it protects the latter; it allows free expansion of the barrel when heated, facilitates equal radiation of the heat into the air-space between the barrel and casing, and mitigates the evil effects of warping of the stock. There are, however, also very obvious objections to this casing, and it has only been adopted by Germany, Belgium, and Denmark. The cartridge used is rimless (see Fig. 17). There is a slight advantage in this class of cartridge in that there is no necessity to make any provision for preventing the rim of a cartridge getting in front of the cartridge next above it. A reference to Fig. 9 will show that a jam would result if this occurred. The German clip can therefore be put into the rifle either way up, the Austrian clip in only one way.

France.—This rifle (see Figs. 18 and 19) calls for no special remark. Its bolt is very similar to that of the British rifle, and its special peculiarity—its tube magazine—has already been discussed.

The rate of fire with magazine rifles, if we merely reckon the time to load and *discharge* the rifle, may be taken roughly at ten rounds in about 15 to 20 seconds. This rate is, however, valueless for practical purposes. The only rate worth considering is that of *aimed* fire. This is roughly about three times that of a single-loader, and at a very easy target ten rounds might be fired with fairly good results in from 30 to 40 seconds.

Description of Figures.

Number of Figure.	Description.
1	Metford rifling.
2	Enfield "
3 (I.)	Lee-Metford, Mark I.* Section, breech closed, rifle fired.
3 (II.)	" " " " Side elevations of rifle and bayonet.
4 (I.)	" " " II. Section, breech closed, full cocked.
4 (II.)	" " " " Side elevation of rifle and bayonet.
5	" " " " Side elevation, breech closed, full cocked.
6	" " " " Side elevation, bolt fully withdrawn.
7	" " " " Top plan, bolt open, showing ejection.
8	Lee-Metford, Marks II. and II.* / Lee-Enfield, Marks I. and I.* — Top plan, showing magazine action.
9	" " " " Side elevation, and part section, showing magazine action.
10	Lee-Metford, mark II.* / Lee-Enfield, mark I. and I.* — Section of safety catch.
11	Cartridge, all magazine, and ·303 inch calibre arms. Part section and elevation.
12	Lee-Metford or Lee-Enfield carbine, mark I. Side elevation.
13 (I.)	Austro-Hungarian rifle, pattern 1890. Section, bolt withdrawn.
13 (II.)	" " " " " Side elevation.
14	" " " " 1895. Section, breech open.
15 (I.)	German rifle, pattern 1888. Section, bolt withdrawn.
15 (II.)	" " " " Side elevation.
16	German carbine, pattern 1888. Side elevation.
17	German cartridge. Part section and elevation.
18 (I.)	French rifle, pattern 1886. Section, bolt nearly withdrawn, fired, case about to be ejected, carrier depressed.
18 (II.)	French rifle, pattern 1886. Side elevations.
19	" " " " Section, bolt fully withdrawn, carrier raised.

Reference Table for Figures.

N.B.—The same letters and figures are used in all the plates to denote similar parts or parts which perform similar functions.

A. Barrel.
A′. Casing for barrel.
B. Body.
C. Butt.
D. Fore-end.
D′. Hand-guard.
E. Stockbolt (British rifle only).
F. Bands securing barrel to fore-end.
G. Screws securing butt and fore-end to barrel or body.
H. Rivet securing fore-end to body (British rifle only).
I. Bolt.
I′. Lever cylinder carrying knob (Austro-Hungarian rifle only).
J. Trigger.
K. Trigger sear.
L. Trigger sear spring.
M. Magazine.
M′. Clip for cartridges.
N. Magazine catch or clip catch with spring.
O. Bolt-head.
P. Bolt rib to strengthen bolt (British rifle only).
Q. Resistance pieces or lugs on body which take or assist to take the pressure on discharge.
R. Projections on bolt which lock against Q or into resistance grooves S.
S. Cam-shaped resistance grooves.
T. Recess at breech for bolt-head.
U. Groove for hook of bolt-head (British rifle only).
V. Striker.
W. Striker or main spring.
X. Cocking-piece attached to striker V.
X′. Projection on cocking-piece (Fig. 10 only) working in conjunction with (22) and (23).
Y. Toe of cocking-piece.
Z. Nose of trigger sear K.
Z′. Half-cock notch on cocking-piece X.

(*a*) Safety-catch projection. } Fig. 10 only.
(*b*) (*c*) Slots on projection (*a*).
(*d*) Body of safety catch.
(*e*) Axis of thumb-piece of safety catch.
(*f*) Thumb-piece of safety catch.
(*g*) Magazine lid or cut-off (British rifle), or thumb-piece for action lever (27) of French rifle.
(*h*) Magazine platform or carrier for cartridges.
(*h′*) Horns on front of carrier (French rifle only).
(*k*) Extractor and extractor claw.
(*l*) Extractor spring.
(*m*) Ejector screw or lever.
(*n*) (*n′*) Magazine platform spring.
(*o*1) Top cartridge in magazine.
(*o*1) (*o*2) (*o*3) Positions of top cartridge as it is being pushed from the magazine into the breech.
(*p*) Attachment link of magazine (British rifle only).
(*q*) Back-sight bed and leaf.
(*q′*) Short leaf of back-sight (German rifle only).
(*r*) Fore-sight.
(*s*) Long range back-sight.
(*t*) " " fore-sight.
(*u*) Bead of (dial) long range fore-sight. } British rifle only.
(*v*) Aperture of long range back-sight. } British rifle only.

(1) Axis of falling block R (Fig. 13 only).
(2) Wedge of lever cylinder (Fig. 13 only).
(3) Top slot of clip } (Figs. 13 and 15 only).
(4) Bottom slot of clip } (Figs. 13 and 15 only).
(5) Front top corner of clip, at which point the cartridge is freed from the clip (Figs. 13 and 15 only).
(6) Axis of trigger sear.
(7) Axis of trigger.
(8) (9) Points of bearing of trigger against body with "double pull-off."
(10) Cartridge stop lever. } French rifle only.
(11) " " " spring.
(12) " " " beak.
(13) " " " axis.
(14) Projection under carrier (*h*).
(15) " " bolt-head O.
(16) " on top of carrier (*h*).
(17) Long arm of cartridge stop lever.
(18) (19) Cartridges in magazine (French rifle only).
(20) Helical feathers for revolving bolt-head (Fig. 14 only).
(21) Retaining bolt preventing bolt I from being entirely withdrawn from body B. In this rifle it is worked by pushing the trigger J *forwards* (Fig. 14 only).
(22) Cam groove in rear of bolt. } Figs. 6 and 10 only.
(23) Projection in cam groove (22) } Figs. 6 and 10 only.
(24) (25) (26) Arms of a lever working in conjunction with the action lever (27) for single or magazine loading (French rifle only).
(27) Action lever. } French rifle only.
(28) Action lever spring. } French rifle only.
(29) (30) Inclined faces on end of action lever spindle, working in conjunction with action lever spring (French rifle only).

(H. W. B.)

UNITED STATES.

Rifles.—The United States magazine rifle, calibre ·30, model 1892, adopted after exhaustive competitive tests and improved in the models 1896 and 1898, is upon the Krag-Jörgensen system. The fixed magazine for five cartridges is placed horizontally under, and also to the left side of, the receiver. The normal use of the rifle is as a single-loader, a cut-off allowing the cartridges in the magazine to be held in reserve. The main advantages claimed for this reserve magazine rifle over a clip-loading repeating rifle, designed only for magazine fire, are its convenient use as a single-loader, the full reserve of ammunition always instantly available for the supreme moment in an action, the moral support which a knowledge of this reserve is presumed to give, and the restraint upon officers and men produced by the desire to retain it intact until the instant when its expenditure shall produce the greatest effect. This restraint, however, requires greater fire discipline on the part of the soldier. With guns of the repeating non-reserve type, a slightly more rapid fire can be obtained than from a reserve magazine rifle, but with the disadvantage that, at the very moment when the highest rate of firing is most desired it is probable that the soldier may find his gun either empty or only partially full.

The Krag-Jörgensen model.

The principal parts of the rifle are as follows:—The barrel (B, Fig. 20) is rolled from open-hearth steel of an elastic limit of 70,000 ℔ and an ultimate tenacity of 120,000 ℔ per square inch; annealed, bored, turned, chambered, tested at a high proof pressure, rifled, finished and oil-tempered to compress the bore initially; length 30 inches; rifling, uniform twist, one turn in 10 inches; 4 grooves ·004 of an inch deep; width of grooves, in terms of land, 3. The receiver (R) is a solid forging, machined to shape, having a hole or well to receive the bolt (O), the magazine (M) and a connecting channel enlarged in front so as properly to direct the passage of the cartridge from the magazine into the chamber (C) of the barrel. Excepting this channel, which is to the left, the bottom of the receiver is closed, and affords a smooth surface on which cartridges may be placed when using the arm as a single-loader. Fig. 20 is a sectional view of the operating parts, consisting of the bolt and magazine mechanism.

The bolt mechanism consists of the bolt (O), sleeve (V), extractor (X), safety lock (Y), firing pin (F), and striker (K), and main spring (Z). The bolt moves backwards and forwards and rotates in the well-hole of the receiver; it carries a cartridge, either from the

magazine, or one placed by hand in front of it, into the chamber, and supports its head when fired. The locking lug (L) will sustain any powder pressure liable to occur. The sleeve unites the parts of the bolt mechanism and directly carries the extractor; their rotation with the bolt is prevented by their engagement in the opening between the walls of the receiver. The hook of the extractor engages the rim of the cartridge case, and retains the head of the latter in

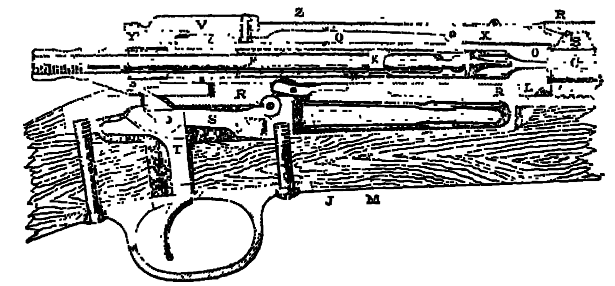


Fig. 20.

the countersink of the bolt until the case is thrown out by the ejector (J), operated at the end of the rear movement of the bolt by a groove in the under surface of the latter. The safety lock prevents accidental firing of the piece. The firing pin is made of two pieces—the rod, with its cocking-piece (P) below, and the separate striker (K) easily removed for repairs.

The gun having been discharged, to remove the empty cartridge, reload, and fire, the bolt mechanism operates as follows:—To open the bolt, raise the handle until it comes into contact with the sleeve, then pull directly to the rear until the locking lug strikes the shoulder of the receiver. Raising the handle rotates the bolt and separates the locking lug from the shoulder of its recess in the receiver. This separation is made easy by the slight inclination to the axis of the receiver of the vertical planes containing the rear surface of the locking lug and the shoulder of the recess. This rotation of the bolt causes a cocking cam on its rear under surface to force back the cocking-piece and firing pin, withdrawing the point of the striker and partially compressing the main spring (Z). Closing the bolt by a reverse motion compresses the main spring and cocks the piece completely, seats the cartridge in the chamber, and forces the extractor hook over the rim of the cartridge case. Pulling the trigger (T) releases the sear (S) and allows the firing pin and striker to move forward and strike the primer, firing the cartridge.

The magazine mechanism (Figs. 21 and 22) includes the gate (G), carrier (A), follower (W), magazine spring (N), hinge bar (H), and cut-off (U). Fig. 21 represents a cross section of the gun through the point of ejector, the bolt closed, the magazine filled and "off."

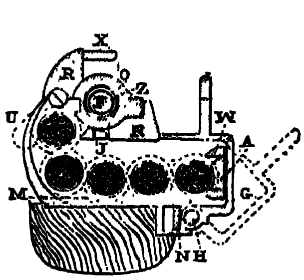


Fig. 21

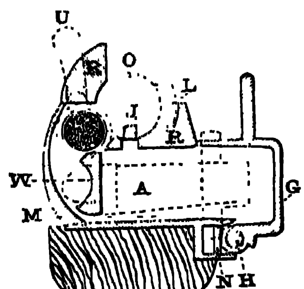


Fig. 22.

Fig. 22 shows the same cross section, when all but the last cartridge have been fired; the magazine is "on" and the bolt opened.

To charge the magazine, open the gate, by revolving it to the right on the hinge bar pin (see dotted lines, Fig. 21), insert the cartridges by hand or from a quick-loader, and then close the gate. As the gate is opened the carrier is retracted, leaving an unobstructed opening for the insertion of the cartridges. As the gate is closed the magazine spring swings the carrier into the magazine against the last cartridge inserted. When the thumb-piece of the cut-off is turned up the magazine is "on" (see Fig. 22). The spindle of the cut-off is then in its hole in the upper wall of the magazine channel and permits the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward through the magazine channel and well of the receiver into the chamber, the point of the bullet being directed by a ramp on the receiver. When the cut-off thumb-piece is turned down the magazine is "off" (see Fig. 21). The point of the cut-off spindle then bears on the rim of the upper cartridge and holds it down in the magazine channel below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The stock with hand-guard is of walnut. The sight is graduated up to 2000 yards and provided with adjustment for windage, and jointed ramrod and oiler are carried in a hole in the butt. The bayonet is of the knife pattern and is carried in a metal scabbard with hook for attachment to woven cartridge belt holding 100 cartridges; weight of belt and cartridges, 7·4 ℔; weight of gun, 9·2 ℔. The United States magazine carbine, model 1899 (see Fig. 23) is practically the same as the rifle, using the same cartridge, giving about 80 feet per second less velocity. The stock and mountings are different, the barrel 22 inches long, and the total weight about 8 ℔.

The ball cartridge (see Fig. 24) consists of the case A, the bullet B, the primer C, and the charge of smokeless powder D. The bullet has a core of tin and lead composition, jacketed with cupro-nickel steel, weight 220 grains, velocity, fired in the rifle, 2200 feet per second. The maximum pressure is about 48,000 ℔ per square inch.

Forty-two aimed shots have been fired in two minutes with the arm, used as a single-loader, and 43 shots in the same time, using magazine. The maximum range is about 4400 yards. The penetration in white pine at 53 feet from the muzzle is about 56·5 inches.

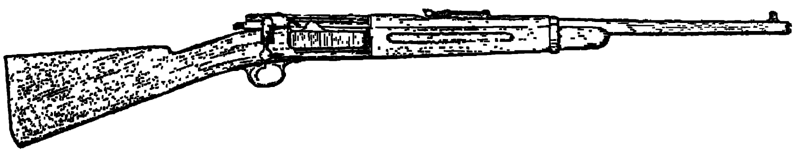


Fig. 23.

The infantry and foot artillery of the army are armed with the rifle, and the cavalry with the carbine; both of them passed successfully the crucial test of field service in the Spanish-American war. In addition to the ready use of the United States magazine rifle either as a single-loader with magazine in reserve or as a magazine arm, the following mechanical advantages are claimed for this gun:—(1) The mechanism requires but little force to operate. The first portion of the motion of unlocking the bolt and starting the empty cartridge shell, the final seating of the cartridge, and the locking,

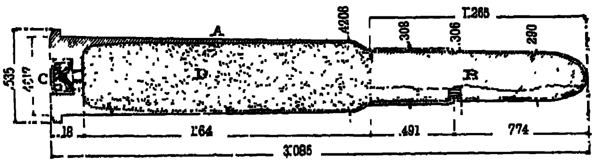


Fig. 24.

are accomplished by a motion of rotation, bringing into play the assistance offered by cams on the bolt and receiver. The compression of the main spring is given in the same manner, and not by a direct forward push of the hand against the main spring; (2) The locking lug which supports the bolt at discharge is at the forward end, with two supplementary supports in the nature of a rib and a lug farther to the rear; (3) The cut-off can be easily seen by the squad leaders and operated with full, partially full, or empty magazine; (4) The magazine is readily charged or replenished with single cartridges, or loaded by charging packets or quick-loaders, but these devices do not constitute any essential part of the mechanism; (5) The magazine can be charged whether the bolt is opened or closed, and whether the gun is adjusted for magazine or single-loader fire; (6) The bolt is in a single piece, without any separate bolt-head—the extractor does not rotate with the bolt; (7) If the bolt be not entirely closed upon pulling the trigger, the action of the main spring closes and securely locks the bolt before the firing pin can reach the primer; (8) In case of miss-fire the piece is cocked either by turning the handle up and down or by pulling the firing pin directly to the rear by means of its thumb-piece; (9) The mechanism is simple, strong, and composed of few parts, assembled with a minimum of screws or pins. The bolt can be readily removed and the bolt and magazine mechanisms easily dismounted or assembled without the use of special tools.

The United States magazine rifles and carbines, sabres and swords, are made at the Springfield Armoury, Springfield, Massachusetts, established in 1795. The capacity of the armoury is 500 magazine rifles per day. A small-arms plant of about the same size is being installed at Rock Island Arsenal and Armoury, Rock Island, Illinois.

Both these armouries are under officers of the ordnance department of the army. The national guard is armed with the Springfield rifle and carbine, calibre ·45, mostly model 1884. The model 1888 has a ramrod and bayonet combined.

The breech mechanism of the *Springfield rifle* consists of a receiver or frame, and a breech lock which rotates around a hinge pin perpendicular to the bore of the gun, above the bore and in front of the block. Fig. 25 represents a section of the breech mechanism by a vertical plane through the axis of the receiver, with the several parts projected thereon, showing their relative position.

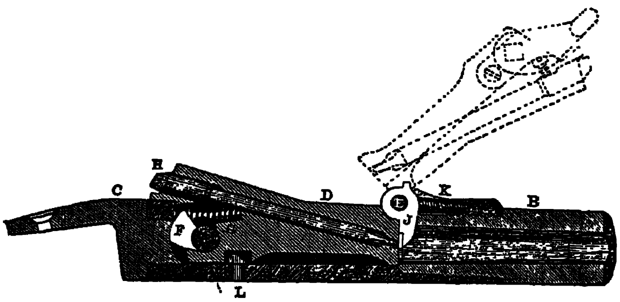


Fig. 25.

The barrel (B) is screwed into the receiver (A). The principal parts of the breech mechanism are the breech block (D), the hinge pin (E), the cam latch (F), the cam latch spring (G), the extractor (J), and the ejector spring and spindle (K). The breech block has an oblique hole through it for the firing pin (H). The hinge pin hole is elongated in the direction of the axis of the bore. The hinge pin passes through two holes in the lugs in the receiver. The cam latch locks the breech block in firing by entering a circular recess in the breech screw (C). The axis of the cam shaft projects on the right side, and to it is attached a thumb-piece, by which the cam latch is operated. This axis fits loosely. The extractor is mounted on the hinge pin, and part of its extremity is cut into such shape as to form, when in place, a part of the counterbore of the chamber, in which the rim of the cartridge rests. To load, the cartridge is inserted in the chamber in advance of the face of the breech block, when the block can be closed and locked (Fig. 26). When the piece is fired the breech block moves bodily slightly to the rear, owing to the elongation of the hinge pin hole. Owing to this motion of the block and to the loose fit of the cam latch shaft in its hole in the block, the pressure of the powder gas is transmitted directly through the breech block and the body of the cam latch to the breech screw, and there is no strain on the hinge pin or cam

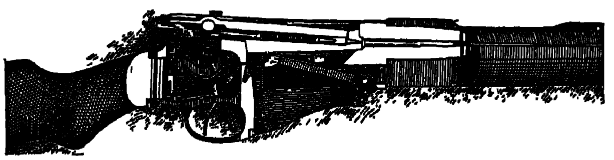


Fig. 26.—Action Closed.

latch shaft. The bearing of the cam is above the centre of the breech screw, the resistance of which tends to press the rear end of the breech block downward and forward under pressure of the powder gases. The block is opened by pressing the thumb-piece forward, which disengages the cam latch from the recess (Fig. 27). When the block has nearly completed its upward rotation it strikes against the projecting lug of the extractor and rotates the latter slowly, thus partly extracting the empty cartridge case. When the rear end of the ejector spindle passes below the axis of the hinge pin, the extractor becomes an ejector, and, with accelerated motion, completes the withdrawal of the shell and throws it against the ejector stud (L) and out of the gun. The Springfield rifle, without bayonet, weighs 9·3 ℔; the carbine, similar in construction, 7·9 ℔. The rifle cartridge consists essentially of a rim brass case, a lubricated bullet weighing 500 grains, and a charge of smokeless powder substituted for the 70 grains of black musket powder formerly used, giving the same velocity, 1316 feet per second, and about the same pressure, 25,000 pounds per square inch.

For uniformity the United States navy and marine corps have adopted the "Army Magazine Rifle," calibre ·30, which will gradually replace the United States navy rifle, model 1895, calibre 6 millimetres (approximately 0·2362).

This latter arm is known as the *Lee straight-pull rifle*, and is essentially a rapid-fire or repeating arm, rather than a magazine gun, since there is no provision for cutting off the supply of ammunition from the magazine and using the arm as a single-loader while the magazine contains cartridges. It may be used as a single-loader if the magazine be not charged, but in general it will be used as a repeater, five cartridges in a clip being entered in the magazine and the gun not being loaded until the charge is exhausted. In case loose ammunition is furnished, the magazine may be charged with single cartridges, any number from one to five being entered.

The motion of the hand, while not strictly "straight-pull," is such in effect that the operator makes no motion other than in a

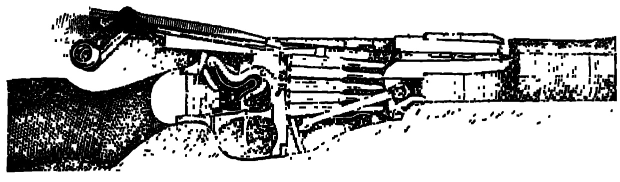


Fig. 27.—Action Open.

direction straight to the rear, the shape of the cam and the cam seat causing the rear end of the bolt to rise in the first part of the motion, carrying the hand with it. The extraction of the cartridge case is accomplished by the motion to the rear of the extractor, a hook-shaped piece moving in a groove on the left side of the receiver and acted upon by a flat spring. The extractor does not move to the rear until the bolt has moved about 1⅝ inches, when the front lug on the bolt strikes it and draws it to the rear with a sudden jerk. The ejection of the cartridge case is accomplished when the bolt has been fully drawn to the rear by the tail of the extractor striking the bevelled front face of the bolt-stop, which arrests it suddenly and imparts to it a quick, short, transverse motion, which ejects the empty case. The retraction of the firing pin is caused by the first motion of the lever handle, which brings the nib of the lever handle to bear against the cocking toe of the firing pin and pushes it to the rear, the bolt during this time having practically only an upward motion of its rear part. At the same time the nib of the lever handle slips into a notch in the cocking toe of the firing pin, preventing any forward motion of the firing pin with respect to the bolt. The cocking of the firing pin is caused by the sear arresting the forward motion of the firing pin (in closing the breech) while the bolt moves on, compressing the main spring. The locking lug is part of the bolt, and is a rectangular lug on the under face. In closing the breech, in the final motion of the bolt (which is down), the locking lug is seated and bears against a corresponding shoulder in the lower part of the receiver. In opening the breech, the first motion of the bolt is upward, raising the bolt so that the locking lug clears the shoulder and the bolt can move to the rear. Safety devices are provided to prevent the bolt from being opened until the piece is fired, and to lock the firing pin when the gun is cocked.

Cartridge.—A cannelured cartridge, weight about 309 grains, having a charge of 33 grains of smokeless powder and a hardened lead bullet, with a copper jacket plated with tin, weighing 112 grains, is used. The maximum chamber pressure is 49,000 ℔ per square inch. The bullet has a velocity of 2550 feet (777·24 metres) per second at 60 feet from muzzle, with the consequent advantage of a very flat trajectory. The weight of the loaded belt,

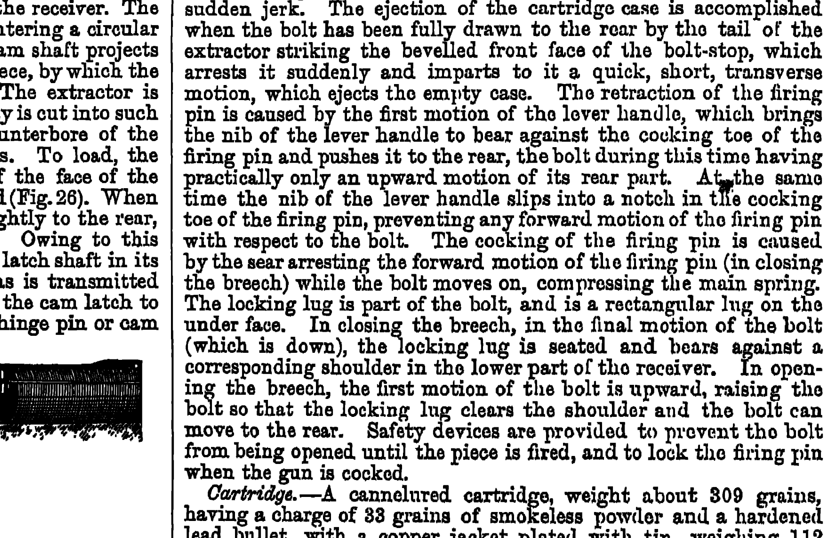


Fig. 28.—Action closed.

containing 180 cartridges in 12 pockets of 3 clips each, is about 9¾ ℔.

The *Winchester repeating rifle, calibre* ·30, *model* 1895, is a fixed box magazine lever-action gun (Figs. 28 and 29).

The receiver, open at the top, permits the symmetrical lockings of the breech-bolt. The first opening motion of the lever withdraws the trigger from contact with the sear, before the gun is

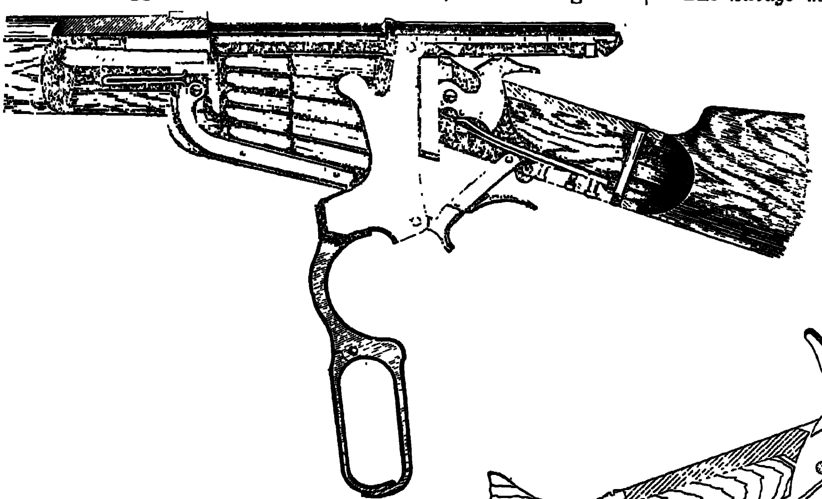


Fig. 29.—Action open.

unlocked, so that it is impossible to fire the gun except when fully locked. The continued opening motion of the lever draws down the locking bolt and withdraws the breech-bolt, cocking the gun and ejecting the cartridge or fired shell. The breech-bolt, passing over the hammer, presses the firing pin lock against the latter, and makes fast the firing pin. When the breech-bolt is in its rearmost position, the hammer is made to hold it open by contact, so that the magazine may be easily loaded. When in this position, the upper cartridge in the magazine is so presented as to engage the breech-bolt.

The closing action of the lever carries forward the breech-bolt, forcing the cartridge out of the magazine into the chamber. After the breech-bolt has reached its closed position, the locking bolt is lifted into place, first locking the gun and afterwards unlocking the firing pin. The final closing movement of the lever presents the trigger against the sear, leaving the gun in position for firing. The magazine, of the box type, contains five cartridges, and the number in the magazine can always be known by opening the gun, if light serves, or by feeling, if light fails. The magazine follower presents the cartridges to the lower front edge of the breech-bolt in position to be forced into the chamber, and is arranged to prevent the escape of the cartridge following before the preceding one is in the grasp of the extractor, thus preventing the jamming of the gun by false movement.

The *Remington-Lee rifle* (see Fig. 30) is a box magazine rifle, arranged to load with a filler or clip containing five cartridges. It is manufactured to fire the ·30 calibre army, the 6 millimetre navy, and other small-calibre smokeless cartridges.

This rifle is also made of the same general form, with a flat cut-

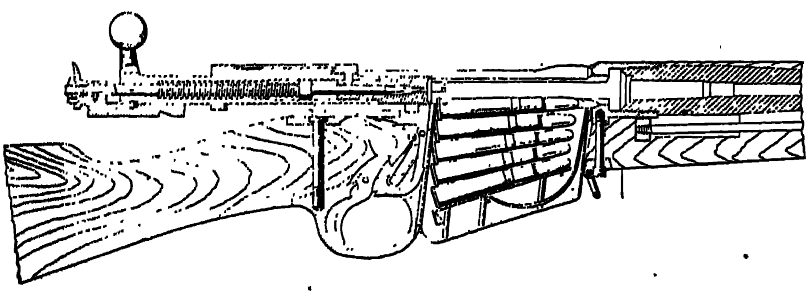


Fig. 30.

off which can be pressed in, forming a false bottom for the receiver, so as to convert the gun into a single-loader, or with detachable magazines, a number of which, filled with cartridges, can be carried in a belt, so that the rifle can be used as a repeater for rapid continuous fire. The Remington Armoury, at Ilion, N.Y., also manufactures the single-loader small-bore rifle for smokeless powder, to meet the demand on the part of Mexico and Central and South American countries for a simple system for certain troops (Fig. 31).

The *Savage magazine rifle, model* 1899, is a "hammerless," lever-action repeating arm, with a revolving cartridge carrier in a fixed magazine under the receiver for five rimmed cartridges, charged one at a time by hand. It can be used readily as a single-loader (Figs. 32 and 33).

The magazine is charged while the system is open. The finger-lever (A) is opened to its fullest extent (see Fig. 32). The cartridges are inserted into the magazine by pushing them down and under the catch (B) on the automatic cut-off (C). A sixth cartridge can be placed in the breech-opening (D) above the catch (B). On closing the finger-lever (A) the cartridge in the

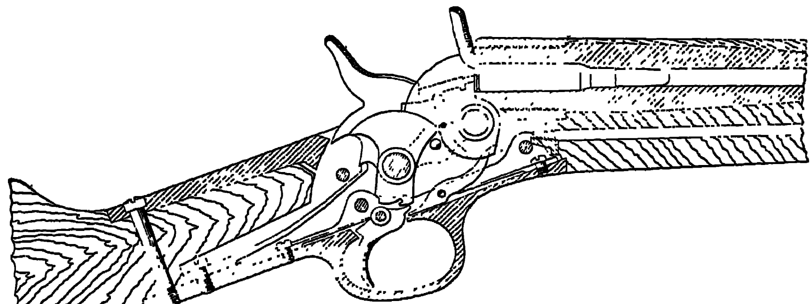


Fig. 31.

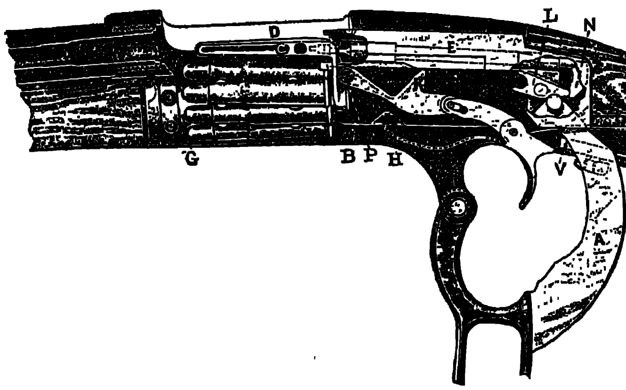


Fig. 32.—Action Open.

breech-opening (D) will be carried forward by the breech-bolt (E) into the chamber of the barrel, making the rifle ready to fire.

In using the rifle as a single-loader, the placing of a cartridge in the breech-opening (D) forces the automatic cut-off (C) back into its recess in the receiver, retiring the uppermost cartridge in the magazine below the line of movement of the breech-bolt (E), so that only the cartridge in the breech-opening will be engaged by the breech-bolt on its forward travel. For magazine fire, there being no cartridge in the breech-opening (D), but one or more cartridges in the magazine, the breech-bolt (E) on its forward travel, will engage and carry forward into the barrel chamber the uppermost cartridge in the magazine. The automatic cut-off (C) has on its face a projection which ejects the fired shells, after being withdrawn by the extractor (F) on the breech-bolt (E). The numerals on the magazine carrier (G) show, through the opening in the receiver, the number of cartridges contained in the magazine. The breech-bolt (E) is positively operated by the finger-lever (A), without any intermediate mechanism, and when closed, ready for firing, is immovably locked by the finger-lever resting on a solid projection at (H) in the receiver. The recoil of the discharge is supported at (U), and is in the direct line of the strain. The breech-bolt (E) carries the extractor (F), a retractor (L), the hammer (N), the main spring (O), and indicator (Y). The firing mechanism is operated as follows:—If the rifle has been fired, the act of opening the finger-lever, and thereby the breech-bolt, locks a retractor (L) by engagement with the sear pin (P), and the hammer (N, with firing pin) is positively retracted and held back from the

face of the breech-bolt. The closing movement of the breech-bolt brings the hammer (N) in engagement with the face of the sear (K), compressing the main spring (O), and the rifle is fully cocked. The

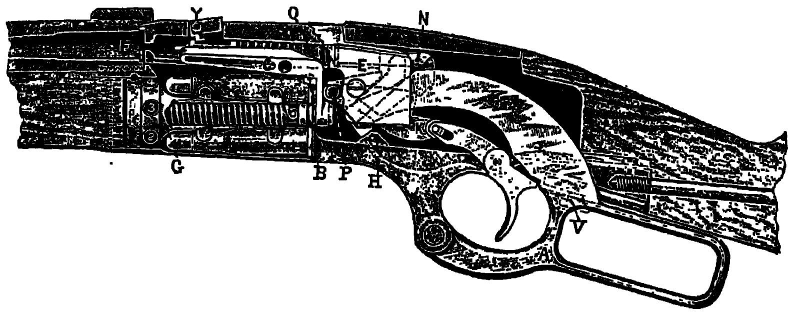


Fig. 33.—Action closed.

action can be locked by pushing forward the lock (V), which locks the trigger and lever. The indicator (Y) shows the position of the firing mechanism.

Revolvers.—The *Colt's double-action revolver, calibre* ·38, *model* 1896, is used in the United States army. The United States navy revolver, calibre ·38, model 1895, is practically the same arm. The revolver can be cocked by hand before each fire, or the cocking and firing can be accomplished by simply pulling the trigger.

Revolvers.

The revolver consists of the barrel (B), the cylinder (C) with six chambers, the frame (F), and the firing mechanism, all of steel. The muzzle velocity with a charge of 16 grains of black powder and a bullet of 150 grains of lead, is about 708 feet per second, giving at 25 yards a penetration of about 5 inches in pine. Eighteen shots can be fired in 44 seconds, loading each chamber

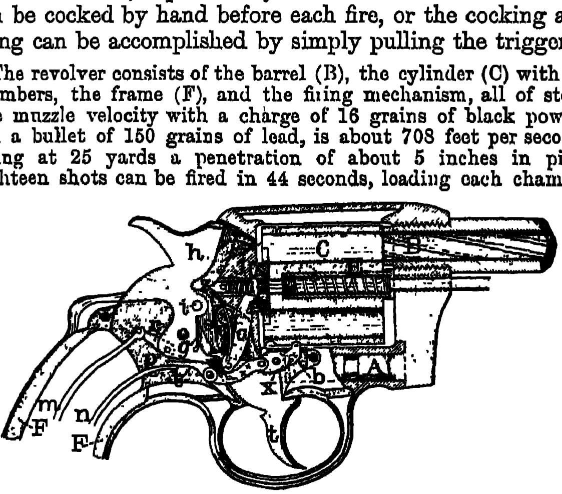


Fig. 34.

separately, and beginning and closing with cylinder closed and chambers empty (Figs. 34 and 35).

The lock mechanism consists of the hammer (*h*), with its stirrup (*r*), stirrup pin (*p*), strut (*s*), strut pin (*i*), strut spring (*g*); the trigger (*t*); the rebound lever (*l*); the hand (*a*), with the spring (*z*); the cylinder bolt (*b*), with its spring (*x*); the locking lever (*v*); the main spring (*m*), and rebound lever spring (*n*). The hammer (*h*), trigger (*t*), and rebound lever (*l*) are pivoted on their respective pins, which are fastened in the left side of the frame. The lower end of the rebound lever spring (*n*) is secured to the frame and the free end bears under the rear end of the rebound lever so that the latter, when the trigger is released, cams the hammer back to its safety position, and forces the trigger forward. Pressure upon the trigger causes its upper edge to engage the strut, and thereby raises the hammer until nearly in the full-cock position, when the strut will escape from the trigger, and the hammer, under the action of the main spring, will fall and strike the cartridge. A projection on the upper part of the trigger, working in a slot in the frame, prevents the cylinder from making more than one-sixth of a revolution at a time by entering one of the grooves nearest the rear end of the surface of the cylinder. When the cylinder is swung out of the frame, the parts are arranged to prevent the cocking of the hammer. The cylinder bolt is pivoted on the trigger pin, and its spring, bearing on the rebound lever arm, causes the nose of the bolt to project through a slot in the frame ready to enter one of the rectangular cuts in the cylinder surface. During the first movement of the trigger in cocking the revolver, the nose of the bolt is withdrawn, allowing free rotation of the cylinder. The object of the bolt is to prevent rotation of the cylinder in transportation. The hand is attached by its pivot to the trigger, and, as the latter swings on its pin when the hammer is being cocked, the hand is raised and revolves the cylinder, and also serves to lock the cylinder in position at the time of firing. An abutment on the side plate supports the hand spring in rear. The spring ensures the engagement of the hand with the ratchet (*y*). The revolver is cocked by hand by withdrawing the hammer by the pressure of the thumb until its full-cock notch engages in the rear sharp corner of the trigger. Pulling the trigger then releases the hammer, allowing its firing pin (*f*) to move forward and strike the cartridge.

The locking lever is pivoted by its screw in a recess in the left side of the frame, and so connected with the latch that it locks the hammer and trigger when the latch is pushed to the rear for opening the cylinder, and does not unlock them until the cylinder is positively closed and is locked by the latch. The cylinder revolves and is supported on a central arbour of the crane (E). The crane fits in a recess in the frame below the barrel and turns on its pivot arm (A). The ejector rod with its spring passes through the centre of the cylinder arbour and is terminated in rear by the ejector with a ratchet (*y*). Pushing against the front end of the ejector rod will empty the chambers, the cylinder being swung out for loading. The thumb-piece of the latch (*j*) slides to the rear in the left side of the frame, unlocking the cylinder for opening, but upon closing the cylinder, the body of the latch firmly enters a recess in

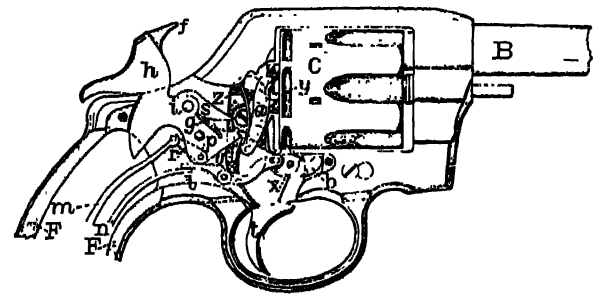


Fig. 35.

the ejector, locking the cylinder in position for firing. The barrel is firmly screwed to the frame. The Smith and Wesson revolvers are essentially of the divided frame type, the barrel and cylinder tipping downwards on a pivot in the lower forward part of the frame, at the time of loading the cartridges or ejecting the shells. The ejection is automatic.

The Colt Automatic Pistol, calibre ·38. The action of this pistol is semi-automatic, the trigger being slightly pulled for each shot fired. The magazine being charged with cartridges and in position, the first cartridge is loaded into the barrel by pulling the slide to the rear, and fired by pulling the trigger, when the operations of extracting the empty cartridge case, reloading a new cartridge into the barrel, and cocking the piece, are performed automatically.

The pistol (Figs. 36 and 37) consists of four main parts: the frame (F), the barrel (B), the slide (S), and the magazine (M). The frame

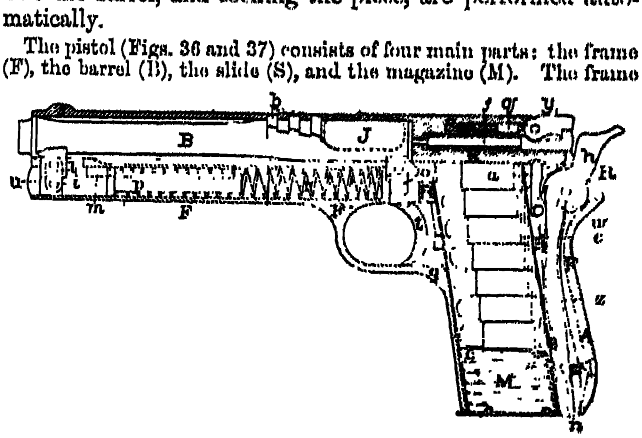


Fig. 36.

forms, at its rear and lower part, the handle (A), which is hollow, and contains the seat for the magazine. After being charged with seven cartridges, the magazine is seated from below and held in place by the magazine catch (*n*), which slightly projects from the bottom of the handle. This projection serves to release the magazine from the catch, when it can be readily drawn from the

handle for re-charging. In front of the handle is the trigger guard (g), in which the trigger (t) is found, and in the rear and above the grip the firing mechanism is placed in the part of the frame called the receiver (R). The firing mechanism consists of the hammer (h), the sear (w), the trigger (t), a safety device (a), the main spring (z) and sear spring (e), the lower part of the latter serving to operate the magazine catch. The top of the receiver extends forward from the handle, and to it the barrel is attached by two short links, one (l) near the front end of the barrel, and the other (o) at its rear end; these links are pivoted to the receiver and also to the barrel, and allow the barrel to swing rearwards thereon. As both links are of the same length, the rearward movement of the barrel in swinging on these links carries the barrel slightly downwards, but keeps its longitudinal axis in parallel positions during all its movements. Below the barrel the receiver forms a tubular seat for the retractor spring (r), which in front is closed by a plug (u) fastened in the receiver by the lower pivot-pin (i) of the front barrel-link. The upper surface of the receiver and two longitudinal grooves on its sides form the seat for the slide which is guided thereon in its rearward and forward movements. The rear part of the slide forms the bolt or breech block (K), and the front part forms a partly tubular cover (s) which encloses the barrel. In the forward part of the receiver is a transverse mortice extending through the retractor spring seat, and transverse recesses in the forward part of the slide serve to admit a key (m) which, passing through the sides of the slide and through the mortice, serves to lock the slide to the frame. The retractor spring (r), in its seat in the frame, consists of a spiral spring, the rear end of which rests against the receiver, and the front end of which

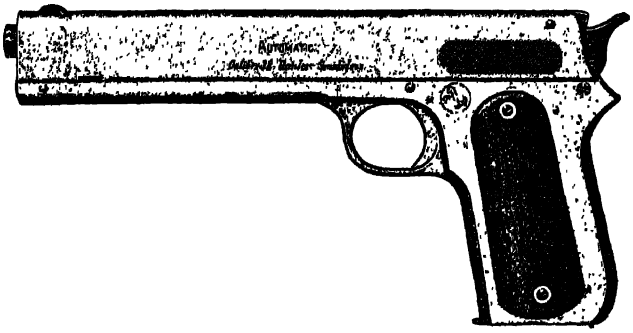


Fig. 37.

carries a piston (p). The rear face of the key (m) has a slight recess, and when the key is in its place the front end of the retractor spring rests in this recess, thereby confining the key laterally. The tension of the retractor spring is exerted to force the key and the slide to their forward position. Upon the barrel are provided three transverse ribs (b), and in the interior of the slide are three corresponding recesses. These serve to lock the barrel and the slide firmly together when in their forward position. Between the locking recesses and the bolt, the slide has an opening on its right side for the ejection of the cartridge cases (J), and the bolt is provided with an extractor, a firing pin (f), a firing pin retraction spring (q), and a firing pin lock (y). This latter is pivoted at the rear end in the top of the slide, and when depressed, locks the firing pin in its retracted position, thus preventing its point from coming in contact with the cartridge primer. When raised, the firing pin lock releases the firing pin, and in this position also serves as the rear sight, being provided on the top with a sighting notch.

The *operation* of the pistol is as follows:—When a charged magazine (M) is inserted, the slide (S) is drawn once to the rear by hand, thereby cocking the hammer (h). In this position of the slide, the carrier (c) and carrier spring in the magazine raise the topmost cartridge so as to bring it into the path of the bolt (K). On releasing the slide, it, with the bolt, is carried forward by the retractor spring (r), and during this movement the bolt forces the topmost cartridge into the barrel (B). As the slide approaches its forward position the front of the bolt encounters the rear end of the barrel and forces the latter to its forward position. During this forward movement the barrel swings forward and upward on the links (l, o), and thus the locking ribs (b) on the barrel are carried into the corresponding locking recesses in the slide. The barrel and slide are thereby positively interlocked, and the pistol is ready for firing.

A slight pull on the trigger (t) now serves to move the sear (w) so as to release the hammer (h) and fire a shot. The force of the powder gases driving the bullet from the barrel is exerted rearwardly against the bolt, and, overcoming the inertia of the slide and the tension of the retractor spring, causes the slide and the barrel to recoil together. After moving rearwards together, for a distance, enough to ensure the bullet having passed from the barrel, the downward swinging movement of the barrel releases the latter from the slide and stops the barrel in its rearmost position. The momentum of the slide causes the latter to continue its rearward movement, thereby again cocking the hammer and compressing the retractor spring, until, as the slide arrives at its rearmost position, the empty shell is ejected from the side of the pistol and another cartridge raised in front of the bolt. During the return or forward movement of the slide, caused by the retractor spring, the cartridge is driven into the barrel, and the slide and barrel are interlocked, thus making the pistol ready for another shot. These operations may be continued so long as there are cartridges in the magazine, each discharge requiring only the slight pull on the trigger. The pistol is provided with a safety device (a) which makes it impossible to pull the trigger so as to release the hammer unless the slide and barrel are in their first forward position, and safely interlocked. (J. T. T.)

Smart, Henry (1813–1879), English organist and musical composer, born in London, 26th October 1813, was the son of a violinist, and nephew of Sir George Smart. After studying for the legal profession, Smart turned to music and worked with W. H. Kearns. In 1831 he became organist of Blackburn Parish Church, where he wrote his first important work, a Reformation anthem; then of St Giles's, Cripplegate; St Luke's, Old Street; and finally of St Pancras, in 1864, which last post he held at the time of his death, 6th July 1879, less than a month after receiving a Government pension of £100 per annum. Although Smart is now known chiefly by his compositions for the organ, which are numerous, effective, and very melodious if not strikingly original, he wrote many vocal works, including some of the best specimens of modern part songs. His cantata *The Bride of Dunkerron* was written for the Birmingham Festival of 1864; *Jacob* for Glasgow, in 1873; and his opera, *Bertha*, was produced with some success at the Haymarket in 1855. In the last fifteen years of his life Smart was, to all intents and purposes, blind.

Smell. See PHYSIOLOGY, *Special Senses.*

Smetana, Friedrich (1824–1884), Bohemian composer and pianist, was born at Leitomischl, 2nd March 1824. He made such rapid progress in his studies under Ikavec, at Neuhaus, that at the age of six he appeared in public as pianist so successfully that his father's opposition to a musician's career was overcome. He then went to Proksch, at Prague, until, a spirit of restlessness seizing him, he left for Leipzig to make the acquaintance of Schumann and Mendelssohn. Limited means prevented him from studying with the latter, and he returned to Prague, where he at once became Konzert-meister to the Emperor Ferdinand. In 1848 he married Katharin Kólar, pianist, and with her founded a music school at Prague. At the same time he met Liszt, who subsequently influenced him greatly, and with whom he afterwards stayed at Weimar. In 1856 Smetana accepted Alexander Dreyschock's suggestion to go as conductor of the Philharmonic Society at Gothenburg. There he remained five years, when, owing to his wife's ill-health, he returned to Prague after a successful concert tour. The death of his wife at Dresden on their return, caused Smetana to change his mind, and he went back to Sweden. But the opening of the Interims Theater in 1866, and the offer of its conductorship, induced his return. In Sweden he had already written *Hakon Jarl*, *Richard III.*, and *Wallenstein's Lager*, and had completed his opera *Die Brandenburger in Böhmen* (5th January 1866). Five months later it was followed by his best-known opera, *Die Verkaufte Braut*, and in 1868 *Dalibor* was given. Between 1874 and 1882 he produced *Zwei Witwen*, *Hubicka* (*Der Kuss*), *Tajewstvi* (*Das Geheimniss*), *Certova Stena*, and *Die Teufelsmauer*, as well as the "grand prize" opera *Libuse*, written for the opening of the National Theatre at Prague, 11th June

1881. In *Die Teufelsmauer* were clear signs of decay in Smetana's powers, he having already in 1874 lost his sense of hearing. To celebrate his sixtieth birthday a fête was arranged by the combined Bohemian musical societies; but on that day Smetana lost his reason and was removed to a lunatic asylum, where he died, 12th May 1884. A great deal of his pianoforte music is interesting, the *Stammbuchblätter*, for example; while his series of symphonic poems, entitled *Mein Vaterland* (*Vlast*), and his beautiful string-quartet, *Aus meinem Leben*, have made the tour of the civilized world. He was an admirable pianist, and in many ways justified his countrymen's title of the "Czechish Beethoven." (R. H. L.)

Smethwick, a municipal borough (1899) in the Handsworth parliamentary division of Staffordshire, England, 3 miles west of Birmingham by rail. Among modern buildings are two Established churches and a Roman Catholic church. Victoria Park (35 acres) was opened in 1888, and West Smethwick Park in 1895. Area, 1872 acres. Population (1891), 36,170; (1901), 54,560.

Smichow, chief town of a government district in Bohemia, Austria, on the left bank of the Moldau, opposite Prague, with which it is connected by a bridge and in which it is now practically merged. Population (1890), 32,646; (1900), 47,094, mostly Czech.

Smiles, Samuel (1812——), British author, was born at Haddington, 23rd December 1812. He was educated there and at Edinburgh University, where he studied medicine; and for some years practised as a surgeon at Haddington. Abandoning the medical profession he took to journalism, and from 1838 till 1844 edited the *Leeds Times*. Though he gave up regular journalism in 1844, he continued to be a frequent contributor to periodicals. From 1845 till 1854 he was secretary of the Leeds and Thirsk Railway, and from 1854 till 1856 of the South-Eastern Railway. In 1857 he published a *Life of George Stephenson*, which was the precursor of a series of biographies from the world of industry, such as *Lives of the Engineers* (3 vols., 1861–62), *Industrial Biography* (1863), *Lives of Boulton and Watt* (1865), *The Life of a Scotch Naturalist* (Thomas Edwards) (1876), *Life and Labour* (1887), *A Publisher and his Friends* (a history of the house of Murray, under "glorious John") (1891), *Jasmin* (1891), *Josiah Wedgwood* (1894). In 1859 appeared *Self-Help*, a volume of popular ethics which was very widely read. Its success prompted successors, such as *Character* (1871), *Thrift* (1875), *Duty* (1880). Dr Smiles (who was made hon. LL.D. of Edinburgh University) also published two works dealing with the history of the Huguenots, and a *History of Ireland*.

Smith, Goldwin (1823——), British historian, educational reformer, and publicist, was born at Reading on 13th August 1823. He was educated at Eton and Magdalen College, Oxford, and after an undergraduate career of exceptional brilliancy was elected to a fellowship at University College. A Liberal in his outlook, not only on politics but on every aspect of life, he threw his keen intellect and trenchant style into the cause of university reform, the leading champion of which was another fellow of University College, Arthur Penrhyn Stanley. On the Royal Commission of 1850 to inquire into the reform of the university, of which Stanley was secretary, he served as assistant-secretary; and he was secretary to the commissioners appointed by the Act of 1854. His position as an authority on educational reform was further recognized by a seat on the Popular Education Commission of 1858. In 1868, when the question of reform at Oxford was again growing acute, he published a brilliant pamphlet, entitled *The Reorganization of the University of Oxford*. Besides the abolition of tests, effected by the Act of 1871, many of the reforms there suggested, such as the revival of the faculties, the reorganization of the professoriate, the abolition of celibacy as a condition of the tenure of fellowships, and the combination of the colleges for lecturing purposes, were incorporated in the Act of 1877, or subsequently adopted by the University. Among those that have not yet found favour are "the creation of a responsible department of government with adequate powers for the visitation of endowed institutions," to which would be transferred all powers now vested in the Privy Council or in the Visitors of Colleges, "with regard to the amendment of statutes or the appropriation of revenues"; the abolition of religious tests in the theological faculty, and its conversion into a department of unfettered research; the conferment only of real degrees; the election of the vice-chancellor by congregation; the abolition of the Hebdomadal Council, and what he calls "the most indispensable though perhaps the most difficult reform," the abolition of the Convocation of non-resident graduates. He gave the counsel of perfection that "pass" examinations ought to cease; but he recognized that this change "must wait on the reorganization of the educational institutions immediately below the University, at which a passman ought to finish his career." His aspiration that colonists and Americans should be attracted to Oxford has been realized by Mr Rhodes's will. On what is perhaps the vital problem of modern education, the question of ancient *versus* modern languages, he pronounces that the latter "are indispensable accomplishments, but they do not form a high mental training"—an opinion entitled to peculiar respect as coming from a president of the Modern Language Association. The same conspicuous openness of mind appears in his judgment, delivered after he had held the regius professorship of Modern History at Oxford from 1858 to 1866, that "ancient history, besides the still unequalled excellence of the writers, is the best instrument for cultivating the historical sense." But though penetrated with the sense that all modern intellect and art derive their greatness from Greece and Rome, no man's writings "palpitate with actuality" more than his, nor has any one wielded a more eager weapon on every battlefield of political or social reform.

The multiplicity of his interests, indeed, injured his work as a historian; he did not, like Gibbon, devote his life to one monumental work that should preserve his fame to future generations. His chief historical writings—*The United Kingdom: a Political History* (1899), and *The United States: an Outline of Political History* (1893)—though based on thorough familiarity with their subject, make no claim to original research. Both are remarkable examples of terse and brilliant narrative, and of the subordination of details to a consistent effect. The *United States* stands without a rival in its kind; the *United Kingdom* naturally challenges comparison with Green's *Short History of the English People*, but its insistence on the political rather than the picturesque aspect of history, its view of affairs from the arena no less than from the study, and its fuller treatment of the great problems of the 19th century, make it rather the complement of Green's work than the rival. A peculiar breadth of outlook is lent to both his histories by his equal familiarity with the conditions of the Old World and the New. The outbreak of the American Civil War proved a turning-point in his life. Unlike most men of the ruling classes in England, he warmly championed the cause of the North, and by his pamphlets, especially one

entitled *Does the Bible sanction American Slavery?* (1863), played a chief part in converting English opinion to what was afterwards universally recognized as the right side. Visiting America on a lecture tour in 1864, he received an enthusiastic welcome, and was entertained at a public banquet in New York. In 1868 he threw up his career in England and settled in the United States, where he held the professorship of English and Constitutional History at Cornell University till 1871. In that year he removed to Toronto, where he edited the *Canadian Monthly*, and subsequently founded the *Week* and the *Bystander*. He did not, however, cease to take an active interest in English politics. He had been a strong supporter of Irish Disestablishment, but he refused to follow Gladstone in accepting Home Rule. He expressly stated that "if he ever had a political leader, his leader was John Bright, not Mr Gladstone." Speaking in 1886, he referred to his "standing by the side of John Bright against the dismemberment of the great Anglo-Saxon community of the West, as I now stand against the dismemberment of the great Anglo-Saxon community of the East." These words form the key to his views of the future of the British Empire. He always maintained that Canada, separated by great barriers, running north and south, into four zones, each having unimpeded communication with the adjoining portions of the United States, was destined by its natural configuration to enter into a commercial union with them, which would result in her breaking away from the British empire, and in the union of the Anglo-Saxons of the American continent into one great nation. These views are most fully stated in his *Canada and the Canadian Question* (1891). Though describing himself as "anti-Imperialistic to the core," he was yet deeply penetrated with a sense of the greatness of the British race. Of the British empire in India he said that "it is the noblest the world has seen. . . . Never had there been such an attempt to make conquest the servant of civilization. About keeping India there is no question. England has a real duty there." His fear was that England would become a nation of factory-workers, thinking more of their trade-union than of their country. These forebodings were intensified in his *Commonwealth or Empire?* (1902)—a warning to the United States against the assumption of imperial responsibilities. Among other causes that he powerfully attacked were liquor prohibition, female suffrage, and State Socialism. All these are discussed in his *Essays on Questions of the Day* (revised edition, 1894). He also published sympathetic monographs on *Cowper* and *Jane Austen*, and attempted verse in *Bay Leaves* and *Specimens of Greek Tragedy*. In his *Guesses at the Riddle of Existence* (1897), he abandons the faith in Christianity expressed in his lecture of 1861 on Historical Progress (where he forecast the speedy reunion of Christendom on the "basis of free conviction"), and writes in a spirit "not of Agnosticism, if Agnosticism imports despair of spiritual truth, but of free and hopeful inquiry, the way for which it is necessary to clear by removing the wreck of that upon which we can found our faith no more." Particularly characteristic are his two little books, designed primarily as guides for American visitors to England. *Oxford and her Colleges*, with its blending of complete sympathy and knowledge, stands alone in its way. In *A Trip to England* he has, with a few masterly strokes, drawn a perfect miniature of English society and English landscape.

Smith, Sir William (1813–1893), lexicographer, was the eldest son of William Smith, of Enfield, a Nonconformist. He was originally destined for a theological career, but instead took up law, and was articled to a solicitor. In his spare time he taught himself classics, with such success that, when he entered University College as a student, he carried off both the Greek and Latin prizes. After pursuing his studies there he obtained a post at University College school, and at the same began to write on scholarly subjects and publish editions of the classics. He next turned his attention to that branch of work for which he is chiefly known—the collection of information in lexicographical form. His first attempt was the *Dictionary of Greek and Roman Antiquities*, which appeared in 1842. The greater part of this was written by himself. In 1849 followed the *Dictionary of Greek and Roman Biography*, and the *Greek and Roman Geography* in 1857. In this work some of the leading scholars of the day were associated with him. In 1850 he published the first of the school dictionaries; and in 1853 he began the Principia Series, which marked a distinct step in the school teaching of Greek and Latin. Then came the *Students' Manuals of History and Literature*, in which the Greek History was the editor's own work. In carrying out this task Smith was most ably seconded by Murray, the publisher, who, when the original publishers of the dictionaries got into difficulties, volunteered to take a share in the undertaking, and contributed largely to the great success attained by these encyclopædic volumes. The most important, perhaps, of the books edited by William Smith were those that dealt with ecclesiastical subjects. These were the *Dictionary of the Bible* (1860–65), the *Dictionary of Christian Antiquities* (1875–80), undertaken in collaboration with Archdeacon Cheetham; and the *Dictionary of Christian Biography* (1877–87), jointly with Dr Wace. The *Atlas*, on which Sir George Grove collaborated, appeared in 1875. All these books have become standard works, and the Dictionaries of the Bible and the Greek and Roman Antiquities appeared in new and revised editions before the editor's death. From 1853 to 1869 Smith was classical examiner to the University of London, and on his retirement he became a member of the Senate. He sat on the Committee to inquire into questions of copyright, and was for several years Registrar of the Royal Literary Fund. He edited Gibbon, with Guizot's and Milman's notes, in 1854–55. In 1867 he became editor of the *Quarterly Review*, which he directed until his death in 1893 with marked success, his remarkable memory and accuracy, as well as his tact and courtesy, specially fitting him for such a post. He was D.C.L. of Oxford and Dublin, and the honour of knighthood was conferred on him the year before his death. (A. Z.)

Smith, William Henry (1825–1891), English man of business and statesman, was born in London 24th June 1825. His father was the founder of the great distributing firm of W. H. Smith & Son, in the Strand, and at an early age he became a partner and devoted himself to the business. He betrayed no political aspirations until 1865, when he came forward as a Conservative to contest Westminster against John Stuart Mill and the Hon. Mr Grosvenor. Defeated on that occasion, he triumphed in 1868, winning a victory when his party was in general vanquished on all sides. The prestige thus obtained, and the accident of representing so important a constituency, combined with wealth and his business abilities to recommend him to Disraeli, who in 1874 made him secretary to the Treasury. In 1877 he gained cabinet rank as first lord of the Admiralty; in 1885 he was successively secretary for War and chief secretary for Ireland; in 1886 he was again at the War Office; and when late in that year Lord Randolph Churchill's

resignation necessitated a reconstruction of the ministry, Mr Smith found himself first lord of the Treasury and leader of the House of Commons. He was no orator, and made no pretence to genius, but his success in these high offices was complete, and was admittedly due, not merely to business ability, but to the universal respect which was gained by his patience, good temper, zeal for the public service, and thorough kindness of heart. He died at Walmer Castle (which he occupied as Warden of the Cinque Ports) on 6th October 1891. In recognition of his services, a peerage in her own right was conferred on his widow, with the title of Viscountess Hambleden.

Smith, William Robertson (1846-1894), Scottish philologist, physicist, archæologist, Biblical critic, and the editor, from 1880, of the 9th edition of this Encyclopædia, was born 8th November 1846 at Keig in Aberdeenshire, where his father was Free Church minister. He was educated at home and at Aberdeen University, where he attained the highest academic distinctions, winning among other things the Ferguson mathematical scholarship, which is open to all graduates of Scottish universities under three years' standing. In 1866 he entered the Free Church College at Edinburgh as a student of theology. During two summer sessions he studied philosophy and theology at Bonn and Göttingen, making friends in all branches of learning. From 1868 to 1870 he acted as assistant to the professor of natural philosophy in Edinburgh University. During this period he was not only most successful as a teacher, but produced much original work — especially in the experimental and mathematical treatment of electricity — which is still regarded as standard. In 1870 he was appointed and ordained to the office of professor of Oriental languages and Old Testament exegesis at the Free Church College, Aberdeen, and here he began that series of theological investigations which, characterized as they were by learned research and the use of the most scientific methods, were destined to make his name famous. He was the pupil and personal friend of many leaders of the higher criticism in Germany, and from the first he advocated views which, though now widely accepted, were then regarded with apprehension. The articles on Biblical subjects which he contributed to the 9th edition of the *Encyclopædia Britannica* distressed and alarmed the authorities of the Free Church. In 1876 a committee of the General Assembly of that Church reported on them so adversely that Smith demanded a formal trial, in the course of which he defended himself with consummate ability and eloquence. The indictment dropped, but a vote of want of confidence was passed, and in 1881 Smith was removed from his chair. During this long struggle he was sustained by the conviction that he was fighting for freedom, and at the end of the trial he was probably the most popular, if not the most powerful, man in Scotland. Marks of sympathy were showered on him from all sides.

In 1875 he was appointed one of the Old Testament Revisers; in 1880–82 he delivered by invitation, to very large audiences in Edinburgh and Glasgow, two courses of lectures on the criticism of the Old Testament, which he afterwards published (*The Old Testament in the Jewish Church*, first edition 1881, second edition 1892, and *The Prophets of Israel*, 1882, which also passed through two editions); and soon after his dismissal from his chair he joined Professor Baynes in the editorship of the *Encyclopædia Britannica*, and after Professor Baynes's death remained in supreme editorial control till the work was completed. His versatility, firmness combined with tact, width of view, and painstaking struggle for accuracy were largely responsible for the maintenance of its high standard. But he did not let his other duties interfere with his Semitic studies. He visited Arabia, Egypt, Syria, Palestine, Tunis, and southern Spain, and had an intimate knowledge of, and personal acquaintance with, not only the literature, but the life of the East. His early friendship with J. F. McLennan, that most original student of primitive marriage, had a great influence on Smith's studies, and his attention was always strongly attracted to the comparative study of primitive customs and their meaning. His chief contributions to this branch of learning were his article SACRIFICE in the *Encyclopædia Britannica*, his *Kinship and Marriage in Early Arabia* (Cambridge, 1885), and above all his *Lectures on the Religion of the Semites*, 1st edition 1889, 2nd edition 1894. His originality and grasp of mind enabled him to seize the essential among masses of details, and he had in a marked degree the power of carrying a subject further than his predecessors.

In 1883 Robertson Smith was appointed Lord Almoner's Professor of Arabic at Cambridge, which henceforth became his home. He occupied rooms in Trinity College till 1885, when he was elected to a professorial Fellowship at Christ's College. In 1886 he became University Librarian, and in 1889 Adams Professor of Arabic. In 1888–91 he delivered, as Burnett lecturer, three courses of lectures at Aberdeen on the primitive religion of the Semites, of which only one course has been published (see above). Early in 1890 grave symptoms of constitutional disease manifested themselves, and the last years of his life were full of suffering which he bore with the utmost courage and patience. He never ceased to work, and when near his end was actively engaged in planning the *Encyclopædia Biblica*, which he had hoped to edit. He died at Cambridge, 31st March 1894, and was buried at Keig. Small and slight in person and never robust in health, Robertson Smith was yet a man of ceaseless and fiery energy; of an intellect extraordinarily alert and quick, and as sagacious in practical matters as it was keen and piercing in speculation; of an erudition astonishing both in its range and in its readiness; of a temper susceptible of the highest enthusiasm for worthy ends, and able to inspire others with its own ardour; endowed with the warmest affections, and with the kindest and most generous disposition, but impatient of stupidity and ready to blaze out at whatever savoured of wrong and injustice. The sweetness and purity of his nature combined with his brilliant conversational powers to render him the most delightful of friends and companions. (A. E. S.)

Smolensk, a government of West Russia, lying to the east of Moscow, with an area of 21,638 square miles and a domiciled population which numbered 1,191,172 in 1882 and 1,551,068 in 1897, when there were 810,765 women and the urban population numbered 121,383. In 1898 the population was estimated at 1,671,000. It is chiefly composed of White Russians (47 per cent.), in the west, Great Russians (42 per cent.), in the east, and a mixture of both (11 per cent.). Most of the inhabitants (98 per cent.) belong to the Orthodox Greek Church; the rest are Nonconformists. The province is divided into 12 districts, the chief towns of which are Smolensk (see below), Byelyi (6956), Dorogobuzh (6640), Dukhovschina 3115), Elnya (2429), Gzhatsk (6312), Krasnyi (2755), Poryechie (5692), Roslavl (17,848), Sytchevka (4805), Vyazma (15,676), and Yukhnoff (2253). In 1899 there were 1492 schools, attended by 78,700 scholars, of whom only 15,400 were girls. Forty per cent. of the children of school age received no education at all. The county and district councils, however, are very active in organizing

hospitals and infirmaries, and all the peasants in the province are embodied in a mutual insurance against fire. Out of a total area of 13,687,000 acres 5,342,000 were held by the village communities, 7,172,000 by private persons, and 324,000 by the Crown. No less than 5,029,000 acres, or 37 per cent. of the total area, are under forests, and 1,215,000 are uncultivable. Nearly 30 per cent. of the surface is arable land, and 20 per cent. is under meadows. In the year 1900 there were 2,200,000 acres under crops, and the average yield in 1895–99 was: rye, 6,932,000 cwt.; wheat, 80,500 cwt.; oats, 4,260,000 cwt.; barley, 755,000 cwt.; all cereals, 12,104,000 cwt.; also potatoes, 7,473,000 cwt. This supply is not sufficient for the population, and grain has to be imported. Improved agricultural implements are beginning to be manufactured within the province, and to be applied on the landlords' estates, and partly also by the peasants. Flax (121,500 acres) and hemp are important crops, and some tobacco is also grown. There were in 1898, 438,000 horses, 564,844 horned cattle, 629,250 sheep, and 242,920 pigs in the province. In the way of mining industries only phosphorite is extracted, and of this, 32,000 cwt. is obtained annually. The domestic trades are not so well developed as in the other parts of Central Russia, while in 1898 there were only 1762 factories, employing 13,000 workers and showing a yearly return of about 14,000,000 roubles. The most important industry is that represented by a large paper mill, which employs no fewer than 4000 hands. A considerable part of the population is, however, compelled to leave their homes in search of work in different parts of Russia. (P. A. K.)

Smolensk, the capital of the above government, built on both banks of the Upper Dnieper, 260 miles by rail west-south-west of Moscow, at the junction of the two important railways from Warsaw to Moscow and Riga to Orel. The city has much improved of late years. It has monuments in remembrance of the war of 1812 and of the Russian composer Glinka. It is well provided with schools, and has three public libraries, a historical and archæological museum which contains very interesting antiquities, a people's palace and a people's theatre, and several philanthropic and scientific societies. It is well supplied with water, and has an extensive network of telephones. Factories and trade, however, are but feebly developed. Population (1897), 46,900.

Smyrna, *Ismir*, the capital of the Aidin vilayet, and the most important town of Asia Minor, situated at the head of a gulf 30 miles long, in 38° 26′ N. and 27° 9′ E. It is one of the principal ports of the Ottoman empire, and has a large trade, of which the greater part is with Great Britain. The total values of the general trade for 1898, 1899, and 1900 were:—

Year.	Exports.	Imports.
1898 . .	£3,294,529	£2,677,948
1899 . .	3,782,781	2,562,885
1900 . .	2,541,172	1,425,480

Earlier returns are not very trustworthy. The chief items of export are figs, tobacco, valonea, carpets, raisins, and silk. The British share of the total trade amounted in 1899 to 50 per cent., and in 1900 to 57 per cent. In 1900 the appearance of plague, and the consequent imposition of quarantine by Turkish and foreign ports upon all arrivals from Smyrna, paralysed trade. Until 1894 the two railways from Smyrna to the interior belonged to British companies, but in 1897 the Smyrna–Ala-shehr line passed into the hands of a French syndicate, which completed an extension to Afiún Kara-hissar, and so effected a junction with the Anatolian railway system. The Smyrna–Aidin line has been extended to Dineir. The population is about 250,000, of whom more than half are Greek, including 45,000 Hellenic subjects, and less than one-fourth Moslems. The Moslems, Armenians, Greeks, Europeans, and Jews live in separate quarters of the city. Interesting discoveries throwing light on the water-supply of Roman Smyrna have been made.

Smyth, Charles Piazzi (1819–1900), British astronomer, was born at Naples on the 3rd January 1819. He was called Piazzi after his godfather, the celebrated Italian astronomer of that name, whose acquaintance his father, Admiral Smyth, had made at Palermo when on the Mediterranean station. His father subsequently settled at Bedford, where he erected the well-known Bedford Observatory, at which Piazzi Smyth received his first lessons in astronomy. At the age of sixteen he went out as assistant to Maclear at the Cape of Good Hope Observatory, where he soon distinguished himself by his observations and drawings of Halley's comet and of the great comet of 1843; also taking an active part in the verification and extension of La Caille's arc of the meridian and the measurement of the Zwartland Base. In 1845 he was appointed astronomer royal for Scotland and professor of astronomy in the University of Edinburgh in succession to Henderson. On assuming this post his first task was to complete the reduction of the observations made by his predecessor (see *Edinburgh Observations*, vols. xiv. and xv.). In 1856 he undertook an interesting experiment to test the advantages of a mountain station for astronomical observations, selecting for this purpose the Peak of Teneriffe, as being situated in a low latitude and fairly easy of ascent. The Admiralty made him a grant of £500 for the purpose of this mission, and a yacht—the *Titania*—of 140 tons and a fine 7½-inch equatorial telescope were placed at his disposal by friends. The first station occupied was at a height of 8900 feet on the southern wall of the crater of elevation, the 7½-inch telescope being afterwards erected at Alta Vista, 10,700 feet above the sea-level. The principal result of the astronomical observations made at these great heights was to verify Newton's surmise, that a "most serene and quiet air . . . may perhaps be found on the tops of the highest mountains above the grosser clouds," a discovery subsequently turned to splendid account at the American mountain observatories of Mount Hamilton, in California, and Arequipa, in Peru. Accounts of the results of this expedition, including measures of the radiation of heat from the moon, observations of the solar spectrum, and of the meteorological characteristics, are contained in the "Report on the Teneriffe Astronomical Experiment of 1856, addressed to the Lords Commissioners of the Admiralty, 1858," in the *Phil. Trans.* of the *Roy. Soc.* of the same year, and the *Edinburgh Observations*, vol. xii. A more popular account of the expedition will be found in *Teneriffe, an Astronomer's Experiment: or, Specialities of a Residence above the Clouds*, 1858. About 1874 Piazzi Smyth began to study the spectra of luminous gases, of the rainband, the aurora, and zodiacal light. In 1877 he went to Portugal to observe the solar spectrum under more favourable conditions than was possible in the atmosphere of Edinburgh, and was eminently successful in resolving into their constituent lines the broad bands at the red end of the spectrum. For these results, published in the *Trans. R. S. Ed.* vol. xxix., he received the Macdougall-Brisbane prize in 1880. Accounts of later spectroscopic researches are published in *Madeira Spectroscopic* (1882) and in the *Trans. R. S. Ed.* vol. xxxii. Pt. ii. He also carried out in the laboratory an extensive

investigation on the spectra of gases, and in conjunction with Professor A. S. Herschel discovered a remarkable relation connecting the chief lines of carbonic oxide. Amongst his other published works may be mentioned *Three Cities in Russia* (1862), *Our Inheritance in the Great Pyramid*, *Life and Work at the Great Pyramid*, and a volume *On the Antiquity of Intellectual Man, from a Practical and Astronomical Point of View*. In 1888 he resigned his professorship and the post of astronomer royal of Scotland, and retired to the neighbourhood of Ripon, where he died on 21st February 1900. (A. A. R*.)

Sneek, a town in the Dutch province of Friesland, to the west of Sneek Lake, 12 miles south-south-west of Leeuwarden. It is connected by steam tramways with Heerenveen and Harlingen, and a railway to Stavoren was opened in 1885. There is an industrial school and a school for teachers. Population (1900), 12,100.

Sniatyn, the chief town of a district in Galicia, Austria, on the left bank of the Pruth, near the frontier of Bukovina, with important horse and cattle fairs and tanning. Population (1890), 10,939; (1900), 11,498.

Snoilsky, Carl Johan Gustaf, COUNT (1841———), Swedish poet, was born at Stockholm on 8th September 1841. He was educated at the Clara School, and in 1860 became a student at Upsala. He was trained for diplomacy, which he quitted for work at the Swedish Foreign Office. As early as 1861, under the pseudonym of "Sven Tröst," he began to print poems, and he soon became the centre of the brilliant literary society of the capital. In 1862 he published a collection of lyrics called *Orchids*. During 1864 and 1865 he was in Madrid and Paris on diplomatic missions. It was in 1869, when he first collected his poems under his own name, that Snoilsky took rank among the most eminent contemporary poets. His *Sonnets* in 1871 increased his reputation. Then, for many years, Snoilsky seemed to have entirely abandoned the art of poetry, and to have devoted himself to the work of the Foreign Office and to the study of numismatics. In 1876, however, he published a translation of the *Ballads* of Goethe. In 1879 Snoilsky's life underwent a violent crisis, which was the subject of infinite gossip in Sweden. He had risen to the highest distinctions in official life; he had in 1876 been appointed keeper of the records, and he had succeeded Bishop Genberg as one of the eighteen of the Swedish Academy. He resigned all his posts, and left Sweden abruptly in company with the Baroness Ruuth-Piper, whom he married in 1880. In his exile, Count Snoilsky turned again to poetry, and sent home in 1881 a volume of *New Poems*. *Savonarola* followed in 1883, and *The White Lady* in 1885. This period of activity also came to an end with the publication of a collection of *Poems* in 1887, and during later years Count Snoilsky contributed little to current literature. Since 1891 he has been principal librarian of the Royal Library in Stockholm. His influence, however, continues to be great; his verses are read with eagerness by the old and the young alike. He has always sung of joy and liberty and beauty, of the greenness of spring and the glory of the morning, and in his lyrics, more than in most modern verse, the ecstasy of youth finds its due expression. He is remarkable, also, for the extreme delicacy and melodiousness of his verse-forms, for he is essentially and almost exclusively a lyrical poet.

Snowdon (Welsh, *Eryri*), a mountain in North Wales. It is built up of slates, grits, and porphyries belonging to the Cambrian and Silurian systems, and consists of five ribs, meeting together at the summit (Y Wyddfa), 3560 feet above sea-level, and embracing between them steeply scarped depressions or vast precipitous hollows, of which the best known are Cwm-Glas on the north and Cwm-y-Llan on the south. Snowdon lies far below the snow-line, and is indeed, as a rule, quite free from snow between April and October. The mountain is encircled by a cluster of similar peaks, 1500 to 500 feet lower in altitude. Between it and them there is, however, a girdle of glens or passes, which present much wild and striking scenery. Of these the most notable is the Pass of Llanberis, which skirts the north-east foot of Snowdon, and is steep and narrow, being shut in on both sides by bare mountain slopes. It disputes with the Pass of Aberglaslyn, which proceeds due south from Beddgellert, at the south foot of Snowdon, the supremacy as the wildest pass in this part of Wales. The two passes are connected by the Nant-Gwynant defile, which skirts the south-east foot of the mountain. Along the south-west foot runs the glen of Nant-Colwyn, which is continued to Carnarvon, 12 miles north-west from Beddgellert. The summit of Snowdon is frequently shrouded in mist, of which good imaginative use is made in Mr Watts-Dunton's novel of *Aylwin*. Since 1897 it has been ascended by a rack-and-pinion railway, 4¾ miles long, which starts at Llanberis, at the north-west foot of the mountain, and terminates at the hotel which crowns the top. One of the charms of Snowdon is its lakes, of which there are two at Llanberis; one on the east side, filling the bottom of the hollow between the Crib-goch and Lliwedd ridges; a couple in the Nant-Gwynant defile; and another at the western foot of the mountain. Close to Llanberis the primitive beauties of the scenery are sadly impaired by the extensive slate quarries of Dinorwic, which employ some 2000 men. This region is naturally the resort of crowds of holiday-makers during the warmer months of summer. The most popular centres within the district itself are Llanberis, Beddgellert, Pen-y-Gwryd, and, a little farther away, Capel-Curig—the last two on the east side of the mountain; while convenient centres outside the immediate district are Carnarvon, Bangor, Bettws-y-Coed, and even Llandudno. The minor attractions of the region embrace Dolbadarn Castle, which figured in the Anglo-Welsh wars of the 13th and early 15th centuries, and the falls of Ceunant Mawr, both near Llanberis; and the church and the reputed tomb of Llewelyn's famous hound at Beddgellert.

SOCIALISM.

FOR the purposes of modern discussion, Socialism may be described as that policy which aims at a more equal distribution and, in subordination thereto, a better production of wealth by means of the direct action of the central authority. It is thus distinguished (*a*) from the policy of *laissez-faire*, or least-possible interference with the competition of private persons or groups of persons among themselves, and (*b*) from the policy of Regulation, where the central authority deliberately watches and controls the action of industrial competitors, but avoids direct initiative in production and direct attempts to level inequalities of wealth. The leading idea of the Socialist is to convert into a general benefit what is now the private gain of one or a

General description.

few. He shares this idea with such reformers as the Anarchist, the Positivist, and the Co-operator; but, unlike them, to secure his end he would employ the compulsory powers of the State or the municipality. Where the public direction or diversion of industry is mainly for the benefit of a few, as in the protective system of some countries, this is hardly Socialism. It employs the same machinery, the compulsory powers of the central authority; and it secures a revenue which may or may not be for the general benefit; but so far as the "protection" is successful, the main result is the private gain of a few, whereas Socialism would secure the main benefit for society as a whole. Communism has the same aim as Socialism and the terms are often used convertibly. But the Communist need not be a Socialist or the Socialist a Communist. The Socialists of the beginning of the 20th century rarely demand that all wealth shall be held in common, but only that the large workshops, and the land, and the materials and means of production on a large scale, shall be owned by the State or municipality.

The Socialism of this period has in fact a quality of its own. It is founded on a more or less clearly understood economic theory, and therefore is frequently described as Economic or Scientific Socialism. It may be true that in the first instance men become Socialists not from logic but from observation of suffering and from sympathy with the sufferers. But the Socialism of our own time, without disowning sentiment, is better aware than its predecessors of the need of facts and arguments for the persuasion of the public. It is significant, in this connexion, that, while all over the civilized world there is evidence that the volume of suffering has since the 'seventies grown somewhat less, the influence of Socialism has grown somewhat more. Nowhere is this more true than in Germany, the birthplace and stronghold of the new doctrines.

Germany.

The earlier history of Socialism in Germany has been already given with sufficient fulness (*Ency. Brit.* 9th edition, vol. xxii., SOCIALISM); and the briefest reference to the chief common doctrines of the school may be made here. From the study of Hegel, both Marx and Lassalle had been impressed with the idea of Evolution; they had learned that the world of men, like the world of things, was in constant process of development; but, unlike Hegel, they conceived the evolution as purely materialistic; the progress of civilization was effected by a struggle between classes in society for material wealth and well-being. Feudalism, itself the result of such a struggle, had given place to the rule of the middle classes (*bourgeoisie*), and the struggle is now between the privileged capitalists and the disinherited working men. At present those who do not possess capital are so placed that they must work for such wages as will keep them alive, and the gains from invention and industrial economies fall to the employers and the capitalists generally. Because of the helplessness of the labourer, he is forced (*a*) to work at his cost price (or the bare necessaries of civilized life), but (*b*) to produce much more than his cost, the surplus going to his employer. This is what Lassalle called the Brazen Law of Wages, founded on Ricardo's supposed doctrine that the value of an article produced under conditions of competition is determined by its cost in labour, and that the wages of labour tend to equal the labourer's subsistence. Without labour, capital cannot utilize its advantages, and the tendency of the labouring population to increase beyond the means of their constant employment is a frequent benefit to the capitalists in the periodic expansions of investment and enterprise arising in response to new inventions and new discoveries. Large businesses swallow up small; not only independent artisans and the workers in domestic industries, but small capitalists, who cannot afford the economies and low prices of their larger rivals, are disappearing. But the growth of the proletariate, together with the concentration of all business in fewer hands, will accomplish the downfall of the present system of industry. The proletariate will realize their own strength; and the means and materials of production will be concentrated one degree more, namely, in the hands of the commonwealth for the good of all. This revolution, like that which overturned feudalism, is simply the next stage in an evolution that will happen without human will, fatally and necessarily, in virtue of the conditions under which wealth is produced and shared in our times.

Such was in substance the view of all the leading German Socialists of the last half of the 19th century. Rodbertus alone practised as well as preached the belief that "the social question was a purely economic question," and confined himself to his study; but even he was not content with a mere statement of the fact of evolution—he advanced, like the rest, a claim of right on behalf of working men. The others went further. They made "the social question" a question of politics. Marx and Engels from the days of the French Revolution of 1848 had appealed to the "proletariate of all countries" to unite to hasten the day of their emancipation. Marx founded the International Association of Working Men in the year of Lassalle's death (1864). Lassalle's Socialism was meant for Germany first. He had planned a centralized organization of workmen led by a dictator. He had called on the Government to establish from the funds of the State co-operative associations such as Schultze-Delitzsch had hoped to plant by "self-help." Lassalle's Socialism was rather national than international. But before the common danger of police prosecution his followers united with the followers of Marx at the Congress of Gotha in 1875. The name Social Democrats crept into use about 1869, when the followers of Marx founded, at a Congress at Eisenach, "the Social Democratic Working Men's Party." The party began to be a power in Germany about the year 1875. It is a power now; but the doctrines and policy of the party have undergone some change.

The last quarter of the 19th century witnessed (1) the repressive laws of 1878, (2) the repeal of them in 1890, (3) the three Acts of Insurance, and, above all, (4) the progress of German industry and wealth. After the occurrence of two attempts (in 1877) on the life of the aged Emperor William, Bismarck's Government, already alarmed by the increased number of votes given to Socialist candidates for the Reichstag, procured the passing in October 1878 of the "Exceptional Powers Act" (*Ausnahme-Gesetz*). The legislation of 1878 resembled in its purpose and effects the Six Acts of 1819 in England. Combined action in Germany became almost impossible, and for organs of the press the Social Democrats had recourse to Zürich. Liebknecht and Bebel could still raise their voice for them in Parliament, for Bismarck's attempts to deprive members of the Reichstag of their immunities was foiled (March 1879). But the agitation as a whole was driven underground; and it speaks well for the steady patience and self-control of the German people that no widespread excesses followed. The declaration of the Social Democratic Congress at Wyden, Switzerland, in 1880, that their aims should be furthered "by every means" instead of, as formerly, "by every lawful means," was a natural rejoinder to the law that deprived them of the lawful means; and it seems to have had no evil consequences. After twelve years, repression was so far relaxed that (in 1881) workmen's trade unions were allowed to recover legal standing. In 1890 the Reichstag refused to

renew for a fifth period the obnoxious law of 1878; and finally, in 1899, the Reichstag repealed the law forbidding amalgamation of workmen's trade unions and specially aimed at the new socialistic unions, the natural allies of the Social Democrats. It might thus seem that the party was never so powerful as at the opening of the 20th century. Since 1890 the vexatious prosecutions and condemnations for *lèse majesté* have done the cause more good than harm. In 1878 the Socialists polled 437,438 votes for the Reichstag; in 1881, 311,961; in 1884, 549,990; in 1887, 774,128; in 1890, 1,427,000; in 1894, 1,800,000; in 1898, 2,120,000; and the number of their representatives increased from 12 in 1877, 37 in 1890, 46 in 1894, to 56 in 1898.

This increase of Socialism in Germany is the more remarkable because of the remedial measures, intended to forestall Socialism, that had been passed in the interval between 1878 and 1890. Bismarck, as he himself allowed in the debates of 1878 (6th September), had known and admired Lassalle, and he had none of the scruples of abstract theorists against the intervention of the State. Accordingly, he planned the series of measures for the insurance of workmen against sickness, accidents, and old age, which became law, in 1883, 1884, and 1891 respectively. The Socialists at first sneered at these measures, and then accepted them. They not very unreasonably regarded the Government as their convert. They could also point to at least two other unwilling witnesses — the Christian Socialists and the Socialists of the Chair (*Kathedersocialisten*).

In Protestant parts of Germany the Socialists as a rule were Social Democrats. In the Catholic parts the following of the Social Democrats was more scanty; but Socialist sentiment and doctrine were represented as early as 1863 and 1864 by Dr Döllinger and Bishop Ketteler, followed by Canon Moufang. Ketteler, who had been under the influence of Lassalle, thought of inducing the Church to make productive associations her special care. Moufang would depend more on the State than on the Church. All were awake to the evils of the workmen's position as described by the Socialists of the ordinary type, and they were anxious that the Catholic Church should not leave the work of curing those evils to be done without her sympathy and aid. Ketteler died in 1877; and the Pope's Encyclical of 28th December 1878 bore no trace of his influence, mixing up as it did Socialists, Nihilists, and Communists in one common condemnation. The Encyclical *De conditione opificum* of 1891 showed that the views of the Catholic Socialists had penetrated to headquarters; but the Encyclical on *Christian Democracy* (January 1901) betrayed no sympathy with them. The Protestant Church in Germany has been hampered by fear of offending the Government. But it contains a vigorous, if tiny, body of Christian Socialists. Rudolf Todt, a country pastor, was the prophet of their movement; his book on *Radical German Socialism and Christian Society*, written in 1878, led Dr Stöcker, the Court chaplain, to found an organization for "Social Reform on Christian Principles." This was denounced rather unfairly by politicians of all ranks, Socialist and otherwise, as an organized hypocrisy. For whatever reason, its influence was shortlived, and its successor, the Social Monarchical Union (1890), shared in the unpopularity of Stöcker, its founder. Even the Socialists of the Chair, middle-class Protestants as they often were, would have nothing to say to it, but preferred to go a way of their own.

There had existed in Germany since 1858 a league of economists and statesmen called the "Economic Congress" (*Volkswirthschaftlicher Congress*), bearing a general resemblance to the Cobden Club, though its chief object was to bring about free trade among German states in particular. After the Empire, its work seemed finished; and some statesmen and economists formed a new society, the "Union for a Policy of Social Reform" (*Verein für Socialpolitik*). Professors Schmoller, Roscher, Hildebrand, Wagner, Brentano, the statistician Engel, and others met at Halle in June 1872, and a meeting of their supporters was held at Eisenach in October of that year. These academic Socialists, or Socialists of the Chair, agreed with the ordinary Socialists in recognizing the existence of the "social question," the problem of how to make the labourer's bad condition better. The orthodox economists saw no problem there for legislation; competition was supposed to solve its own problems. But, while the ordinary Socialists looked for Social Revolution, the academic Socialists were content to strive after Social Reform on the basis of the existing system of private property and rights. This social reform, however, was to be actively furthered by the State, without regard to the scruples of the Manchester School. The State was regarded as a "great moral institution for the education of the race." Bismarck is said to have declared in 1875 that if he only had time he, too, would join the union. It was, in fact, a union of moderate State Socialists, Socialists who relied on the State, and the State as it then was, for social reform. The Government Insurance Acts owed not a little to the labours of these men, who gave their services freely for the necessary preliminary investigations. The union, as a rule, met once in two years at some German town.

The German people have been prepared for State Socialism by the efficiency of the German bureaucratic Government, made so manifest in the wars of 1866 and 1870. If the insurance laws are successfully carried out, the confidence of the people in the Government, and in the State as it is, may be so strongly confirmed as to put any idea of a complete revolution out of their thoughts. It can hardly be said that this idea is absent now; but the attitude of the Social Democratic party is at least less uncompromising than it was in the beginning. Since they regained their liberty in 1890, they have been well kept in hand by their leaders. Their journal, *Vorwärts*, is conducted with remarkable ability. Their agitation has been as peaceful as that of trade unionists or co-operators in England. They have ceased to denounce the Churches. They have tried to gain converts and sympathizers by showing themselves ready to take up the cause of any specially distressed class of workers, and press their special claims on the State. From a necessary evil or mere stop-gap, the present State has become to them gradually, and perhaps unconsciously, their own State. The Anarchists had been disowned and expelled as early as 1880. The Socialists who demanded return to the old uncompromising tactics, were cast out at Erfurt in 1891, and exist as "Independent" Socialists. The controversies between the advocates and the opponents of Socialism still go on in learned circles, and produce a prodigious quantity of literature year by year; but the Social Democracy, which Schäffle the academic Socialist regarded in 1885 as "without prospects," would deserve less severe treatment now than it received from him then. Though the programme adopted at Gotha in 1875 stands almost unaltered, the parts due to Lassalle have fallen into the background. For many years Marx has been the chief economic authority of the party. Marx died in 1883, but remained an oracle till 1894 when (just before his own death in 1895) Engels published the last volume of his friend's book on "Capital." This volume was expected to solve certain serious logical difficulties in the

system; and instead of this it caused a feeling of disappointment, which can be traced even in the *Neue Zeit*, the literary and scientific organ of the party, as the *Vorwärts* is the popular. Many, like Bebel and Kautsky, keep up the old adoration of Marx; but the younger, like Bernstein, have rightly felt that to give up Marx is not to give up Socialism, any more than to give up Genesis is to give up theology. Bernstein has openly proposed in Congress that the old doctrines and policy of the party, involving as they do despair of Reform and insistence on Revolution, shall now be dropped. Though he has not yet carried his point, his opponents have not succeeded in expelling him from the party. The death of Liebknecht (August 1900) removed not only an almost heroic figure from the ranks of the Social Democrats, but an old-fashioned Socialist who was a serious obstacle to any change of front. Yet Liebknecht himself, though he once thundered against the Bavarian von Vollmar for proposing a truce (1891), had latterly been drifting in this very direction. It was impossible for a man of his practical wisdom to close his eyes to what the State had done for the German workman. It was also impossible to ignore the great progress that Germany had made in wealth and industry since the creation of the Empire in 1871. Germany has been fast becoming a manufacturing instead of a merely agricultural country; and, though the rise of large manufacturing towns in the Rhine valley and elsewhere has multiplied Socialists, whose numbers are chiefly recruited from the towns, it has added to the income of the ordinary German workman. He is farther from poverty and distress than he was a generation ago; and his Socialism is an endeavour after a larger life, not, as formerly, a mere struggle against starvation. It is likely, therefore, to have less and less of mere blindness and violence in it.

The condition and prospects of the working man in Germany are fast becoming those that have prevailed in England since the repeal of the Corn Laws in 1846. They fall far short of perfection, but also of hopelessness. The German Corn Laws must pass away like the English, and for the same reasons. In 1902 the Social Democrats threw their weight on the side of repeal.

Great Britain.

England, which sheltered Marx and Engels, has never itself been a soil very favourable to Socialism; but in the last quarter of the 19th century, in the poorer districts of our large towns, the Secularism of, say, 1875, has been supplanted by Socialism. Certainly among all classes there are more Socialists in England now than formerly; and it is more easy to say when than why the change has occurred. In 1879 Mill's essays on Socialism were published. The writings of Henry George (1880) and his lecturing tour (1881–82) in Great Britain revived interest in the claim for the nationalizing of the land, a form of Socialism endemic in England for more than a hundred years. It had been taught by Thomas Spence (1775), James Mill (1821), Dove (1850), Herbert Spencer (1851), and A. R. Wallace (1882). The Irish Land League included advocates of it; but Gladstone's Land Act of 1881, though it was an interference with private bargaining and in many ways approached Socialism, settled the main question of ownership entirely in an individualistic sense. The English Land Restoration League makes way very slowly. Socialists pointed out that George's single tax on rents was illogical; he would take away all the surplus value secured by the landlord, but would leave all the surplus value secured by the employer and capitalist. The more logical Socialists had formed, in 1880, the Democratic (called afterwards, in 1883, the Social Democratic) Federation, of which the two principal leaders were William Morris, "poet and paper-hanger," and H. M. Hyndman, journalist and stockbroker. Its weekly organ, *Justice*, is still published. In 1884 William Morris seceded, and with Aveling (son-in-law of Marx) and Mr Belfort Bax established the Socialist League, with its organ, *The Commonweal*. Morris abandoned the League in 1890, though he held to the end, if somewhat vaguely, his belief in Socialism. Bellamy's book, *Looking Backward* (1888), made some impression in England; and a greater was produced by *Merrie England*, written in 1894 by Thomas Blatchford, editor of a Socialist newspaper, the *Clarion*. But there was still no sign of a strong party such as we have found in Germany. Socialists in England have been forced to adopt the ordinary English methods for the redress of grievances, finding their best opportunities, very naturally, in times of a general depression in trade (as in 1887). Nevertheless a change has come over the spirit of politics in England, in the direction they desire, though hardly through any efforts of theirs. It is the change deplored by Herbert Spencer in his *Man versus the State* (1885), though it is neither sudden nor wonderful, but, in the light of events, inevitable. The period had passed when extension of the suffrage and free trade, and, generally, the removal of obstacles, could be considered panaceas. There was now a general feeling, seldom expressed in formulas, that there should be secured to all citizens the conditions under which a civilized life was possible. Hence there was a demand for greater stringency of Factory Acts and their administration. Increased attention was paid to elementary education and sanitary requirements. It is significant that the movement in favour of the better housing of the poor began in a speech of John Bright, an individualist of the old school (Glasgow, 1884). Sir William Harcourt said (1888), "We are all Socialists now," when he really meant that we were all social reformers, who would use the help of Parliament without scruple. The English people have neither set themselves against Socialism nor pronounced in its favour. Except in the solitary case of free trade in foreign imports, they are indifferent to general principles, and pride themselves on judging each case on its merits, as if no general principle affected the merits.

The English poor law is frankly socialistic; but the amount of its Socialism varies according to the administration of it in the several localities. In this matter the English have all been Socialists since the Act of Elizabeth, and have not gone either backwards or forwards on purely logical grounds. Of recent years the State has taken more care than formerly to preserve common lands. No general scruples have prevented interference with individual freedom in the matter of education (1870), vaccination, the labour of children and young persons in factories and workshops, the regulation of railways, the compensation of workmen for injuries (1897), to say nothing of sanitary requirements. Little of all this is socialistic in the strictest sense of the word. The workmen's compensation is not out of public funds. Where education is "free," or grants are made "in aid of rates," or the income tax and death duties are progressive, there is, perhaps, such an inroad on the revenue of one class for a real or supposed general benefit as would justify the term. But regulation, not initiative, is still the prevailing feature of the proceedings of the State in Great Britain. The railways are still in private hands. The Post Office, the telegraphs, the Post Office Savings Banks, are a group by themselves, and the first, at least, existed before there was any thought of Socialism.

The lesser central authorities have been much more inclined to conduct business for themselves. The supply of gas, water, and (more recently) electric light, the maintenance of docks and tramways, the acquisition not only of parks but of house property — all these symptoms of

municipal Socialism, some of them a generation or more old, have increased and multiplied in recent years, and perhaps most conspicuously in towns (like Glasgow, Birmingham, Bristol, Manchester, Liverpool, Leeds, Bradford, Huddersfield) where political Socialism has feeblest hold.[1] The passing of the Local Government Acts (1888, 1894), and the new interest aroused in municipal politics, throughout London in particular, by the establishment of its County Council and Borough Councils, may seem to have provided ready tools for municipal Socialism. But the actual achievements of London have certainly not surpassed those of the provincial cities, except in greatness of scale. It is the demand persistently made for permission to tax ground-rents and "unearned increment" that points to State Socialism, for such permission must sooner or later lead to State taxes of the kind described.

Public men and journalists deplore or defend the extension of municipal trading; meanwhile the trading goes quietly on, with the connivance of the classes most likely to suffer from a really socialistic or levelling policy. It may be that the middle classes have learned from Ruskin and Tolstoy some sympathy for the aims of Socialism; and a few of them have become avowed converts. Anarchist colonies have been founded at Purleigh, Essex (1897), and at Sheepscombe, Gloucester, on the principles of Tolstoy. A band of Christian Socialists has gathered together, and news of foreign agitations (as of Bellamy and Henry George) and colonial experiments has not been without interest; but the strongest movements in England are still such as Lassalle ridiculed as "self-help." English public opinion was sceptical when the Trades Union Congresses declared themselves powerless to establish an eight hours' working day without the help of the State (*e.g.*, Congresses of 1891, 1892). Resolutions in favour of the nationalizing of the land and of the other means of production have been passed at most of the meetings since 1888, first on the ground that only by these means could the unemployed be effectually helped, afterwards for more general reasons. The programme proposed on such occasions is always bolder than the policy eventually adopted. Mr John Burns, for example, said at Cardiff in 1895: "The Eight Hours Bill, the Miners' Eight Hours Bill, the Railway Hours Act (which had given employment to 10,000 men), higher wages and eight hours for Government workmen—all these things were in the direction of helping the unemployed. . . . He had endeavoured to get the immediately possible, and in doing so he believed he was bringing about the social revolution."

The agitation on behalf of the unemployed had led to disturbances in London in February 1886 and November 1887. With the return of brisk trade the problem departed for the time. Depression is always the Socialists' best opportunity. They can hope to impress their views on the unemployed masses, and profit by the fear of the trade unionists that the competition of the unemployed will endanger the position of the trades societies. In the last quarter of the 19th century a new unionism grew up. It is less aristocratic than the old, aiming at the inclusion of the comparatively unskilled labourers (as the dock labourers, formed into a union in London in 1889); and it seeks the federation of all trades societies, with a view to joint action. Moreover, within the separate unions the old government by mass meetings of all the members has given place to a government by representatives, and administration by permanent paid officials. This seems to lead not to democracy, but to bureaucracy; but it serves as some preparation for the Democratic Socialism held out by some of the leaders as the ideal. A better preparation, because in the way of actual business, is given by the co-operative societies, whose members are nearly as numerous as those of the trades societies, and more especially by the co-partnerships of Leicester and Northampton, &c. But these last are a very small body; and even the trade unions had in 1898 only about 1,644,000 members, or about one-eighth of the estimated number of the working classes. A decision of the highest Court (in the case of the Taff Vale Railway Co. *v.* The Amalgamated Society of Railway Servants, 1901) gave to the trade unions, in place of the privileges of a club, the liability of a corporation to be sued as a whole. The financial dangers of this position are fully understood by trade unionists. The ultimate results cannot be foreseen. The immediate effect is to drive the men into more earnest political action.

Attempts had been made to influence politics directly by means of an Independent Labour Party (founded at Bradford in January 1893 by Mr Keir Hardie), which bound itself to support only candidates of sound socialistic views. This was a sectional effort, which, except in municipal politics, had scant success. In municipal politics, again, especially in London, the Fabian Society, founded in 1884 by a group of young literary men, had exercised some influence; but, if we compare the "Fabian Essays" of 1889 with the later utterances of their writers, it becomes clear that these Socialists have become for the most part hearty Radical politicians, energetic in municipal work beyond their fellows, but hardly otherwise to be distinguished from them. They "do not suggest that the State should monopolize industry, as against private enterprise or individual initiative, further than may be necessary to make the livelihood of the people and their access to the sources of production completely independent of both" (*Fabian Tracts*, No. 70, 1896). The reservation is wide; but fortunately it is added: "they accept the conditions imposed by human nature, and by the national character and political circumstances of the English people." The course of events has reconciled Socialism with political reform. In Germany itself (at the Congress held at Mainz in September 1900), the proposal of Bebel, that Democrats be allowed on occasion to ally themselves with ordinary political parties, was accepted, under qualifications that are likely to disappear.

France.

Marx said that nothing great could be done even in Germany for revolution without the aid of England. But he had also said that there must be "the crowing of the Gallic cock." French passion is as indispensable as German reason. The enthusiasm for revolution is rather latent than wanting in France. The country population, with their small properties, will not favour revolution; but the working classes in the large towns are almost to a man Socialists or Anarchists in sentiment. They lack only opportunity and organization to be formidable. Something like a general movement towards organized Socialism began, on the return of some prominent leaders of the Commune of 1871 from exile. A Congress was held at Havre in 1880, which, under the leadership of Guesde and Ferroul, adopted a Social Democratic or "Collectivist" programme. In the following years a minority of the party, under Brousse and Joffrin, broke away from the main body and stood out for municipal Socialism, decentralization, and (in 1887) "self-governing workshops" aided by public money. Co-operative workshops are already helped

[1] The subject of municipal ownership and municipal enterprise has come more and more to the front in England in late years. Curiously enough, in the United States the opposite tendency was shown, the experience of a preceding generation having caused a reaction. Reference should be made to Sir Henry Fowler's paper on "Municipal Finance" (*Journal of Statistical Society*, vol. lxiii., 1900), and to the remarkable series of articles in *The Times* on "Municipal Socialism," which appeared during the autumn of 1902.

forward in France by public funds, preferences in public works, and other privileges, without striking results. The *Broussistes* are also called *Possibilistes*, content with such Socialism as is immediately practicable. They support, for example, agrarian reform on the present basis of private property (Marseilles, 1892). After several unsuccessful attempts, the amalgamation of the Collectivists, Possibilists, and Extreme Revolutionaries (*Blanquistes*) was accomplished in 1899. But this body has not the cohesion of the German party. Though the Socialists in the French Chamber act more or less loyally together, they are not so directly under the orders of the organization outside. M. Millerand's acceptance of the ministry of commerce caused some misgivings among his fellow Socialists (Congress at Paris, September 1900). The *Revue Socialiste*, founded by Malon in 1893, has not the same standing as the German *Vorwärts*. The wayward guerilla warfare of the French Socialists is a contrast to the disciplined strategy of the Germans, perhaps because political liberty is greater in France. The intervention of the French Socialists at Carmaux (Toulouse) in the dispute between the Glass Company and the workers was ill-managed (August to October 1892), and we may contrast with it the part taken by Socialist leaders in stopping riots in Berlin (February 1892).

In France the State has been always more ready than in England to interfere with the course of competitive trade, and to take the initiative on itself. Besides having control of the Bank of France, it owns most of the railways, administering them with tolerable success. It controls secondary as well as primary education. After the disturbances at Carmaux, it proposed to take over the mines. There is still no general poor law; and old age pensions are not yet fully organized, though they are on the way, and workmen's compensation has already come (1888). State Socialism would probably have gone farther if the French bureaucracy had not proved less efficient than the German. There is little academic Socialism. The bulk of French economists stand somewhat stiffly by the economic policy of J. B. Say; but men like Laveleye (who died in 1892), Gide among the younger economists, and the School of Le Play, at least acknowledged the existence of a "social question." There are also literary men of economic training (like Naquet) who advocate mild forms of Socialism. But the "Gallic cock" is not likely to crow at the bidding of Germany.

German Social Democracy found easier access to Belgium and Holland, and these countries have been a favourite meeting-place for Congresses of all denominations of Socialists. Crowded manufacturing Belgium had in 1876 two socialistic parties—the Flemish, led by Dr de Paepe, an ardent disciple of Marx, and the Brabantine or Walloon. They united in 1879, and helped the Liberals in 1893 to procure a much wider suffrage. The flourishing co-operative societies, the *Vooruit* in Ghent, and the *Maison du Peuple* of the Brussels bakers, are the work of their members. The Belgian Professor Colins has been an eloquent advocate of the nationalizing of the land. Belgium adopted Old Age Pensions for the Poor in 1900.

Belgium. Holland. Switzerland.

In Holland, which is still an agricultural and pastoral country, Socialism has not a strong foothold, though the Socialist leader Nieuwenhuis succeeded (1889) in bringing his party into line with German Social Democracy. The Dutch are active social reformers. They have had a Factory Act since 1889, and they passed an Act for Insurance of Workmen against Accidents in 1900. Reform is preferred to revolution.

Switzerland, for generations a refuge of exiles, usually shows them hospitality without sharing their views. The Confederation has not gone so far as compulsory insurance against sickness and accident (rejected on Referendum, May 1900), but it has a legal working day (of 11 hours). There is most Socialism in the German cantons. Scandinavia stands apart by its situation. In Denmark, especially in Copenhagen, German Socialism has had some influence. The trade unions are largely socialistic, and some converts have been made among the farm labourers. Denmark, in turn, has influenced Norway and Sweden, the latter with greater success than the former. But in neither is Social Democracy a political power.

Where, then, are we to look for the spread of the Social Democratic gospel? In Austria it has taken root among the German population, quietly and in face of severe measures of repression. In the Reichsrath of 1897 the party secured 12 out of 353 elected members. But if it had conquered all German Austria, there would still be Hungary and Bohemia to overcome; and political disunion tells against it.

If it is true that where there is poverty there will be Socialism, no country should be more socialistic than Italy, which has been described as "all proletariate." But the very wretchedness and ignorance of the masses, both on the land and in the cities, fitted them better for Anarchism than Socialism. Since 1882 there has been a Social Democratic organization, which has gradually drawn into itself the previously existing socialistic bodies. It was founded by Andrea Costa, and its most notable men now are perhaps Turati and De Amicis. In spite of the Government and the Anarchists, it has fought a good fight for the extension of the suffrage. In 1895 it returned 15 members to the Italian Parliament. Milan has been the real capital of the movement. Laveleye had the curious idea that the prospects of revolution were hopeless in Italy because malaria made Rome uninhabitable every summer. But Social Democracy, in its native country, does not stand or fall with Berlin. The truth seems to be that Italy, especially southern Italy, must go farther in industrial and political development before it is ripe for the reception of the new ideas, and still farther before it outgrows them. In too many parts of Italy the taxes and local rates are in no ordinary sense a heavy burden, and the people revolt from sheer despair. At the end of 1893 there was a formidable outbreak in Sicily, really against the tax-gatherer. The socialistic clubs called *Fasci dei lavoratori* actively aided the people; and though the rising was put down by military force, some lightening of taxation followed, and there was a general sympathy with the rebels. But the policy of the Government has been mainly repressive. It tried to suppress the Socialist Union, and (in October 1894) it put down 271 workmen's associations as socialistic. The State Socialism of the Italian Government of 1902 was not of a kind to compensate for this repression. The railways, owned by Government and leased to companies, are not well administered, and the management of the Bank of Rome in 1892 received a damaging exposure. There are as yet no effective Factory Acts. Professor Loria of Padua describes the labour law as "still mediæval." The professors in Italy are in advance of the statesmen in enlightenment if not in public spirit.

Italy.

Social Democracy might be expected to find disciples in Spain, as there is discontent in that country both among artisans and country labourers. Paradoxical as it may seem, the converts are chiefly country labourers, the working men of the cities (when they are not Anarchists) trusting more to their trade unions and other forms of self-help. Its weakness in the great northern nation, Russia, is due to entirely

Spain. Russia.

different causes. The principal is the strength of its rival, Anarchism, though the strength of the Imperial Government would by itself be enough to drive both of them underground. As Germany is the classical ground of Social Democracy, Russia is so of Anarchism; and in the history of revolutionary parties in Russia the Social Democrats have only a subordinate place. The Russian Socialists have many of them propounded a view which seems hard to reconcile with the "scientific" Socialism of Marx. They think that Russia might pass straight from its mediæval system of village communities to a system of Collectivism, without passing through the stage of modern Capitalism. They are unwilling to countenance the destruction of the village communities by modern industry. Yet Marx had laid it down that progress was necessarily from feudalism and a patriarchal system, through Capitalism, to Collectivism, Capitalism forming the necessary preparation (of materials and methods and men) for its successor. When Marx was directly challenged by his Russian friends (1877), he made the unexpected statement that the course of development need not be in that precise order unless the country itself so willed it. However, since 1877 the development of industry in Russia has made straight for Capitalism, and there will soon be no temptation for other Socialists to fall into the heresy, such as it was.

If Scientific Socialism requires for the final revolution only the full development of modern industry, enterprise, and invention, nowhere should we expect to find it so near the goal as in America or the British colonies. In the latter, it is true, there is little of the Socialism due to poverty; but there is much that is due (*a*) to the imperfect development of a new country, where there is a want of the accumulated capital utilized in the mother country by companies; and (*b*) to the greater power of the working classes, and the intelligent consciousness of that power.

Australia is the land of democracy, and even of socialistic democracy, of a certain kind. There is manhood suffrage; members of Parliament are paid (except in West Australia); the railways belong to the State; there is free education of the poor, when not of all and sundry. In South Australia women have the suffrage. In New South Wales the State owns the tramways, the water-supply, and the sewage works, and it gives subsidies to municipalities. The States of the Commonwealth are ceasing to pay settlers for coming to them; but they all (except New South Wales) keep up the imperfect Socialism of a protective tariff. Crown lands and mines are a chief source of revenue and expenditure. In 1897–98 more than one-half of the revenue of New South Wales was drawn

Australia.

from public works and services, more than one-fifth from lands, about one-fourth from taxation. In the case of England the proportions are (for 1899) about one-sixth from works and five-sixths from taxation, the income from lands being negligible (about one-two-hundredth).

But the young state of New Zealand, with a population of 800,000, shut off from Australia by 1200 miles of sea, and from the world in general by protective duties, is in some respects more like the "closed State" of the Socialist philosopher Fichte than any other State in the civilized world. Besides owning the railways, its Government is the largest land-owner and rent-receiver in the islands, possessing two-thirds of the whole acreage, and letting it on long leases. It limits the estate that can be held by any one individual, and has a right of compulsory repurchase. In 1893 it purchased the Cheviot property of 84,000 acres and divided the land into farms, now supporting about 900 prosperous tenants. The colonies for the unemployed, begun by Ballance in 1886, were less brilliantly successful; but about 5000 farmers, holding 20 to 50 acres on perpetual lease, are the result. The policy is that of the nationalizing not of rack rents, but of fixed ground rents. Of the State's intervention in other directions there is no lack. The working men of New Zealand drew together into strong organizations in the year 1890, their "maritime strike" following close on the London Dock strike of 1889. Ballance became the head of a Labour Party in Parliament, and eventually prime minister in January 1891. The result of the pressure of this new political party was a progressive income tax and land tax, an extension of the taxing powers of municipalities and local bodies, local option in regard to liquor (1893), a system of advances to settlers (1894), the adoption of the principle "one man one vote," the admission of women to the franchise (1892). The labour laws were extended and reformed on English lines as to Truck and Factory regulations and freedom of combination. A Department of Labour was created in 1891, and a scheme of compulsory arbitration in industrial disputes was passed in 1895. In Government works the "direct employment" of workmen, without a contractor, is the rule. In 1898 an Act was passed providing old age pensions of a shilling a day, under strict conditions of race, character, and income. Besides conducting the usual Post Office Savings Bank, the Government, since the crisis of 1894, has had control of the Bank of New Zealand; since 1871 it has conducted life insurance; it appoints a public trustee, who cares for the interests not only of widows and orphans, but of the Maoris; it does most of the conveyancing of land, though, as in insurance, without exclusion of private competitors. "The State, without being in any way a monopolist," says the Hon. W. P. Reeves, "is a large and active competitor in many fields of industry."

This tentative Socialism, in a colony unusually free from foreign elements, proves that a certain kind of Socialism is not un-English. It has still, for the most part, to abide the test of time. It is acknowledged that the railways of Australia and New Zealand, though efficiently worked, are not remunerative in the sense in which competitive railways running through similar districts in the United States are made to be so. They are often laid down by the Governments in advance of the demand for them, to attract settlers for the Crown lands. When allowance is made for this motive, the experiment may be said to prove, as it has done in very different circumstances in Prussia, that Government can manage a railway almost as well as a controlled private company. In regard to the Crown lands, it is clear that a new colony starts with an advantage that an old country could hardly recover, without unreasonable outlay; but, given the recovery, the machinery of administration might move as smoothly in the old country as in the new. But the Pensions and Arbitration Acts are unfinished experiments. The denser and more largely urban character of the English population, and the greater complication of industries, would prevent us from too readily drawing conclusions, even from the finished experiment; and it is significant that the birth-rate is declining in New Zealand much faster than in England. Politically there was centralization when the present state replaced the local governments in 1876. But the policy most nearly justified by success in the new state is rather that of drastic democratic regulation of Capitalism than the substitution for it of Collectivism. The Government tenants are allowed to keep nearly as much of the unearned increment as tenants elsewhere; the Maoris in the Reserve are allowed to become great landowners. No attempt is made to abolish competition in general business, but only so to regulate it as to secure healthy conditions of labour, and something like equal opportunities for the leading of a decent human life. No fear

of Collectivism need prevent a nation from trying to secure these benefits for its subjects in its own way, even if they are the benefits declared by the Collectivists to be only obtainable in their way.

The self-governing British colonies in the Antipodes have thus furnished valuable experiments in the direction of State Socialism. The paternal government of a dependency like India is less instructive, as being for the people, not by the people. America is in this respect a land of greater promise. Canada has paid members of Parliament, free education, Crown forests, and a Department of Labour; but is following England, not leading her, in social policy. It is not so across the border. Yet though the United States is a world by itself, it is entirely English in its attitude to Socialism. Like Great Britain, it is not fond of general principles of policy. But, unlike Great Britain, it has in its large continent a wide room for experiments. Though it sounds a paradox, its numerous experiments in Communism belong to Individualism; none are made by Governments, but by groups of individuals already under protection of Government. But the opening up of the West—Ohio, Indiana, Illinois, Missouri—was assisted actively by the Governments, which made grants in aid of roads, canals, and railways, and lent capital to settlers, or promoted banks for such loans. This eagerness to quicken the pace of industrial progress, in the United States as in the Australian states, is the mark of an irreflective State Socialism, hardly to be ranked with the State Socialism of old countries. At present the socialistic experiments go on more slowly; but they are nearly as various as there are states in the Union. Many states have a usury law, as once in England, fixing the maximum rate of interest on loans. Many states exempt homesteads from seizure for debt, an exemption extended in Texas to nearly all the customary goods and chattels of the settler. Wyoming and three other states claim control over all water; Indiana controls the use of natural gas; Maine, not to mention other states, forbids the sale of intoxicating liquors. These are only a few instances out of many.[1] The railways are not owned by the states, and the legislatures of the states are the scene of constant attacks on the railway companies. Decisions of the Federal Court in 1876 established the right of a state to a control over undertakings of the nature of monopolies. In 1887 the Federal Government itself, by the enactment of the Inter-State Commerce Law, exercised public control over railways running beyond one state into another.

America.

This is State Regulation, not State Socialism; and the same is true of the attempts under the Sherman Anti-Trust Law of 1890 and the numerous attempts of the legislatures of the individual states to deal with the great corporate combinations such as those formed to forestall and engross the supply of sugar, tobacco, soda, wall-paper, coal, indiarubber—to say nothing of the monopoly of oil under the Standard Oil Trust, and of steel under the Steel Trust of 1901. Trusts were thought to be specially dangerous in the case of articles deemed necessaries. Socialists of the modern scientific school have always regarded them as inevitable results of competitive trading, paving the way for the engrossment of all large industries by the State. But in America the mischiefs do not seem to be leading to the socialistic consummation. Trusts are seen to cure the evils of fluctuation, speculation, and wasteful overlapping. The people would prefer to see trusts controlled by Government rather than swallowed up in a Government trust.

[1] For a longer list, see Bryce, *American Commonwealth*, part v. ch. xcv., ed. 1895.

From various causes trade unionism is not even now so well organized in the United States as in Great Britain. With the formation of the Knights of Labour (1878) under Stevens and Powderly, there seemed to be growing up a new power in the country; but Powderly attempted impossibilities, trying to unite workmen generally, without regard to divisions of locality, or allowance for difference of skill or for rivalry between trade and trade. The Federation of Labour goes more wisely to work, dealing with particular grievances of particular trades, and pressing for redress of flagrant grievances. Appeal is made to the State mainly when the Federation has failed; action through the State is the second resource, not the first. The Convention of 1892 demanded Collectivism; the Convention of 1893 retracted the demand. Yet Socialism makes its converts, even in the New England states, and not simply among German immigrants. Henry George, on his return from England in 1883, formed the United Labour Party, to spread his views of the righteousness of a single tax on land rents, to displace all other State revenues. Henry George has been often hailed as an Individualist, and his "nationalizing of the land" stops far short of Social Democracy—the Social Democrats were expelled from the United Labour Party in 1887. But George's programme included more State intervention than is involved in the single tax. Almost the entire body of Socialists of all denominations supported his (unsuccessful) candidature for the mayoralty of New York City in 1886, when he received 68,000 votes. A village in Maryland tried (though in vain) to get legal powers to adopt his single tax (1893). Having made a convert of Father M'Glynn in New York, he imagined that the Pope's Encyclical, *De conditione opificum*, was aimed entirely at him; and he wrote an open letter to the Pope in reply (1892). George's death (during his second candidature for the mayoralty of New York, October 1897) did not end his influence, in some respects a very healthy one.

The Social Democrats have been represented since 1877 by the Socialistic Labour Party, consisting mainly of Germans. The aim of Edward Bellamy's *Looking Backward* (1888) was "to nationalize the functions of production and distribution," converting the United States into a gigantic industrial army under the generalship of the President, and so abolishing the evils of trusts and corners and modern competition generally. The *Nationalist Magazine* appeared in 1889 to advocate at first full-formed Nationalism, and afterwards, when the times seemed less ripe, experiments like Robert Owen's in the way of socialistic colonies. But the magazine died from lack of support in 1892.

Almost simultaneously with Nationalism, the People's Party, or Populism, sprang into being, at a convention of the Farmers' Alliances, Knights of Labour, and other organizations (1889). Its programme included (with some vacillation) abolition of the present banks, taxation for revenue only, Government ownership of railways and canals, free coinage of silver. This party was one of the chief supports of Mr Bryan in his unsuccessful campaign for the Presidency in 1896. It has taken its place as one of the fighting political parties; and it is hardly to be reckoned, except incidentally, a socialistic body. It has been well said that a Socialism which proposes, like Bellamy's, to abolish the separate states of the American Union, is therein attempting quite as hard a feat as the abolition of private property. The Populist Party is not fully committed to either attempt. Its members have little devotion to general principles, and would probably accept social reform with or without Socialism. Accommodation to altered circumstances is being forced on Socialists by experience, in America as elsewhere; and in

the experience of modern nations centralization is possible without Social Democracy, and decentralization without Anarchism.

Since the knowledge of opposites is one, to understand modern Socialism we must know something of Anarchism, which haunts it like its shadow, and resembles it only (though that is much) in attacking the system of private property as it now is. In America the Socialistic Labour Party is confronted with the Anarchist International Working People's Association. Anarchism has proved to be more truly international than Socialism. Social Democracy itself was felt by Marx and his disciples to be comparatively feeble unless international. Like modern Bimetallism, without an international agreement it may be crippled by the proceedings of nations that do not adopt it. The International Working Men's Association, founded by Marx in May 1864, was the practical scheme into which he threw himself heart and soul. He lived to see the International feared by all Governments on the continent of Europe. Its motto was that of the Communistic Manifesto of Marx (1848): "Proletariate of all countries, unite!" It held congresses at Geneva, Lausanne, Brussels, Basel, but survived the Paris Commune little more than a year; and after meeting in London (1871) held its last meeting at The Hague in 1872, when it expelled the Anarchists. A new International met at Geneva in 1873; and though from time to time International congresses have been held at the usual centres, the control of the International, in the narrower sense, had passed, from that year onwards, into the hands of the Anarchists. The old International had been successful in planting the ideas of Social Democracy over all the countries of the Continent; it had not succeeded in bringing about united action of the proletariate of all countries for the ends of Social Democracy. At the Ghent Congress of September 1877 the differences between the sections of the party led to sharp contentions. Many delegates declared themselves Anarchists: "Communism, 'they said,' is community and government; we desire Anarchism, which is community and anarchy." By "communism" they here understand Social Democracy, the communism of the Communistic Manifesto of 1848. This Manifesto, as compared with the contemporary plans of Louis Blanc for self-governing associations, seems to the Anarchists entirely retrograde. They dread the prospect of a government of industry after a military pattern; a strong centralized government is certain, they say, to be a tyranny. The most scholarly writers of the Anarchist Party (like Kropotkin, Elisée Reclus, and Tcherkesoff) consider that the pretensions of Marx to having founded a Scientific Socialism are unjustified historically, and that the Socialism itself is unjustified logically. They desire the abolition of all great central governments, and the establishment, in place of the present system of things, of groups of autonomous small communities, in which the individual man shall support himself according to his wants and capacities. But the Anarchist benefits us more by his keen criticism of defects than by his plans for reformation. Even in the soberest sections of the party it is hard to find men who reason out the way to their ideal.

Anarchism and the International.

We might divide Anarchists, very roughly, into three classes. There are, first, those who use the Universal Negative: they feel sure that political government as it is, is bad, and they would destroy all government; they are Nihilists. This is the class associated with deeds of violence. There are, next, those who would have Communism established without a central political government, but under a public control, exercised by local councils till the time come when public opinion will be a sufficient control by itself. William Godwin taught a similar doctrine in 1793. William Morris, when he left the Social Democrats, was drifting in this direction. There are, finally, the extreme Individualists, described in Carlyle's words as content with "Anarchy plus the street constable," and regarding the intervention of the State as a necessary evil, to be reduced to the smallest possible dimensions. These views are represented by Mr Herbert Spencer and Mr Auberon Herbert. They regard private property as the stronghold of individual liberty. They are rather an academic than a popular party. The really powerful party among the Anarchists is the middle party, disowning mere violence, and yet refusing to work in parliamentary harness, seeing no virtue in political government, even when representative. There is now a Parliamentary Socialism; there cannot logically be a Parliamentary Anarchism. Such a return to nature as is involved in successful Anarchism would be truly a revolution. The whole course of civilization hitherto has been hand in hand with law. The Anarchists would persuade us that there can be order without law, and a better order than with the best laws. But when they propose practical schemes, these are found to involve laws on a small scale, the laws laid down by the autonomous groups into which the Anarchists would break up present states. That such groups can live and work under the ægis of a State has been proved possible, but not that they can take the place of a State. Before the group could be secure against disturbance from without, it must either be under the shelter of a powerful military State, or rest assured that there is nothing but peaceable groups of like mind all around it. This last alternative would demand an international agreement, and a moral change in average human beings of a far more sweeping character than is required even for Social Democracy. If men cannot be made virtuous by Act of Parliament, neither are they so virtuous, or wise, or well-instructed as to dispense with Acts of Parliament. Anarchism, in short, seems, like the doctrines of the Society of Friends, on the whole too high for human nature, as we know it; and no convincing proof is given by the Anarchists that human nature is changing in the right direction so rapidly as to justify their aspirations. Moreover, if the change did take place, the world would probably have thereby become a tolerable world for us all even under the present system.

Both Socialists and Anarchists have claimed that the theory of Evolution, especially in the form founded by Darwin, tells in their favour. Mr Herbert Spencer has found it necessary to disclaim the socialistic conclusion in his own case. Evolution, in his interpretation, tends to Anarchism. But all the Scientific Socialists see in it the contrary tendency, with at least equal reason. Strictly speaking, the school of Marx and Engels ought to abstain from prediction altogether, and rest content with the reflection "What must be, shall be." The rest of the world, believing that human affairs are not fatally determined by purely economical causes, may criticize Social Democracy as an ideal, which it is perhaps in men's power to realize.

The Anarchists seem to be right in thinking that a strong central government, to which all power was given over industry as well as over all other departments of human life, would be contrary to liberty. Supervision would necessarily become more and more importunate, and great powers would mean great temptations to abuse of power, if men remain as we know them to be in all present kinds of government, bureaucratic, aristocratic, and democratic. The objection is not weakened if we take seriously the claims made by the old-fashioned Social Democrats for the supremacy of the working classes in the narrow sense

of the word. There is no reason to believe that working men are either better or worse than men of the other classes, and that they would behave differently under like temptation. Apart from actual tyranny of such a collectivist government, there might be a danger that individual initiative, however encouraged in theory, might be discouraged in practice. In fact, many of the objections found in old text-books of Political Economy have truth in them, and the Social Democrats show by their changed policy that they are well aware of this. It is true, however, that the objection from population applies to social reform generally, and not to Socialism in particular; and it is true that the objection from natural indolence applies less to Socialism than to Anarchism; Socialism would probably give not too much but too little indulgence to what it considered laziness.

The Anarchists, again, seem to be right in thinking that their rivals have misread the signs of the times in modern industry, and that the tendency towards concentration, both of businesses and incomes in fewer hands, is not the general rule. Gas and electricity seem likely to revive domestic and local industries. Great companies with some thousands of shareholders are becoming commoner than businesses held by single persons or families.

Even if all were tending to concentration, it is not easy to see how all is tending to prepare the bulk of the people for the revolution that is supposed to follow the concentration. Without more knowledge, self-control, and habits of business than they have now, the great world of the employed would not be fit to direct the course of industry and of their own employment. Without an industrial and moral preparation, therefore, Collectivism could not be a temperate and wise and permanent government. Yet the old-fashioned Social Democrats delighted in telling us that Capitalism made and kept men unfit for the higher functions of a human life by the bad social conditions it created. If the change is not to be sudden (and the modern Social Democrat usually admits this), then the necessary discipline must go on now, even under Capitalism; and it will fit men to use even their present opportunities better than formerly. Till they are capable of co-operation they are not ready for Socialism. The improvement of the workman is more important for the future of society than the improvement of the millionaire. There are signs that both are advancing together; and the result may well be that when men are ripe for Social Democracy, they will find Social Democracy superfluous.

Half a century's experience of Scientific Socialism seems to have served the cause of progress, though not in a way expected either by the Socialists or by their opponents. The programme of the Manifesto of 1848 has not been accomplished. The proletariate of all countries knows each other better, but the nationalities have not disappeared. Achievements in State Socialism have been carried out by the several states, each one for itself, modified sometimes by a common understanding, which is far from being united action. While the Social Democrats have gone the way of Marx, Germany, since German unity, has in one sense gone the way of Lassalle. The old fear of Socialism, as a sort of unknown force for evil, has given place to a familiarity which has bred deference, if not compliance. In Great Britain and America, Socialism has helped to popularize the serious study of industrial and social questions, where too many persons had been content with mother-wit and tradition. Socialism, by teaching that competition in industry is all evil, has taught many to distinguish between the good and the evil of it. Instead of killing Political Economy, it has caused a healthy revival of it. Politically, the old-fashioned Social Democrats insisted too abstractly on the all-pervading power of the State, as if that could replace the laborious ant-like efforts of its millions of subjects. But it helped to remind rulers that government is founded on opinion, and that the best way to avoid the need of the Social Democratic revolution is to make the government really democratic. At first the appeal to force was met by force; both parties have needed to learn that force without opinion makes no permanent institutions.

AUTHORITIES.—The list of these would be too long to quote in full. The German bibliography of Stammhammer, the handbook of Stegman and Hugo, and Warschauer's *History of Socialism* give endless references. Schmöle and Kulemann give the history of German trade unions. For the latest aspect of German controversies, see E. Bernstein's *Voraussetzungen der Sozialdemokratie*, 1899. For the general history, see Rae's *Contemporary Socialism*, 2nd ed., 1891; for that of America, see Ely's *Recent American Socialism*, 1885; and of New Zealand, Reeves' *Long White Cloud*, 2nd ed., 1899. For Anarchist criticism of Marx, see W. Tcherkesoff's "*Pages d'histoire Socialiste: Doctrines et Actes de la Social Democratie*" (from the *Temps Nouveaux* of 1896). For general references, historical, biographical, bibliographical, see the files of the *Economic Journal* (London), the *Quarterly Journal of Economics* (Harvard), and the *Political Science Quarterly* (New York).

(J. B*.)

SOCIAL PROGRESS IN GREAT BRITAIN.

IN common use the phrase Social Progress refers especially to the conditions under which the mass of the people lives rather than to changes which take place among the rich, and it is in this sense that it is used to cover the subjects dealt with in this article. Building is the most evident sign of development, and in the last twenty years of the 19th century the amount of building was remarkable. Great towns are now generally surrounded by new suburbs inhabited mostly by people with incomes under £300 a year. These suburbs have busy thoroughfares lined by shops, and long, straight roads, where each house has a little garden and some attempt at ornamentation. The number of houses in Great Britain of the annual value of £20 and upwards in 1878 was 18·9 of the total; in 1900 the number had become 22·3. The growth of such suburbs is, however, matched by that of others occupied by city merchants and rich people, whose houses are almost mansions, and stand in their own grounds. In 1900 there were 23,120 dwelling-houses in Great Britain assessed to house duty at an annual value exceeding £200 a year, as compared with 18,108 in 1878.

Building.

But perhaps the most conspicuous house-building of the period is that at holiday resorts. Whole towns have been built by the seaside, and places which, in the early 'eighties, were hardly known as villages have now a large population of residents retired from business, besides accommodation for thousands of visitors during the summer who have both time and money to take holiday. Within the great towns themselves the builders have not been idle. Slum dwellings have been cleared under Cross's Acts, 1875–82, and the Housing of the Working Classes Act, 1890; and on the spaces so cleared, as well as on others privately acquired, block dwellings have been erected. The character of neighbourhoods in the heart of great towns has thus been much changed. Instead of small tenement houses—built originally for the occupation of one family, but used

much more rapid in the second period. Along with better dressing and better feeding has come a greater sense of self-respect. People as a rule are more polite, if not more considerate; there is not the same horse-play on holidays; and notwithstanding outbreaks of "Hooliganism"—*i.e.*, riotous and brutal conduct by boys in the streets—people are more courteous, if not more gentle. Better health equally with better education has secured this result, and this is largely due to the development of sanitary science. Towns are more adequately lighted and cleansed, houses are fitted with more scientific appliances, and if water is still somewhat sparingly supplied, it is of decidedly better quality. The lighting of towns and villages has been improved. The standard of cleanliness in streets has been raised. The number of official inspectors has been doubled, often quadrupled, so that dirt is continually limited, defective drainage remedied, and foul places made sweeter. The sick of infectious diseases are immediately removed in public ambulances to a hospital situated in good air, provided with every appliance which skill and money can reach; and there they are nursed till they can be restored well and free of infection. In 1893 there were 587 local authorities in England and Wales who had provided accommodation for infectious diseases. Since that date, under the pressure of the Local Government Board, great strides have been made. There are now many more such hospitals. The healthy have the advantage of enjoying the open spaces, small and large, which have been made available. During 1898 the sum of £786,233 was expended on open spaces by various municipal authorities; in 1899, the sum of £805,592. Churchyards in crowded neighbourhoods have by this means been laid out so as to afford quiet places to sit and rest, and parks have been provided for the recreation of those who would enjoy the pleasure of walking amid the flowers, listening to music, or the vigorous pastimes of football or cricket.

An observer suddenly lifted from 1880 and planted in a town of to-day would perhaps first of all be struck by the pace at which things are done. Railway passenger traffic has greatly increased, electric trains and trams have been started, people run to and fro about the country and travel daily to their homes. It is computed by Sir J. Wolfe Barry that 1,000,000 persons enter and leave London daily by railways alone. In one hour 1228 vehicles and 5660 pedestrians pass through the Strand. In 1879 the metropolitan tram-cars ran 7,701,999 miles and carried 56,041,767 passengers. In 1900 they ran 31,679,397 miles and carried 337,058,869 passengers. It is impossible to show the absolute growth in London local railway traffic, as the great railways do not furnish returns for their suburban traffic separately from their main line and provincial traffic, but the distinctively metropolitan railways in 1879 carried 112,801,531 passengers, and in 1900 they carried 192,437,707 passengers. In 1882 there were 7,987,877 workmen's tickets issued by railways having London termini, and in 1899 there were 41,831,657 so issued, *i.e.*, a daily average of 134,507. The London General Omnibus Company carried 135,131,902 passengers in 1894, and 195,692,126 in 1899; the Road Car Company carried 44,610,320 in 1894 and 65,326,150 in 1899. The Metropolitan Police in 1881 issued licences for 5800 two-wheel cabs and 3847 four-wheel cabs, and in 1900 for 7531 two-wheel and 3721 four-wheel cabs. Work is everywhere done at increased speed, and the cost of such speed is to be found in the terrible death-roll of industry. It is stated in the report of the Royal Commission on Accidents to Railway Servants that in 1898, 542 servants were killed on the railways and 12,979 disabled; the proportion who suffer in mines is about the same. The total number of workpeople killed by industrial accidents in 1900 is reported as 4785—434 more than in 1896; and the total number injured was 104,464—46,982 more than in 1896.

Sunday is less quiet than it used to be. People wanting something to do get out of town by cycles or by trains; they go to concerts or picture galleries; they visit their friends and entertain parties. The Sunday League organizes gigantic excursions from town to town or from town to the seaside, the profits of which are spent in providing free or very cheap concerts of high-class music. The Sunday Society's long agitation for the opening of museums and picture galleries was crowned with success in 1896, when Parliament resolved that institutions under their control should be opened. The use made of the opportunity is at present not great. People are not sufficiently educated, and the numbers who visit the National Gallery show little yearly increase. The municipalities, with some notable exceptions, open the public libraries, and in many towns lectures are given.

Work is done and life is lived under greater pressure, but at the same time more leisure has been secured. A half holiday in the week is general, and the provision for week-end excursions is being developed; many trades have secured a nine hours' and some an eight hours' day. The leisure so gained is used largely in the enjoyment of sport, actively by some, and by a larger number as spectators. Schools are valued for their games as much as for their teaching; a hero of the football or cricket club is more honoured than a scholar, and nations hang on the issue of international contests. All classes seem equally to delight in the development and use of physical strength. Every town, almost every parish, has an athletic club, and every individual is interested in its success. A football match easily draws 50,000 spectators, sometimes 100,000, and every year the language is enlarged, if not enriched, and the thoughts of people modified, from the vocabulary of games. The development of athletics is matched by the increase of popular literature. In 1870 the total number of London newspapers filed at the British Museum was 224, provincial 667, Scotland 136, Ireland 154. In 1900 the London newspapers were 1226, provincial 1664, Scotland 282, and Ireland 222. Halfpenny papers have been started, and although no special returns are available, it is computed that every town of 45,000 inhabitants has such a paper. The number of periodicals is constantly increasing, and is now roughly computed at 21,000 per annum. The characteristic of both popular journals and magazines is news and stories shortly told. They seem meant for readers in a hurry who have no time to think, and they appeal to the more sensational side of human nature. The expiration of the copyright of many standard authors has thrown on to the bookstalls an abundance of good literature which finds a ready sale. Sport and newspapers together have opened greater facilities for the gambling which now takes a place near drunkenness as a cause of crime. Matches are got up not only for the sake of the show of skill, but to give opportunities for bets, and many newspapers obtain a large sale by supplying food for the gambling appetite. The statistics of drunkenness and of the efforts to control the drink traffic are given in the special sections below; but, speaking generally, the habit of getting drunk seems to have decreased and the habit of taking drink to have increased. The character of popular pleasure is what might be expected to follow an education which leaves the mind untrained to think and a life strained and hurried. People demand excitement at the least cost of mental effort. They like, therefore, as well as gambling and drinking, sports and sensational literature, exciting plays and songs. There has been a marked increase in the provision of theatres and music-halls. There is also a much

more widely spread desire to attract attention and to appear in print. Hence the growth of "personal" journalism. The question whether, with the love of excitement, sensuality has also increased cannot be answered by statistics; but judging from observation, from the tone of talk in clubs, and from the number of persons who require medical care in the infirmaries, it would seem as if less self-restraint were exercised. The occupation of their leisure by the people remains somewhat of a mystery. There are many trades which in winter leave off work at four o'clock. Some of the men so released may be found in continuation schools and libraries, some may frequent public-houses and places of amusement, but the greater number remain unaccounted for, and it seems fair to assume that they return to the homes they have built up by thrift, and spend the evening with their families reading, talking, doing odd jobs, or sleeping.

There has during the period been much more talk of religion, matched by a show of greater respect for religious agencies; but whether this means that the sanctions of religion are more powerful to inspire and restrain conduct, or to give peace and comfort, is a question not easily settled. Statistics would probably show that in every denomination there has been an increase of church membership, but the increase may be due either to the development of party feeling, which leads to zeal for opinion rather than for godliness, or to the interest in the social work undertaken by churches—and this is not necessarily a religious interest. The answer to the question can only be an individual opinion, but the opinion of the writers is that religion is less powerful than it was, say, in the 'seventies. It may be that then religion was more mingled with superstition, but it had a power to restrain and to give peace which it does not at present generally exercise over people whose thoughts have been widened with the process of the suns. Religion lies in a lower intellectual atmosphere than that which is commonly breathed, and does not therefore so deeply affect life. It has not kept pace with the general advance, and thus it is that people are not under authority; they are not bound to certain courses at the cost of profit or life, and they are not at peace when their world is turned upside down. The demand for excitement, the indulgence of vanity, the hurry of life and the absence of control have increased the tendency to mental disease, and one of the problems of the immediate future is the treatment of insanity. In 1881 there were in Great Britain less than 2 per 1000 of the population insane, and at the census of 1891 the ratio exceeded 3 per 1000.

The signs of the period which can be measured leave the inquirer seeking the spirit which lies behind. Perhaps it may be best described as an increased sense of individuality—a greater consciousness of a right to be. This spirit should show itself in attempts to realize the highest individual existence; but because a class of people who have few responsibilities to workmen, or tenants, or neighbours, and indulge themselves as they like, now occupy public attention and the most honourable places in society, it tends to show itself in a desire to escape toil and to reach a life as easy as that of the millionaires. Prosperity has increased the attraction of material comfort. The ideal of the individual is freedom from trammels and mastery over others. There is thus a widely-spread determination to have a good time while it lasts, and there is a growing impatience of control, whether it be that of authority, of public opinion, or even of responsibility for the future. One outcome of this disposition and this aim is to be seen in the spread of socialistic theory. Socialism seems to promise security to the individual to enjoy his life. It promises this result at once without the fatigue of thought, the exercise of

The modern ideal.

responsibility, or the weariness of waiting. It offers to remove the pressure of work, to rescue the individual who is being crushed by competition, and to give to each the means of material enjoyment. There may be some signs of a disposition to "think in communities" and of a tendency to subordinate the present to the future, but as yet the most powerful motive is the individual's longing to do the best for himself in his own time. Another outcome of this development of the sense of individualism is to be found in the prevalence of a more arrogant or insolent tone. There is thus at one and the same time a demand for the stricter enforcement of law to secure rights, and a defiance of the laws which are in existence. The "haves" incline to assume, and the "have-nots" incline to rebel. They who are strong tend to show their strength. Hence come some of the extravagances of fashion, the lawlessness in high places and low places, the impatience of reforms whose fruits are in the future. The prevalence of this sense of "a right to be" is not inconsistent with the increased care for others which is shown in legislation, in charity, and in the administration of law. *Succès oblige.* People who have a high sense of their own claims recognize the claims of their neighbours; and there is undoubtedly, alongside the increased demand for more of the good things of this world, an increased goodwill to grant such things. The conqueror is often kind, and there is a certain pleasant pride in being generous. Much has been done; the progress of a generation measured by figures is immense; but there are still many old ills of society waiting a remedy—poverty, ignorance, and suffering. There are other ills—vanity, love of mastership, and the desire for pleasure—which seem to be taking a deeper root. (S. A. B.; H. O. B.)

Baths.

It was not till 1846 that it was deemed advisable, for the "health, comfort, and welfare" of the inhabitants of towns and populous districts, to encourage the establishment therein of baths by the local authority acting through commissioners. A series of statutes, known collectively as "The Baths and Wash-houses Acts, 1846 to 1896," followed. By the Public Health Act, 1875, the urban authority was declared to be the authority having power to adopt and proceed under the previous Acts, and in 1878 provision was for the first time expressly made for the establishment of swimming baths, which might be used during the winter as gymnasia. By the Local Government Act, 1894, it was provided that the parish meeting should be the authority having exclusive power of adopting the Baths and Wash-houses Acts in rural districts, which should, if adopted, be carried into effect by the parish council. Up to 1865 it seems as if only twenty-five boroughs had cared to provide bathing accommodation for their inhabitants. There is no complete information as to the number of authorities who have adopted the Acts since 1865, but a return of reproductive undertakings presented to the House of Commons in 1899 shows that 110 local authorities outside the metropolis applied for power to raise loans to provide baths, of whom 48 applied before 1875 and 62 after 1875. In 1900 the loans sanctioned for the purpose amounted to £83,294. No loan at all has been raised by any parish council for baths, and the total receipts for the year to 31st March 1899 of such councils under the Baths and Wash-houses Acts was £127. In the metropolis, by the Local Government Act of 1894, the power of working the Act was given to vestries, and by the Act of 1899 this power was transferred to the borough councils. There are 35 parishes in London in which the Acts have been adopted, all of which except 11 have taken

action since 1875. These establishments, according to the return made in 1899, provided 2539 private baths and 85 swimming baths. The maximum charge for a second-class cold bath is 1d., for a hot bath 2d. In 1897–98 the number of bathers was 4,463,109, of whom 2,347,958 were bathers in second-class private baths and 2,115,151 bathers in second and third class swimming baths. In the previous year the gross total had been only 2,000,000. In cases where the proportion between the sexes has been worked out, it is found that only 18 per cent. of the users of private baths, and 10 per cent. of the users of the swimming baths, are females. In 1898 the School Board was authorized to pay the fees for children using the baths if instruction in swimming were provided, and in 1898 the privilege was used by 444,111 children. The cost of this public provision in London—largely on account of the high rate charged for water (£12,522 was paid in 1897–98)—is over £80,000 a year, which has to be paid by the ratepayers. No account can be given of the numbers using the ponds and lakes in the parks and open spaces, but it is computed that on a hot Sunday 25,000 people bathe in Victoria Park, London, some of the bathers starting as early as four o'clock in the morning. These returns show how great is the increase of the habit of bathing, but they also show how even now the habit is limited to a comparatively small part of the population. People require to be tempted to the use of water, at any rate at the beginning. There are still authorities in London responsible for 800,000 persons who have provided no baths, and those who have made provision have not always done so in a sufficiently liberal and tempting way. The comparison between English great towns and those of the Continent is not in favour of the former, but the growth has begun, and promises to go on. Swimming clubs have become common; the contests awake much interest, and the demand for more accommodation is likely to be heard. (S. A. B.; H. O. B.)

Clubs.

Workmen's clubs are a product of the last twenty years of the 19th century. The first were institutes, and liquor was not introduced till 1868. They can be registered under the Friendly Societies Act, but as there is no obligation to do so, the return of 802 registered clubs in England and Wales is no evidence as to their number. In 1900 there were 54 workmen's clubs registered, and at the same time "an enormous growth of dubious clubs." The Working Men's Club and Institute Union has collected returns, and gave evidence before the Licensing Commission, presided over by Lord Peel, that in 1896 there were 3991 clubs in which intoxicants were sold. Of this number 660 were in London, 1583 in English counties, 1291 in English boroughs, 122 in Wales, 157 in Scotland, and 178 in Ireland; 313 are returned as proprietary clubs, but these cannot represent the real number. As regards subscriptions, 1098 have an annual subscription of £1 and over, 1158 from 5s. to £1, 1405 from 2s. to 5s., and 329 stand at 2s. or under. Rather more than one-half the clubs open on Sunday, with a large proportion in Wales and Ireland. On week-days 1582 are open after 11 P.M., or in London after 12.30 A.M.

There is no available record showing the increase of clubs; but it is known that, of the 3991 existing in 1896, there were only 2160 in 1887. According to the returns of the Union, it seems that in 1890 there were 328 clubs affiliated, and in 1900 there were 708. The secretary reports that of these 650 have been started since 1882. The clubs are social or political, drinking or teetotal. The drinking clubs are entirely self-supporting, and sometimes own the buildings they occupy; the teetotal clubs are generally subsidized. In the drinking clubs the average spent per week on drink is one shilling and a farthing per member. There are various opinions as to the object and use of clubs. On one hand it is contended that they exist to provide means of drinking when the public-houses are closed, that they are a fruitful cause of drunkenness, that the spirit of gambling is promoted, and that the entertainments are often of a low character. It is reported that during ten years 352 clubs were closed by the police or the excise. On the other hand it is urged that the clubs against which such charges hold are few in number, and such as should be restricted by police action; that they have been generally formed to promote good fellowship; and that in most of them there is a development of a higher taste and a sense of social duty. In support of the latter opinion the Union offers evidence as to the increased use made of libraries, as to the number of club members holding office on local governing bodies (2320 in 1901), and of the ever-widening interest taken by members in the affairs of the world. The Union, however, acknowledges an increased love of pleasure compared with the increased love of knowledge. The number of clubs having Sunday lectures has decreased, while those having Sunday entertainments and games have increased. The proportion, too, of political to social clubs goes on decreasing. On the whole it may be said that the clubs accurately enough represent the features of the time—the improved conditions which leave men leisure, the possession of knowledge which longs to spread itself in fellowship, the love of pleasure which looks for the easiest ways of satisfaction, and the dislike of restraint which is happy in a club where no one has a master. The Licensing Commission, approving of the benefit to be derived from properly constituted clubs, unanimously recommended a system of registration under such conditions as to ownership and management as would prevent individuals benefiting by the sale of drink or the admission of persons under 18 years of age. (S. A. B.; H. O. B.)

Housing.

The first legislation on this subject was due to Lord Shaftesbury in 1851 and to Mr Torrens in 1868, but for many reasons the laws were not effective. The principle, however, was asserted that the responsibility of maintaining houses in proper condition falls on the owner, and that if he fails in his duty the law is justified in stepping in and compelling him to perform it. In 1875 and 1879, when Lord Cross was Home Secretary, the Government brought in Acts, and a subsequent Act in 1882, "to deal with the whole area where houses are incapable of repair," giving the local authorities compulsory powers to enter as purchaser (but at the commercial and not at the housing value) and proceed to reconstruct. Something was done under the powers thus conferred, but in 1884 the public mind was deeply stirred by revelations about the condition of the poor. A pamphlet published by Mr Mearns, of the Congregational Union, entitled *The Bitter Cry of Outcast London*, described a state of things in which health and decency were impossible. A Royal Commission, of which the then prince of Wales was a member—"one of the most powerful commissions ever chosen"—was appointed in 1885 to inquire into the housing question. Its action brought many details of poor life to light, but its report was followed by the Housing of the Working Classes Act of 1890, which, however, did no more than consolidate all previous Acts.

The Housing of the Working Classes Act, 1890, is divided into three parts. Part I. deals with large areas. When twelve ratepayers call upon the medical officer to investigate a neighbourhood

in which houses exist which are regarded as unfit for habitation, or when, without such a call, the medical officer represents to the local authority that an area is unhealthy, the local authority must consider the representation, and, if satisfied, make an improvement scheme. This scheme has to be approved by the Secretary of State, who will issue a Provisional Order (afterwards to be confirmed by Act of Parliament), which the local authority must obey. Part II. applies to small unhealthy areas and also to individual houses. In the former case the local authority may prepare a scheme on its own initiative, which must be confirmed by the Local Government Board, but no Act of Parliament is necessary. In the latter case, when any house is declared unfit for habitation the local authority may obtain from the magistrate an order for closure and demolition, but the procedure to obtain these orders is beset with difficulties. Part III. gives the local authority power to acquire land compulsorily or by agreement, and erect thereon lodging-houses, separate houses, or cottages containing several tenements.

In carrying into effect schemes under the Housing Acts the Metropolitan Board of Works from 1875 to 1889 displaced some 27,000 persons of the working class and secured the provision of accommodation for approximately the same number. Since 1889 the London County Council has, under the Act of 1890, displaced some 10,000 persons, and under various other Acts some 3000 more. In lieu of the accommodation thus destroyed the London County Council has itself erected dwellings for some 15,500 persons. The net cost of all operations carried out by the Metropolitan Board of Works and the London County Council under the Housing Acts from 1875 to 1901 amounts in round figures to £2,700,000, while the total cost of all works under the Acts (including the remunerative expenditure on dwellings) amounts approximately to £3,500,000. The London County Council has in connexion with its dwellings a rent-roll which now exceeds £40,000 per annum. Mr Blashill, the Council's former architect, thinks that after allowing for the street improvements involved it might be fair to say "that the net loss on the council's housing schemes amounts to £45, or possibly £50, for every person displaced."

In 1898 the council determined to take further steps under Part III. "with a view to the purchase of land and the erection of dwellings thereon," independently of any clearance or improvement schemes. About 40 acres at Tooting were acquired, and subsequently 225 acres at Tottenham to house 40,000 persons, and 30 acres at Woking to house 6000 persons. The borough councils, under the Act of 1899, also have power to put in force Part III. of the Housing Act. The possibilities of work are immense, in the light of the fact disclosed by the census of 1891 that 214,843 persons in London lived in tenements of one room, and 330,238 persons in tenements of two rooms. The census of 1901 showed, however, that progress had been made. The number of one-room tenements in London has declined, and whereas in 1891 there was 9·2 per cent. of the population in such tenements, there was in 1901 only 6·7; whereas tenements of five rooms, which in 1891 were 32·7 per cent. of the whole, rose in 1901 to 34·1 of the whole. The rate of increase during the decade in larger tenements has been exactly double that shown in smaller tenements.

The Cheap Trains Act of 1883 has had a direct bearing on housing by tempting railways to provide workmen's trains. The passenger duty is reduced on condition that cheap trains are run between the hours of 6 in the evening and 8 in the morning. The Great Eastern Railway has thus issued return daily tickets at 1s. a week to stations within 12 miles of London. The consequence has been the great extension of workmen's suburbs in the eastern districts. Other companies have been compelled by the Railway Commissioners to provide additional trains. The effect is shown in the decrease of the growth of population within the London area. Between 1891 and 1896 the rate of increase was 4·8 per cent.; between 1896 and 1901 it was 2·4 per cent. In the ten years preceding 1901 the loss by migration from the county of London exceeded 180,000.

The Public Health and Building Acts have also directly or indirectly affected the housing question, rendering it more easy to condemn houses as unfit for habitation, and making it more difficult to build houses with insufficient or ill-adapted provision for health and comfort. In 1899 the Government passed an Act by which the local authority may advance a sum not exceeding £250 to enable the resident or the intending resident of a house not exceeding £300 in value to purchase such house, but little use has been made of its provision.

Public action by Parliament and local authorities has been more than equalled by the individual work of philanthropists, companies, and builders. The Peabody trustees (1862) and the Guinness trustees (1889) have in some instances bought land cleared by the public authority, but in most cases have secured sites in the open market. There are smaller trusts in some of the great towns: they all build block dwellings, and let tenements at rents which pay a small interest on the capital sum. The receipts accumulate, and are invested in further buildings. Rules are of course necessary, and criticism is sometimes provoked. It is objected (1) that the buildings are too much in the nature of institutions; that people need houses, not rooms in a barrack, and that a family should have a house with easy access to the street; (2) that the tenants who benefit by the somewhat lower rent are not the very poor, and are privileged; (3) that the provision of houses out of charity limits provision in the way of business. But at all events the houses so built have been an education both to their inhabitants and to society. Philanthropic action has not exhausted itself in founding trusts. Miss Octavia Hill has shown even a better way of meeting the housing difficulty. Before the agitation, as far back as 1864, she and Mr Ruskin, feeling that the housing of the people lay at the root of many social evils, obtained possession of a court of low-class property. Miss Hill gathered round her a group of volunteer workers, and, by applying character to character, endeavoured to raise the tenants as she improved the houses. Her plan answered: the houses were made habitable; broken woodwork was made sound; sanitary conditions were gradually—too gradually, it often seemed to impatient reformers—put in order; small playgrounds were secured; and rents were so regularly paid that the owners received fair interest on their capital. By 1902 she herself controlled houses occupied by 1268 families, and her system of management by means of lady visitors has largely extended in London and in many English and Scottish towns. Miss Hill thus originated a way of dealing with the occupants of the lowest class of house which has largely modified the views which are taken of the problem. It is now seen that it is useless merely to put people displaced from their hovels into model dwellings. They will not submit to order; they must be themselves educated, and the change must be gradual. Another result of the Royal Commission was the formation in London of the Mansion House Committee for Improving the Dwellings of the Poor, and of like committees in other towns. These committees have done particular service in bringing public opinion—and sometimes the decisions of the law courts—to stir up inactive local bodies. There are many clauses in the Building Act and in the Public Health Acts which are not enforced. Local bodies have sometimes a sympathy for local landlords; at other times they are unacquainted with the law. The Mansion House Committee, by means of local committees and by employing its own

inspectors, has brought this neglect to light, and in many districts a higher standard obtains. One fact is sufficient to illustrate the progress. In 1885 there were 89 sanitary inspectors over the London area, in 1898 there were 256. In 1878 there were 930 sanitary inspectors recognized by the Local Government Board, and in 1898 the number was 1822.

The housing of the poor has also been taken up on purely "business" principles. A company with this object was started in 1864, but the first notable success was scored by Sir Sidney Waterlow. His company has laid out £1,000,000, and housed over 30,000 people, and the death-rate stands at 9·95 per 1000. The Artisans', Labourers', and General Dwellings Company has invested 2½ millions. Companies on this model are now numerous in many of the great towns, and generally yield a fair dividend. Of late years, however, chiefly by reason of the increased expense of building, or in a less degree by the competition of municipal bodies, the companies have almost ceased to build. The weekly rents paid for rooms in these block dwellings in London average 2s. 6d. or 3s. a room. Private builders have in some instances erected blocks on a like plan to that adopted by the companies, but their activity has been chiefly shown in building cottages in the suburbs. They are often condemned as "jerry builders," but the condemnation is probably used in too wholesale a way; most of the cottages and houses which are now occupied on the outskirts of towns are convenient and sufficiently substantial. In 1878 there were 17,127 new houses built in the metropolitan police district; in 1900 there were 25,161. If, therefore, the Royal Commission was followed by no great measure of reform, there has been decided improvement.

The improvement, however, leaves much still to be done, and it has hardly touched the country districts. The mischief is now, however, much more that of overcrowding than of uninhabitable dwellings. Many causes have in late years tended to aggravate the evil. Agricultural depression has impoverished country employers and prevented the building of cottages, and good trade has brought people into towns. The high wages demanded by trade unions have almost doubled the cost of building—the cost per room in London is now £108, against £70 in 1891—and people being better off, demand more room. Overcrowding, according to a London County Council report, is more excessive now than in 1891. Various solutions of the problem are urged:—(1) Local authorities have been pressed to use their powers under Part III. of the Housing Act to acquire sites and build, even at a loss to the ratepayers; and further, to obtain powers to borrow at an easier rate, and to purchase sites outside their own boundaries. (2) Local authorities have at the same time been advised to interfere less. They are told that their restrictions on the character of the building, and on the number of occupants of a room, are absurd, and that business people, who would at once supply the demand for houses, are deterred by fear of competition supported by the rates. They are warned against creating a privileged class of workmen who have better accommodation or less rents than their neighbours, and may form a constituency who will press their private interests so as to corrupt the governing body. (3) Parliament is asked by some reformers to introduce new methods of rating to make vacant building land subject to rates, and to divide ground values from building values, so that rates may fall on the former. (4) There are others who see no remedy but in dispersion of the population; they advocate the provision of cheap and easy methods of locomotion by means of railways or tram-cars to every part of the circumference of great towns. They sometimes add a hope that power may be given to the local authority to acquire land on this circumference on some fair system of payment, so that sites may be available for either municipal or private building. The proposal of so many remedies shows the urgency of the question. It is long since Lord Shaftesbury first succeeded in drawing public attention to the evil of housing, but it is only since 1875 that efforts have been really made to abate the evil. Figures quoted above indeed show that the population is already tending to move from the centre to the outskirts, and the ambition for a bit of garden or for a sight of the country is more widely expressed as hours of labour are decreased. To a certain extent a remedy is thus being found by a natural process, and it is often urged that overcrowding is due chiefly to insufficient means of locomotion.

There is one class of people outside the working class whose condition especially attracts attention. This is the class found in casual wards, shelters, and common lodgings. It includes some workmen, but derives its character from the presence of many broken-bodied and broken-hearted men and women. These people—ragged and starved—are frequently found on door-steps and under arches, and awaken general sympathy. "If," it has been thought, "there were decent lodging-houses, where health and order could be secured at a small charge, many would be comfortable who are now driven to despair by discomfort." The managers of the Victoria Homes and Lord Rowton have met this need in London by forming companies to build lodging-houses, and the London County Council has itself opened a "doss-house" on the same lines. In some of the great towns—notably in Glasgow, where also a Family Home has been opened—a like provision has been made. The contrast between the new common lodging—a workman's hotel—and the old common lodging house is very striking. Any man who can pay 6d. a night may be secure of privacy in his bedroom and of cleanliness in his surroundings, of a bright sitting or reading room, and perfect order in the arrangements. The only doubt which clouds the satisfaction at the change is lest such good provision for single men may lead them to prefer single life to the responsibility of a home. These model lodging-houses do not, of course, affect the great mass of the class just mentioned. These people cannot pay 6d. a night, and will not endure order; they therefore take refuge in shelters and casual wards, or go to some cheaper lodging. (S. A. B.)

Pauperism.

Pauperism, measured by figures, has greatly decreased in England and Wales. In 1870 the number of persons who received relief was 46·5, in 1850 it was 57·4, per 1000 of the population. In 1899 the number was 26·5 per 1000. In Ireland, however, there has been an increase. In 1870 there were 74,000 paupers, and in 1899 there were 103,866, with a diminished population, but between 1890 and 1901 the tendency was to a decrease in the number. In Scotland there has been comparatively little change, but the tendency is upwards, and there were in 1899, 65,929 paupers with 33,994 dependants. At the same time the money spent on those relieved has greatly increased. Whereas in 1850 a mean number of 123,004 indoor paupers cost £914,264, or £7, 8s. 8d. per head, a mean number now of 216,200 indoor paupers costs no less than £11, 0s. 7d. per head. The change is due to the improved circumstances in which people live, the larger wages, the sanitary improvements, the better education, and the opportunities of saving, but still more directly to the more considerate treatment

which has been introduced into poor-law administration. Pauperism in one sense is the creation of law, or rather of its administration. People may in time of poverty get relief, and go back again to be self-respecting wage-earners; but those who in time of poverty learn to depend on relief grudgingly given are paupers, and the increase of pauperism is largely affected by action which encourages dependence and destroys self-respect. The more humane and thoughtful treatment which during the last twenty years of the century helped to reduce pauperism is shown —(1) in the improvement of infirmaries, workhouses, and casual wards; in the separate provision made for infectious disease, imbecility, and other forms of mental defect; and in the impetus given to voluntary effort in developing the possibilities of malformed or deficient persons by the increased number of homes certified by the Local Government Board adapted to the training of difficult cases; (2) in the provision made for children; (3) in the attention given to the administration of out-relief (see POOR LAW).

(1) The infirmaries—in towns at any rate—in which the sick poor are nursed are now under the care of highly-qualified medical officers, with assistants, and a full staff of trained nurses. The buildings have been altered or built to suit modern requirements, and the medical officer has, in practice, unlimited authority as regards the ordering of necessary "sick comforts," while increasing advantage is taken of special institutions for special diseases or special needs. In London the Metropolitan Asylums Board is a body representative of the several poor-law divisions of London, upon whom extensive duties are imposed by the legislature. When it is observed that its expenditure during the last twenty years of the 19th century reached the amount of 9½ millions, that during the year ending Michaelmas Day 1900 this body expended no less a sum than £832,466, that each bed has often cost £400 to £550, and that the normal accommodation of its twelve fever hospitals and its five imbecile asylums and its five institutions for ophthalmic and other children is more than 15,000 beds, the magnitude of its work will be appreciated. Apart from the provision for smallpox patients which is incumbent on the managers, it devolves upon them to provide and administer a training ship for pauper boys of the metropolis, to organize and maintain an efficient land and river ambulance service, and to provide establishments for special classes of children. In the country districts, and notably in Ireland, reform still lags, and there are many cases where the workhouse characteristics are obvious in the infirmary, where the wards are depressing, and where nursing and treatment are not at the same high standard as in London and many urban centres. By an order, however, of the Local Government Board of 6th August 1899 the employment of any pauper inmate to perform the duties of a nurse was forbidden, while the employment of a pauper inmate in any other capacity in a sick ward must have the approval of the medical officer and be subordinate to the supervision of a paid officer. There has not been the same improvement in the position of the able-bodied; but here too, in many instances, guardians have aimed to educate rather than to deter those who seek relief. They have substituted trades for oakum-picking and stone-breaking, introduced visitors, who interest the able-bodied by talk and reading, or offer them openings and inducements to a working life. They have, in some instances, made it possible for men of more solid determination to get work on the land, and thus train themselves for emigration. The greatest problem has been and is to deal with the vagrant population. In 1882 legislation, following an inquiry, made it lawful to detain people using casual wards over a clear day if they were proved *habitués*.

The exact terms of the law are:—That a casual shall not be entitled to discharge himself from a casual ward before 9 o'clock in the morning of the second day following his admission, nor before he has performed the task of work prescribed for him; and where a casual pauper has been admitted on more than one occasion during one month, he shall not be entitled to discharge himself before 9 o'clock in the morning of the fourth day after his admission. This latter regulation, however, is modified by an order of the Local Government Board of 18th December 1882, which provides that a casual pauper, who has been detained for more than one night, and who represents to the master of the workhouse or superintendent of the ward that he is desirous of seeking work, shall, if he has to the best of his ability performed the prescribed task of work, be allowed to discharge himself between Lady Day and Michaelmas Day at half-past 5 in the morning, and between Michaelmas Day and Lady Day at half-past 6 in the morning.

The same policy of restriction has been followed in the recommendation of cellular wards by the Local Government Board. Guardians have thus at great cost added a sort of prison to their establishment, in which casuals are confined sometimes for four days in solitary confinement and forced to do certain task work in oakum-picking, stone-breaking, grinding corn, or cutting wood. There is a division of opinion among poor-law administrators as regards the result of the policy. On the one hand it is contended that any failure is attributable to the absence of uniformity of treatment; on the other, that such treatment must tend to harden in their ways the somewhat limited number of persons who prefer casual wards to common lodging-homes. In the country the habit of vagrancy does not seem to be checked, but under other influences which make lawlessness easy is even increasing. The number of vagrants relieved on 1st January 1878 was 5108, and on the same date in 1901 the number was 11,658.

(2) The greatest change has been in the treatment of children following on the interest aroused before and by the Education Act of 1870. It was felt that it was unjust and short-sighted to punish the children of paupers by shutting them up in workhouses or by giving them inferior education. The desirability of withdrawing children from workhouses was recognized by the legislature as far back as 1844. The Poor Law Amendment Act of that year empowered the commissioners (now the Local Government Board) to combine poor-law areas into school districts for the management of any class of infant poor not above the age of 16 years. Separate schools were in consequence formed. The schools have been continually improved. Village communities with cottages accommodating from 10 to 30 children have in some cases been substituted for the block buildings, and no expense has been spared, the cost sometimes amounting to £190 per bed. The annual charge for each child's keep then reaches £32. In 1873 Mrs Nassau Senior, the first woman inspector, found the results, at any rate on girls, to be unsatisfactory. It was agreed that more individual treatment was wanted, and many improvements were made. The Metropolitan Association for Befriending Young Servants was formed for the after-care of the girls, and an impetus was given to the practice of boarding out children in the cottages of villagers. The system, however, of aggregating children in large schools continued; and as outbreaks of ophthalmia and other diseases, and disclosures of cruelty and neglect occurred, another inquiry was held, and in 1896 a departmental committee reported, condemning the system of aggregation. Orders were in consequence issued by the Local Government Board for the breaking-up of some of the largest establishments, and encouragement has been given for the adoption of various plans of scattered homes by which parties of children under the care of a house mother are able to join in the life of a community and profit by contact with other children. A perpetual difficulty in dealing with children is the prevalence of a class

of "ins and outs," *i.e.*, of children who are dragged about by vagrant parents, and frequently come in and out of the guardians' hands. With a view to getting control of certain classes of children, a law was passed in 1889 which gives the guardians power to adopt children who may be deserted by their parents, and take upon themselves all the parental powers, even to the extent of emigrating such children. In 1899, by the efforts of the State Children's Association, which was formed to carry into effect the recommendations of the committee of 1896, these powers were extended to include any child the parent of which is, in the opinion of the guardians, by reason of mental deficiency, or of vicious habits, or mode of life, unfit to have control of it.

(3) In the 'seventies social observers were struck by the misuse of charity and its competition with the out-relief given by the guardians. The effect was seen in the increase of dissatisfaction and of poverty. Large sums were being given, some of the recipients being drunken and others starved. An attempt was therefore made to organize charity, and to lay down some principle on which out-relief should be given or refused. Some guardians determined to stop giving out-relief altogether, and carried out that policy. There are different opinions as to the success. On one side it is urged that the people are better off. When relief was given by no comprehensive rule, many poor persons were induced to waste time and strength and character in its pursuit. On the other side it is urged that the needs—especially of the old—cannot be met out of earnings or charity. The facts, in a union like Whitechapel, are that in 1872 there were 1000 indoor and 1568 outdoor paupers, out-relief costing £4730. In 1895 there were 1503 indoor and 5 outdoor paupers, out-relief costing £29. The net result has been to put a limit on pauperism. When the policy of abolition has not been followed, there have generally been more care and more discrimination; and up to 1893 the yearly diminution was regular. In 1894 a change was made in the qualification of the guardians, and the *ex-officio* members—that is, the magistrates—were removed, and the office thrown open practically to all ratepayers, men or women. The persons thus elected have not had the same experience in administration, and have inclined to meet poverty by grants of out-relief. There has been in consequence a slight rise in the pauperism. In the country districts the boards of guardians, under the Act of 1894, have been made identical with the rural district councils. The same members have thus different interests, and it is calculated that they will be less under the sway of policies or parties or classes, and more able to follow the lines laid down by experience.

The net result of a survey of pauperism is that the number of persons in receipt of relief is reduced, and that those who enjoy relief receive it in a better way. The change is due to many causes, and it is possible that what may be called the more scientific method of administration is the cause which has least popular approval. Sentiment favours liberal giving and liberal treatment; prosperity has made liberality possible without undue pressure on the ratepayers. Progress, therefore, does not seem to rest on a secure basis. The lavish expenditure may induce such larger numbers of the sick and afflicted to make use of the State provision for their diseases as to cause a reaction. (S. A. B.)

Amusements.

Holidays imply cessation from work; amusements imply relaxation in work. The provision of means of amusement has extended in every direction. There are more theatres, more novels, more entertainments, and more games. People seem either to work so hard or to find work so dull that they look for amusement which will demand as little effort as possible. The theatres thus incline to afford spectacles, and the novels to give strong sensation. The popular game is football, which provides observers with an interest almost like that of a battle; and people seem to be less and less inclined to join in a game at all, unless it be for the excitement of a prize or of popular notice. There is an increase of athleticism, but it is largely mixed with sport; men practise to take part in contests, and there is less simple healthy pleasure in exertion. People, that is to say, depend for amusement on something outside themselves, just as the children look for toys. A striking feature in advertisements is the offer of all sorts and kinds of toys. Those who are older than children look for something to stir their minds, be it a scene in a play or a contest in sport. The obvious amusement is something exciting—a play, a race, a contest; but alongside there is an increase of other amusements which depend on the exertion of mind and body. There are now picture galleries in many of the great towns; sketching clubs and rambling clubs are formed among young people; music is provided by many town councils; and people are gradually developing a love of social meeting, as by travel and reading they find more subjects for conversation. The period, again, is one of transition. The hard worker in his first freedom from work turns naturally to the excitements which most easily stimulate his senses; but as with more leisure he develops the powers of his mind, he begins to find satisfaction in their use. A review of the means of amusement now provided shows how largely those which excite predominate, but closer observation shows that at the same time there is a growth of other amusements which involve the exercise of the mind and taste. (H. O. B.; S. A. B.)

Clothing.

Observers with memories going back to the 'seventies see that people are as a rule better clad in 1902—more warmly, more appropriately, and often with more taste. Many things have combined to bring about the change. There has been a rapid succession of inventions in clothing making, and especially in boot-making. Women's boots which formerly cost 9s. can be bought for 6s.; good boots for children can be got for 3s. 6d. New sorts of stuffs have been made available, some of which are as serviceable as the more highly priced materials they have displaced. Methods of distribution have also been improved. Large shops or co-operative stores have lowered prices; enterprising traders quickly distribute bankrupt stocks; and the sale and translation of second-hand clothes have been better organized. Education has at the same time developed self-respect, and people tend, therefore, to adopt the same fashions. There are few workpeople who do not appear on Sundays in the same style of dress as that worn by their employers. The clothing of the poor—as far, at least, as outside appearance goes—is always a subject of astonishment. The only classes which look wretched are not those who earn least—widows and labouring families—but the careless and thoughtless, who often earn good wages. Students who have gone into the subject estimate that clothing costs a grown person 6d. a week and a child 5d. But such clothing, if enough for appearance, is said to be insufficient for warmth or protection from weather. (H. O. B.; S. A. B.)

Crime.

During the twenty years from 1881 to 1900 there was a definite diminution of crime in England, but to estimate the amount of the decrease is a matter of some difficulty. The error has been made by some of treating as a measure

of crime the average prison population, which fell from 28,324 in 1880 to 17,435 in 1900; but prison population depends not only on the number of persons sent to gaol, but on the average length of their sentences, and the fall is one mainly due to the increasing leniency of the sentences passed by judges and magistrates. Others, again, have fallen into the opposite error of founding conclusions on the number of technically "criminal" charges, which increased from 649,811 to 770,853; but in this case the augmentation is due, not to any growth of crime in the proper sense of the word, but to the establishment of new municipal regulations in the interest of the public safety, health, or progress. Within the last twenty years of the 19th century the cases under the Education Acts have increased by 34,000, offences with regard to the highways by 19,000, and offences against local police bye-laws by 56,000.

The best standard—statistically definite and covering a wide area of serious crime—is to be found in the number of indictable offences, *i.e.*, of offences which are triable on indictment, whether actually tried on indictment at assizes and quarter sessions, or disposed of at petty sessions under the extensive summary powers which the magistrates now possess. Within this definition of crime fall not only murder and the great offences against the State, but all crimes of violence except minor assaults, all "crimes against morals," all sorts of forgery and fraud, and all larcenies except some petty thefts. Statistics are available, first of the number of such crimes known to the police, second of the number of persons tried, and third of the number of convictions. Under each of these heads the figures for the period 1880–1900 show a decrease; but the second, the number of persons tried for crimes, is generally regarded as on the whole the best test, and under this head there has been a fall from 60,724 in 1880 to 53,628 in 1900, or, taking the proportion per 100,000 of the population, from 236 to 167.

If the view of crime is extended so as to cover every offence, indictable or otherwise, that can fairly be brought within that designation, including all assaults, all petty thefts, and all minor injuries to property, the number of persons charged fell from 183,000 to 152,500, or, taking again the proportion per 100,000 of population, from 711 to 475. All the figures quoted are those for the years 1880 and 1900. These may be taken as representative years in a progressive series, not seriously influenced by casual variations. If the averages of periods of five or ten years are taken, the results are not affected in any material point. The diminution in indictable offences amounts therefore in twenty years (taking population into account) to a little more than 25 per cent.; but this diminution does not affect all forms of crime equally. The general ratio of decrease applies with little variation to larcenies (which constitute the great bulk—more than five-sixths—of all indictable offences), to robbery, and to forgery. It applies also to crimes of violence to the person, though under some of the most important heads, such as murder and manslaughter, the figures are too small to give any regular rate of progression. It does not apply completely to "crimes against morals," which show an increase chiefly in connexion with the offences created or extended in definition by the Criminal Law Amendment Act, 1885, nor to burglary and house-breaking, which on the whole tended to increase. Offences connected with the coinage, on the other hand, show a much more rapid rate of diminution, having steadily fallen from 311 to 70. Suicide, which appears among indictable offences only in the matter of the attempts, increased steadily, the proceedings for attempted suicide having risen from 74 to 192. In the same period actual suicides increased from 1930 to 2863.

These figures, which apply to England and Wales, though in Scotland and Ireland the tendencies are generally similar, have to be qualified by the consideration of various influences not capable of statistical measurement. Thus the increase in numbers and the improved efficiency of the police, while they are probably one of the causes in the actual decrease of crime, tend to increase the statistics of persons tried by ensuring the detection and punishment of a larger proportion of the offences committed; and the actual decrease in crime is therefore probably somewhat greater than appears from the figures quoted. Again, the shorter sentences now passed on habitual offenders, by giving the same individual more frequent periods of liberty, and therefore more opportunities of committing crime, allow the same person to appear more frequently in the criminal records; and if there has been a diminution in the number of crimes, there is reason to believe that the reduction of the number of persons living by crime is in a somewhat greater ratio. On the other hand, the spirit of leniency towards criminals which now prevails shows itself in a greater reluctance to prosecute for minor offences, and if this influence be taken into account, the estimate of the decrease of crime becomes less favourable.

The causes of the diminution of crime must be found partly in changes in the judicial and penal systems, partly in wider influences affecting the national morals. The gradual extension of the protection afforded by the police to life and property has already been mentioned as one of the influences which have tended to repress crime. Another influence in the same direction has been the extension of the summary jurisdiction of magistrates, particularly in the Summary Jurisdiction Acts of 1879 and 1899. The first effect of the Act of 1879, which much lessened the cost and trouble of criminal proceedings, was to increase the number of prosecutions; but in the long run the greater quickness and certainty of punishment which it secured proved a considerable influence in checking crime. Yet another very important factor was the change of prison organization effected under the Prison Act of 1877, by which the local prisons passed into the charge of a Government department and the varying local methods of treating crime were replaced by a uniform national system. The main features of this system were a severity of discipline for short-sentence prisoners, which, without pretence to reforming efficacy, acted with strong deterrent effect on the minor offenders not hardened to prison life, and the separation of prisoners by cellular confinement, which prevented to a great extent the contamination of first offenders by old criminals. This system has now, under the policy embodied in the Prison Act of 1898, been replaced by one which, while less severe in discipline and allowing more association of prisoners, aims at more complete classification of offenders and greater discrimination in their treatment, and seeks to give more scope to directly reformatory influences. Outside the prison system there has been an extension of the agencies for the assistance or reform of the criminal. The establishment of discharged prisoners' aid societies has been encouraged by the Prison Commissioners, and assisted by Government funds, until their operations now extend to the whole country; while other societies less official in character have shared not less effectively in the same work. Still more important has been the part played by reformatory and industrial schools, which deal with children who are actually criminal or are living in conditions which must inevitably lead to crime. These schools were extensively established before 1880, but dealing as they do with children, they had to exercise their influence on a whole generation before its full effect could be shown in reducing the criminal population.

From a wider point of view the net result of the educative

and social influences at work has been antagonistic to crime, with an increased tendency to meet it rather by preventive reform than by severe repression. The spread of common education and the increase of wholesome literature are powerful factors in this influence, though they have to combat the counter-effects of the debasing literature to which the universal ability to read now gives a wide currency. The teaching of the Churches and of other social institutions has become more practical, and therefore more efficient in the contest with crime, notwithstanding the decay in some directions of religious influences and the weakening of some of the sentiments which support the elementary moral obligations. (C. E. T.)

Drunkenness.

In considering the extent to which intemperance now prevails as compared with former years, the statistics of prosecutions upon which such comparisons are usually based are far from being completely satisfactory, but, inasmuch as they constitute the only possible data for such comparisons, we are compelled to accept them. The following table gives the average number of persons per 1000 of the population proceeded against for drunkenness in England and Wales for each quinquennial period since 1857, the first year of the Judicial Statistics:—

1857–61	4·28
1862–66	4·78
1867–71	5·47
1872–76	7·83
1877–81	7·25
1882–86	6·90
1887–91	6·19
1892–96	5·84
1897–99 (3 years)	6·47
1899	6·74

The figures, it will be seen, show a steady decline from 1872–76 (when the consumption of alcohol was quite abnormal) to 1892–96. Since then, however, the figures have again risen. The increase was especially marked in 1899, when a tide of exceptional prosperity was again accompanied by great drunkenness. It is also disquieting to discover that the average number of prosecutions for drunkenness in the three years 1897–99 was 51 per cent. higher than the average for 1857–61, and 35 per cent. higher than the average for 1862–66. That the increase is partly due to more efficient police administration is probable, but that this is not a complete explanation of the figures is made evident by an analysis of the general statistics of crime during the same period, from which it may be seen that, while crime generally (excluding drunkenness) has decreased 28 per cent. in England and Wales since 1857–61, drunkenness has increased 51 per cent.

Speaking generally, it may be said that drunkenness is chiefly prevalent in the seaport and mining districts. If a line be drawn from the mouth of the Severn to the Wash, it will be found that the "black" counties, without exception, lie to the north-west of this line. The worst counties in England and Wales in the matter of drunkenness are Northumberland, Durham, and Glamorganshire, while Pembrokeshire and Lancashire follow close behind. The most sober counties, on the other hand, are Cambridgeshire, Suffolk, Oxfordshire, and Wiltshire. Averages based upon the returns of entire counties do not, however, afford a complete guide to the distribution of drunkenness, inasmuch as offences are not equally distributed over the whole area of a county. A heavy ratio of drunkenness in a small district may often give a county an unfavourable position in the general averages, notwithstanding favourable conditions in the rest of its area. A better classification is that adopted by the compiler of the Judicial (Criminal) Statistics for 1898, and represented in the following table:—

	Drunkenness (No. of prosecutions in 1898) per 1000 population.
Mining counties	11·19
Seaports	10·20
Metropolis	9·94
Manufacturing towns	5·58
Pleasure towns	5·87
Agricultural counties—	
South-western counties	2·84
Home counties	2·63
Eastern counties	1·23
England and Wales	6·98

Further analysis of the prosecutions for drunkenness shows that about 24 per cent. of the total number of offences are committed by women. In the larger towns the proportion, as a rule, is higher. In London, 38 per cent. of the drunkenness is attributable to women; in Manchester, 36 per cent.; in Belfast and Glasgow, 32 per cent. In Liverpool, on the other hand, the proportion is only 24 per cent. The much-controverted question as to whether intemperance is increasing among women can hardly, however, be decided by an appeal to the criminal statistics. So far as these statistics throw any light at all upon the question, they suggest important local differences. A more direct clue is afforded by the Registrar-General's annual returns of deaths directly attributed to intemperance. The figures are given below. In order to eliminate accidental variations, the comparison is based upon the average mortality during consecutive quinquennial periods:—

Quinquennial Period.	Average No. of deaths (England and Wales).	Males per cent.	Females per cent.
1877–81	1071	69	31
1882–86	1320	66	34
1887–91	1710	64	36
1892–96	2044	61	39
1897–99	2577	61	39
1899	2871	60	40

The figures are certainly striking. They show, it will be noticed, that out of every 100 deaths from alcoholic excess in England and Wales at the present time women contribute nine more than they did in 1880. If, instead of taking the total number of deaths, we take the ratio per million persons living, the increase is seen even more clearly:—

	Males per million living.	Females per million living.
1877–81	60	25
1882–86	67	32
1887–91	79	42
1892–96	86	51
1897–99	103	63
1899	112	70

It appears that, while the ratio of mortality from alcoholic excess has increased 87 per cent. among males during the last twenty years of the century, among females it has increased by no less than 180 per cent.

Despite the strenuous and, in many respects, successful efforts of temperance reformers, the consumption of alcohol per head in the United Kingdom has, though subject to fluctuations, increased until it was greater in 1902 than it was in 1840, when the temperance reformation was in its infancy. The consumption per head of alcoholic liquor in the United Kingdom in 1840, as compared with 1900, was as follows:—

	1840 (Gallons).	1900 (Gallons).
Spirits (proof)	0·97	1·12
Wine	0·25	0·39
Beer	28·59	31·75

If the figures are reduced to a basis of proof spirit,[1] the result is as follows :—

	Gallons.
1840 consumption per head	3·89
1900 ,, ,,	4·40

To adopt a familiar method of comparison, the expenditure per head of the population upon alcoholic drinks was in 1840 £2, 18s. 10d., and in 1900 £3, 18s. 8d.

That this increase in consumption is not due to the selection of exceptional years will be seen from the subjoined table :—

Years.	Equivalent in Proof Spirit (Gallons).
1841–45	3·36
1846–50	3·58
1851–55	3·75
1856–60	3·56
1861–65	3·60
1866–70	4·09
1871–75	4·78
1876–80	4·70
1881–85	3·90
1886–90	3·87
1891–95	4·08
1896	4·20
1897	4·28
1898	4·30
1899	4·48
1900	4·40

It will thus be seen that the increase in the consumption of alcohol per head from 1841–45 to 1891–95 amounted to nearly three-fourths of a gallon of proof spirit. The highest figures were reached in 1876 (when the effects of the great wave of commercial prosperity which marked the 'seventies were at their height), when the consumption per head rose to 4·89 gallons of proof spirit. With the subsidence of the commercial "boom" the consumption at once declined, but only to a point that was still slightly above what may be called the normal figures of the ante-1870 period. During the decade 1889–99, however, they rose again steadily, until the consumption in 1899 was higher than it had been for a period of twenty-one years.

That much of the indulgence in alcoholic drinks is excessive and wasteful is not seriously disputed. Opinions, it is true, differ as to the proportion of the total consumption that may be so regarded, and the amount at best can only be approximately determined, but even at the lowest computation it certainly forms a not inconsiderable proportion of the whole. Professor Leone Levi, in his evidence before the Lords' Committee in 1877, estimated the amount of intemperate consumption at one-fifth of the total consumption. Mr Dudley Baxter's estimate is very much higher than this. The figures which he gives for 1869 show that 38 per cent. of the total consumption of spirits and 32 per cent. of the total consumption of beer must in that year have represented intemperate consumption. If we make the most liberal allowance for a more general diffusion of wealth and a consequent increase in the amount of temperate consumption in the interval, and reduce the proportions which Mr Baxter gives to 30 per cent. and 25 per cent. respectively, it would follow that more than £39,000,000 was spent in 1900 in intemperate and wasteful drinking.

The number of public-houses and beer-shops has, it is true, been steadily declining, no fewer than 10,000 having disappeared between 1876 and 1896; but this reduction in numbers has been more than out-balanced by the reconstruction and enlargement of those that remain. The reduction in numbers has affected, for the most part, the smaller and least profitable houses only; but these have been largely replaced by huge "gin-palaces," so that what Lord Randolph Churchill called the "fatal facility of the public-house" has become a more serious social fact than was the case in 1875. In important legislation the last twenty years of the 19th century showed little progress.

Important licensing proposals were made by a Conservative administration in 1888 and 1890, and by a Liberal administration in 1893 and 1895, but in each case they failed to become law. The following is a summary of temperance legislation since 1880 :—

1881. Welsh Sunday Closing Act.
1883. Acts prohibiting the payment of wages in public-houses, and the use of drink-shops or refreshment-houses for parliamentary election meetings.
1884. Municipal Elections Corrupt Practices Act, prohibiting use of public-houses and refreshment-rooms for committee purposes or meetings in connexion with municipal elections.
1886. Intoxicating Liquor (Sale to Children) Bill, prohibiting sale of intoxicants "for his or her own consumption" to children under thirteen.
1887. Beer and Cider Truck Clause, prohibiting the furnishing of beer, cider, &c., to agricultural labourers as part payment of wages.
Also Scottish Early Closing of Public-houses Act, giving discretionary power to licensing benches outside burghs of 50,000 inhabitants to close public-houses one hour earlier on week-nights.
1888. Habitual Drunkards Act.
1894. Prevention of Cruelty to Children Act, which, *inter alia*, empowers magistrates to commit to inebriate homes the drunken parents of ill-used children.
1897. Licensing Amendment (Scotland) Act.
1898. Habitual Inebriates Act.
1900. Beer Retailers' and Spirit Grocers' Retail Licences (Ireland) Act.
1901. Intoxicating Liquors (Sale to Children) Act. (A. SH.)

FOOD.

The abolition of duties, the invention of cold storage, the practice of tinning meat and fruits, and improved means of transit, have enlarged the supply and changed the character of the foods of the people. Casual observation of the shops in poor neighbourhoods shows the tins of salmon, peaches, soups, as well as of ordinary meats, piled up for sale, while on the barrows in the streets there is a plentiful supply of bananas, tomatoes, grapes, &c. Closer inquiry confirms the conclusion suggested by such observation. In 1883 there was imported and retained for home consumption 0·75 ℔ of fresh mutton per head of the total population of the United Kingdom; in 1900 the amount had risen to 9·28 ℔. The figures with regard to bacon and ham show that in 1883 there was 11·01 ℔ imported for each inhabitant, while in 1900 the amount was 19·62 ℔. There is a like increase in the use of imported butter. In 1886—the first year in which it was distinguished—4·57 ℔ per head was imported; in 1900 the amount was 9·11 ℔. In 1883 each person had for his use 26·52 imported eggs; in 1900 he had 49·48. But the most astonishing increase of all, representing the development of the use of jam, is in sugar. In 1883 the import of sugar for home consumption per head of the population was 9·91 ℔ of refined sugar; in 1900 it was 52·23 ℔. It is somewhat more difficult to tell by figures the development of the use of foreign fruits; they were not distinguished in the returns till 1892, but in that year the value of grapes imported was £363,644, and in 1900 the value was £595,000. The dried or tinned fruits imported in 1883 were of the value of £809,938, and in 1900 the value had risen to £1,848,872, an astonishing increase, justifying the conclusion drawn from the tins which fill so many shop windows. It must be remembered that these figures take no account of the home produce,

[1] The Spirits (Strength Ascertainment) Act, 1818 (58 Geo. III. c. 28), defines "proof spirit" to be that which, at a temperature of 51°, weighs $\frac{12}{13}$ parts of an equal measure of distilled water. A gallon of proof spirit contains 57 per cent. of alcohol. The calculation is made on the ordinary basis that wine contains 30 per cent. and beer 10 per cent. of proof spirit.

which must be added to the food supply of the people. If, now, the further question be asked, whether the increased importation has been followed by a decrease in price, the answer is generally in the affirmative. A live ox which was valued at £21·57 in 1883 is valued at £18·19 in 1900; a sheep has gone down from 45·13 shillings in 1883 to 31·87 shillings in 1900. Flour of wheat which was 15·12 shillings per cwt. in 1883 was 9·38 shillings in 1900. Food may therefore be said to be cheaper, more plentiful, and more varied. It is also more closely protected. The Food and Drugs Act, 1875, amended in 1899, aims to protect consumers against adulteration in all its recognizable forms. The Weights and Measures Act, 1878, was amended in 1899, so that local authorities might have more power to enforce its measures. Under these Acts armies of inspectors are always at work. They every year condemn as unwholesome tons of fish, meat, and fruit, and they every week prosecute sellers whose weights and measures have been found to be short. The presence and activity of these inspectors have created a standard up to which public opinion slowly rises, so that there is now greater care on the part of purchasers to avoid bad food. The review of the food supply of the people is so far encouraging. It may be that in developing foreign supplies the home supply has been neglected; that for want of skill gardening near the great towns has not been developed, that by the monopoly of railways the transit from country districts has been made difficult; it may be that food might be fresher and even cheaper; but measured by any test, the advance during the period 1880–1900 was great. There is, however, another set of facts which have to be considered. Casual observers not only see loaded shops and stalls: they see also many poorly-nourished faces and poorly-developed bodies among the people who crowd the streets; they not only hear of increased imports: they also hear from doctors that the diseases of the poor are largely due to underfeeding. Students who look more closely find that for the bare support of life a man in moderate work requires daily 3500 calories of food energy, and a woman eight-tenths of this amount. It is according to this scale that the Local Government Board has framed the dietaries for use in workhouses. Careful inquiry has shown that to provide this amount of food in the cheapest form, without regard to taste, the cost for a man per week is 3s. 3d., for a woman 2s. 9d., for children 2s. 3d. A family, therefore, of five persons would need at least an income of 22s. a week just for rent, clothing, and food, without any margin for drink, holidays, literature, or amusement. The statement of this fact is sufficient to prove that even with this supply of food there must be a large number of people still underfed. Mr Booth and Mr Rowntree, who have made detailed inquiries, both agree that 30 per cent. of the people live in poverty, nearly half of them because of an insufficient income, and the rest because of their ignorance, their wastefulness, or drinking habits. If in a family where the earnings are 22s. or 24s. a week the man falls ill or gets out of work, if a holiday is taken, if a treat be indulged in, if even some food be bought more appetizing but less nutritious than that which has the largest strength-giving power, if there be any change in the ordinary routine—then the necessary food must be reduced and the body be called on to suffer. There are notoriously many families where the income is below 22s. a week; there are at least an equal number of families where, if the earnings be somewhat larger, there is ignorance as to the right choice or use of food, and great waste of substance on drink and amusements.

The conclusion of Mr Booth and Mr Rowntree is, therefore, that 30 per cent. of the population is underfed. The remedy is, first of all, an increase of wages, which means that by intelligence and character the worker shall be worth more wages. But with increased wages there must be also increased knowledge of the value of foods and of the methods of feeding. Mothers frequently give their children meat before the appearance of teeth with which to bite it. Wives prepare their husbands' meals in such a way as to destroy much of their nourishing power. People have often altogether wrong notions as to what is strengthening and what is not. It is something that these facts are known, and already local authorities have started lectures and cookery classes, which ought to be valuable.

(H. O. B.; S. A. B.)

Health.

Examination of the death statistics shows a steadily increasing average length of life in England. The "expectation of life" at birth, which in 1880 was calculated to be 41·35 years for males and 44·62 years for females, had increased ten years later to 43·66 years and 47·18 years respectively. Thus the average length of life in England in ten years increased by about three years, and is still increasing. We find that the decrease in the mortality is still apparent at all ages from 1 year up to 45 years among males and to 55 years among females. The mortality has increased at other ages up to 85 years, after which there is an apparent decrease. From the ages of 5 years to 30 years the decrease in the rate of mortality is relatively large, and, though less marked, the decrease is evident also in all the succeeding age-periods.

But while we recognize the general improvement in the conditions of life, further examination indicates considerations of a less satisfactory nature. There is still a high death-rate among infants under 1 year of age, though this decreased during the period under review. Dr Farr, whose studies of vital statistics have served—and still serve—as models for other workers in this field, mentioned the following conditions as those the influence of which on the health of a community is unquestionable:—(1) the physical well-being of the people as to dwellings, food, drink in excess or defect; (2) firing; (3) cleanliness and clothing; (4) sewage and drainage. The relation between health and the density of population under existing sanitary conditions, and the measures taken to limit the spread of infectious diseases, have also to be taken into consideration. Some of these conditions are under the control of the individual, others are regulated by the State or by local authorities. There are facts to be elicited from the tables of the causes of death which appear to indicate that the improvement in the healthiness of the people is due not so much to a greater attention to health requirements by individuals, as to the sanitary improvements carried out by local authorities and the health regulations initiated or enforced by the State. The regulation of the conditions of labour by the Factory Acts, &c., has tended to reduce the mortality in certain trades and occupations. Without going into detail, the general result is shown by the fact that comparison of 1891 with 1871, with regard to 76 occupation groups where such comparison is possible, shows that at the ages 25–45 (which corresponds with the working period of life) there was decreased mortality in 63 of these groups, during the latter period, whilst in 13 groups only was there an increased mortality. The deaths from zymotic diseases show a diminution, especially in those diseases which are influenced by the sanitation of towns or districts, and those for the prevention of which special regulations are in force. Enteric fever and diarrhœa, the spread of which depends so largely upon drainage and water-supply, are credited with a decreasing death-rate. The mortality from scarlet fever shows a large diminution, and whooping

cough also is less fatal. Measles remains a frequent cause of death, and the mortality from this cause, though diminishing, fluctuated but little during the last thirty years of the 19th century. Diphtheria has increased, and shows a progressive increase in mortality. This disease is especially fatal in young children at an age when isolation is impracticable, and the mortality from this cause may be taken as to some extent a measure of the sanitation of the home as distinct from the sanitation of the locality. There is still much room for improvement in the sanitation of the homes of the poor especially, and in the care which would prevent the spread of infectious illness in the family. The diminution in the mortality from consumption and other tubercular diseases is one of the most noticeable and at the same time satisfactory facts which the death returns demonstrate. This decreased mortality can only be referred to an improvement in the general sanitary and hygienic condition of the people, for as yet it can hardly be said that any special preventive measures have been put in force against these diseases. The influence of overcrowding—the aggregation of individuals —in the causation of consumption is undoubted. The efforts made by the authorities in most towns to prevent the overcrowding, both of buildings on a given area and of inhabitants within the dwellings, have probably had an important influence in the decrease of consumption. But we may reasonably assume that some proportion of this decrease indicates an improvement in the dwellings of the people, and is a sign of increased prosperity. This assumption is borne out by the fact that, although the diminution in the mortality from consumption is to be observed at all age-periods and in both sexes, it is in the earlier stages of life more especially that the reduction has taken place, and the decrease has been greater amongst females than amongst males in the later age-periods. We may take the changes in the death-rate from phthisis (consumption) in children under 15 years of age, and in women, to represent the influence of the home conditions, for these are much at home, whilst the men are subject to outside influences at their work. In illustration we may take from the sixtieth report of the Registrar-General (1897) the following figures, which show the percentage reduction in the phthisis mortality between the period 1861–70 and that of 1891–97 :—

Age Groups.	Reduction per cent. in 1891-97.	
	Males.	Females.
All ages	35	49
Under 5 yrs.	55	58
5	58	49
10	60	50
15	53	56
20	49	57
25	39	53
35	23	42

The reduction, which is considerable for both sexes up to the age of 15, becomes proportionately greater for females as compared with that of males in the succeeding age-periods.

But while we recognize with satisfaction such indications of improvement in the well-being of the people, we have on the other hand to note that the death-rates from anæmia, from rickets, and from diarrhœa show an increase. These diseases are to a large extent dependent upon the hygienic conditions of the home life. There are other considerations also which call for serious attention as indicating evils of national importance. The high mortality of men of all ages after 25 years is especially remarkable in London, whilst the mortality of women is increased to nothing like the same extent. Two causes appear to operate powerfully in producing this result. The first of these is referred to by Dr Farr in these words :—"Not only the roughs but the intelligent artisans of London do not wash the whole of the body daily." The second cause is, in the opinion of the same authority, the greater intemperance in regard to alcohol of the men as compared with women.

The influence of occupation is also seen to be very great, for those most exposed to temptation show the highest death-rate. Innkeepers and inn servants, and those engaged in the manufacture of alcoholic beverages, show the greatest mortality; cab and omnibus servants, costermongers, commercial travellers, come close upon these; and butchers and bakers are also high on the list. It is a significant fact that while the drivers, &c., of cabs and omnibuses show a high mortality from intemperance, engine drivers and railway guards come low on the list of deaths from alcohol; these men have, for the most part, responsible and well-paid posts, which they could not retain if they were intemperate. The death-rate from insanity and that from suicide show a progressive increase. It is notable that those occupations which show a high mortality from alcoholic excess furnish also the highest proportionate mortality from suicide. It is therefore permissible to attribute some portion at least of the increased mortality from insanity to the greater prevalence of intemperance. There remains the fact that the mental strain resulting from the greater competition of the present day may have some influence on this mortality from mental disease, which thus represents the price the community pays for its prosperity. The continued increase in the mortality from diabetes points also to the severity of competition, since nervous strain and worry are important factors in the causation of this disease.

The conditions of life in towns contrast most unfavourably with those of rural districts. The urban death-rate in 1899 was equal to 19·2 per 1000, while the rural rate was 16·3 per 1000. And although the urban rate was equal to the average of the ten preceding years, the ratio of urban to rural mortality (as 118 is to 100) is higher than the average ratio during those ten years. It is abundantly evident from the returns of the Registrar-General that the death-rate of different districts increases according to the density of the population, *i.e.*, the number of persons to a given area. There is a tendency for the people to leave the country districts and flock to the towns, where work is, as a rule, more highly paid and perhaps more plentiful. But though this may lead to the greater prosperity of the individuals, it has an injurious influence on health. And since it is the children who are particularly susceptible to those conditions which make the towns less healthy than the rural districts, it is evidently desirable that so far as possible the families of the town workers should be brought up in the country, or at least on the outskirts of the town rather than in its crowded centre. (J. E. S.)

Holidays.

Holidays have been greatly extended since 1875, and signs of the change are everywhere manifest. Almost all persons in regular employment now stipulate for a holiday period, and employers have to arrange accordingly. The Bank Holidays Act, 1871, expressed the tendency of the time, and gave it great impetus. People who had hitherto taken casual holidays, and perhaps felt somewhat conscience-stricken at neglecting work, now felt justified, and began to plan the use of these days. The railways and caterers for amusement have of course risen to the occasion, and tempting advertisements crowd the walls.

The effect of the Act has been to stimulate the holiday sense and awaken the dormant curiosity of many a mental sleeper. The offer of a whole day has encouraged enterprise in those who hitherto had spent their broken bits of holiday within a few yards of their homes, and it has led those who have learnt to enjoy one day to demand a longer season. But it is a question whether this Act has not now answered its purpose. Enormous crowds of people composed of one social class generate excitement which is unwholesome, the great demand on space in carriages or in places of resort brings about a rise of prices, and there is often a laxity of manner and of morals, followed by incidents which are demoralizing. Many thoughtful members of the industrial classes now hold the opinion that the existence of the Act makes their demand for periodical recreation less effective, and has set apart days on which the lower classes revel and the upper classes remain indoors. "A chasm," they say, "has been made between classes who would have been better for taking their pleasures in relation to one another." The fact, however, remains that bank holidays, and especially the August holiday, are a great institution. They have become the centre of longer holidays, the day necessarily included in the week or fortnight. They draw out vast crowds to places of amusement or to country resorts. The tendency every year is for people to go farther afield and to make more use of the railways. The Crystal Palace, for instance, is more, and the Zoological Gardens less frequented. The railways and steamers are every year more largely used for excursions to more distant counties or seaside places. The habit of travelling has indeed enormously developed. In consequence, there has been a great increase of agencies and facilities, some of which are educational and some simply commercial. Of the latter Messrs Cook have been the pioneers, and now there are various firms who render travelling easy in all parts of the world, by providing couriers and hotels, as well as personal conductors. Of the former the Toynbee Hall Travelling Club is the original on which many others have since been formed. In these clubs the members are instructed, before their journeys, in the history, art, &c., of the countries they visit, or they are accompanied by lecturers, who on the spot tell something of the things and people around.

It is impossible to give any idea of the numbers who make use of either of these agencies, but the presence of English people is very evident to all travellers abroad. In the British Islands the railways and steamers have made travelling easier and cheaper. Third-class carriages are attached to express trains, and on some lines accompanied by refreshment cars. The carriages themselves have been made more comfortable, and access to distant places has been opened. In 1877 the total length of lines open in the United Kingdom was 17,077 miles. In 1900 it had increased to 21,855 miles. In the earlier year the number of passengers (exclusive of season ticket holders) carried was 549,541,325, and in 1900 the total reached was 1,142,276,686, who paid as fares £45,383,988, against £26,534,110 paid in 1877. The reduction in the fares by means of excursion and tourist tickets is shown by the fact that while the passenger traffic has doubled, the amount for conveying them each mile has only increased by one-eighth. Two persons could in 1902 travel for 8d. the same distance as in 1877 one person was conveyed for 7d. These increased facilities for travel have been followed by the increase of places of resort, especially on the coast. A plan for opening more remote country districts has been adopted by the railway companies, who issue at the beginning of each season lists of lodgings at farmhouses, cottages, or moorland homesteads. The children's country holiday funds, followed by the women's and factory girls' clubs, have largely increased the summer exodus from town to the country. By means of these funds the children and the women paying something for themselves are placed for a week or fortnight in country cottages. They get by this means not only change of air and food, but some experience in the habits of country people and country animals. The numbers who are thus sent from each city are very large; 50,000 at least go annually from London in connexion with the funds, and an uncounted number who, having once been by the help of the fund, now make their private arrangements. But it is not only the railways and steamers which have enabled people to get the pleasures of change: the invention and the improvement of the cycle has put much new pleasure within the common reach. In 1878 the Cyclists' Touring Club was formed, with 144 members: in 1900 it had a membership of over 50,000; and, still more recently, motor-cars have offered themselves as new means of locomotion. Increased holidays constitute perhaps the most marked feature of the years since 1875. The feature is due to many causes; but it is to be noted that in 1842 the Early Closing Association commenced its agitation, and has never since ceased. Its object was a half-holiday for every person employed in shops. Its own object has not been reached, and Sir John Lubbock (Lord Avebury) has vainly striven to secure by law what the association has failed to secure by voluntary action. If, however, the association has not reached its object, its influence has undoubtedly been instrumental in educating public opinion.

A review of the whole subject is encouraging. There may still be whole classes whose holidays are uncertain; there may be even larger classes who can never look forward to periods longer than one or two days; there may be some misuse of holidays; but, on the whole, times of leisure are more regularly provided, and are used in getting strength and knowledge. If sometimes it seems as if love of pleasure had become excessive, and that men hurried work so as to get to play, there must be patience over times of transition. It is good that people have time to travel, to get fresh air, and to know one another; if they do not at once use the time for the best purposes, it is something that they have the time to use.

The chief criticisms which it occurs to the writers to make are: (1) that it would be better if holidays were spread over the year, and not so generally confined to the month of August; (2) that the practice which now holds of giving clerks a holiday of weeks should be extended to workmen who now take holidays of days, which in the year often amount to weeks; and (3) that education should be directed to fit people to enjoy themselves in natural surroundings, rather than depend on getting enjoyment from excitement. (H. O. B.; S. A. B.)

Open Spaces.

Since 1847 many Acts have been passed relating wholly or partly to the provision of open spaces, besides those which were framed to deal with special parks and recreation grounds. Section 164 of the Public Health Act, 1875, provided for the acquisition of such spaces; the Commons Acts of 1866 and 1876 secured the preservation from encroachment of lands over which there were public rights; the Open Spaces Acts of 1877, 1881, and 1887 gave further powers to local sanitary authorities to utilize, acquire, and maintain recreation grounds; and the Disused Burial Grounds Act of 1884, by making it illegal to build on any land that had been set aside for interments, assisted the movement, begun in London in 1875, to convert the old closed graveyards into public gardens. A valuable impetus was afforded by the Corporation of London (Open

Spaces) Act, 1878, whereby the Corporation was empowered to levy a tax on grain, and to use the money for the acquisition of public land outside the metropolis, such as Epping Forest, with its area of over 5000 acres. In order to stimulate and encourage the efforts of the public bodies, and to watch the progress of open space legislation, certain useful voluntary agencies came into existence. The Commons Preservation Society has worked most assiduously since 1865 (see COMMONS). The Metropolitan Public Gardens Association, formed in 1882 by the earl of Meath, has carried through, or assisted to carry through, nearly 500 successful undertakings. Open space agencies have been started in Glasgow, Liverpool, Manchester, Norwich, and other provincial towns, in the colonies, in America, and on the Continent; while a sub-committee of the Kyrle Society, under Miss Octavia Hill, has done very useful work. This valuable movement has also from time to time been encouraged by noble gifts of parks and other lands for the use of the public. A joint committee of representatives of the open space societies, presided over by Lord Hobhouse, urged all public governing bodies throughout the kingdom to commemorate the Diamond Jubilee by carrying out some open space scheme; and this Queen's Commemoration Committee reported that 78 such schemes had been carried through to their knowledge, 9 being in London and the suburbs, and 69 in the provinces, resulting in a gain of 651 acres (besides trees and seats), of which 160 acres appeared to have been given and 491 purchased. By the Commons Act of 1899 the county councils acquired the same powers as had before then belonged to the urban and rural district councils, and all these bodies can now preserve, purchase, lay out, or maintain recreation grounds.

The following works on this subject will be found useful:—SHAW LEFEVRE. *English Commons and Forests.*—Sir R. HUNTER. *Open Spaces, Footpaths, and Rights-of-Way.*—Mrs BASIL HOLMES. *The London Burial-Grounds.*—Colonel SEXBY. *The Municipal Parks and Gardens of London.* (I. M. H.)

PUBLIC LIBRARIES.

In 1875 only 82 towns or districts in the United Kingdom had adopted the Public Libraries Acts; and in this number centres of population like London, Glasgow, Preston, Portsmouth, Aberdeen, Edinburgh, Halifax, Belfast, Croydon, West Ham, and Huddersfield were unrepresented. Now every large town in the country has its public library, and not a few of the smaller urban and rural districts. In all, 430 places had established libraries up to the end of 1901, and it is estimated that these institutions are the means of circulating about 40,000,000 volumes of carefully selected literature every year. These issues represent but a tithe of the work actually accomplished by the public libraries of the country, because the total only includes books issued for home reading and books which are referred to in reading-rooms and duly recorded. The immense number of unrecorded references made to commercial, technical, and literary works, which most libraries now place for free inspection on open shelves, are not counted in this estimate, nor does it include the enormous use of artistic, literary, scientific, trade, and other magazines or journals, made by all classes of people, not to speak of the newspapers and miscellanies. Other departments of work which have been undertaken by library authorities, such as lecture courses, classes, museums, juvenile and school libraries, &c., have also to be reckoned as additions to the extraordinary range of activity already indicated. In one respect the public libraries of the present day compare very favourably with those of 1875, and that is as regards general excellence of administration. Scientific methods of arranging and cataloguing books, so as to make them easily accessible to all, had not been devised or widely adopted in the past; and though a considerable number of libraries still lag behind as regards close classification, the cataloguing has improved greatly, and it is now very rarely that a really bad catalogue is published. In other respects improvements have manifested themselves. Greater freedom is now allowed to readers, and restrictive rules and regulations have been relaxed with benefit to all concerned. Some libraries have adopted, with complete success, improved methods of allowing borrowers direct access to the shelves, there to select books by actual examination and comparison in minutely classified libraries, and the result of seven years' experience has been to justify what was regarded as a somewhat dangerous departure. Mr James D. Brown, the librarian of the Finsbury Public Libraries, was the first to initiate this system for lending libraries, and his name will ever be associated with open access to the library shelves. Other libraries, by reducing the age limits at which readers may enter, and otherwise extending the franchise, have not only increased their popularity, but largely extended their spheres of work and usefulness. The funds for carrying out the great variety of work undertaken by public libraries remain the same now as in former years, and with few exceptions no further power has been granted since the penny limit to the rate was fixed in 1855. Some few towns which have secured special legislation have been enabled to raise the amount of rate, or even to abolish the penny limitation, and have thus achieved results in advance of their neighbours. But it is quite clear that until Parliament steps in and empowers local authorities to increase the library rate by a general abolition of the old limit, or fixing a new and higher one, the majority of British public libraries will have to struggle on as best they may—in a healthy but somewhat crippled state. The conditions under which the Acts may be adopted by a community have been greatly simplified by the Public Libraries Amendment Acts, 1893 and 1901, and the London Government Act, 1899. The power of adoption has been transferred from the ratepayers at large to the governing body of the administrative area, saving as regards parish councils, and the result of this transfer has been a large increase in the number of public libraries.

Reference may be made to some of the recent literature on the subject, which has not only improved in quality and increased in quantity since 1875, but is much better represented both in journals and books. For recent statistics, methods of work, &c., see GREENWOOD'S *Library Year-Book*, 1897 and 1900–1. The history of the movement is told at considerable length in THOMAS GREENWOOD'S *Public Libraries*, 4th and 5th editions, and OGLE'S *The Free Library*, 1897. Other aspects of the subject may be studied in the various volumes of *The Library Series* edited by Dr GARNETT; *Manuel de Bibliothéconomie*, by GRAESEL and LAUDE, 1897 (a good general sketch of methods); *A Library Primer*, by J. C. DANA; the publications of the Library Association; the *Library Association Year-Book;* and the current British and American journals devoted to librarianship. (T. GD.)

WAGES AND HOURS OF LABOUR.

Since the formation of the Labour Department of the Board of Trade in 1893, the wages statistics of the country have steadily increased in value and in volume; but the complexity and variety of the wage-earning classes, the limited extent to which representative returns can be obtained, the irregularity of employment, the prevalence of overtime, and the differences in the methods of remuneration—all of which obscure the definiteness and detract from the sufficiency of such returns as are available—are among the causes that make any general statement as to rates of wages and average earnings impossible. Certain general tendencies at the end of the 19th century may, however, be indicated. First, as to the distribution of the wage-earning classes. The diminishing proportion of

the population of the United Kingdom that is engaged in agriculture is one of the salient facts of the century. In 1825 the amount of agricultural and of non-agricultural labour in Great Britain was approximately equal. In 1891 the ratio was about one to five, the totals for the chief agricultural classes having fallen in England and Wales during the decade 1881–91 from about 1,135,000 to about 1,050,000, while the total population of the country was steadily increasing. The general, though by no means the unbroken, tendency has been for wages to increase since 1880, those of agricultural labour having perhaps increased most slowly, and chiefly towards the end of the period, so that the importance of the above figures becomes more manifest. The most notable increases in the occupation returns for England and Wales in the years 1881–91 are shown by coal-miners, railway and general transport employees, machine and boiler makers, and printers, their rates of increase being respectively 84, 78, 24, and 14 to every 10,000 males of ten years and upwards in the country, and their aggregate mounting in the ten years from about 1,060,000 to about 1,400,000.

The general course of trade and employment during the last twenty years of the 19th century may be briefly described as follows. The first of the two decades opened after a period of depression (the reaction from the inflation of the years 1871–74), which had reached its lowest point in 1879. From 1880 to 1883 came a time of expanding trade, checked at the end for two or three years, but afterwards recovering and again expanding until 1891. In the period of decline which then began, 1893–94 marks the lowest point; but from that year until 1900 expansion again took place. During 1900, which had opened with employment still in full flood, and with wages still tending upwards, a slight reaction followed on the prosperity of the preceding six years. There was, however, no general contraction in the demand for labour, and such falling-off in wages as ensued (up to the beginning of 1902) was gradual in character and limited in scope, affecting mainly the mining and metal industries. The knowledge, however, that employment was good in certain years, or that wages tended to rise or fall in such and such a period, has little significance if we remain ignorant as to any movement that may also have taken place in the prices of those commodities on which wages are to a great extent expended: it is necessary to take into account the distinction between real and nominal wages. With the exception of 1889–91 and 1898–1900, the trend of wholesale prices was almost continuously downwards during the period 1880–1900. The influence of this decline upon the cost of living has been sometimes exaggerated, but at no time was there a greater variety of commodities purchasable by the masses of the people of the United Kingdom than at the close of the 19th century; and owing to the continued improvement in methods of production and in facilities for transport, although special classes of workers suffer from the changes and dislocation that even improvements bring, the general course of the markets is still in favour of the working-class consumer. The statistics of consumption of many of the necessaries of life illustrate this development, but perhaps still more significant is the gradual transition of many "luxuries" into the class of "necessaries," due to the gradual rising of the standard of comfort, and thus to the widening of the area of demand. It is no longer possible to find an index of well-being, even among the poorer classes of the community, in the price of the quartern loaf. The most important item in working-class expenditure, which has neither contracted nor even remained stationary, has been house rent. In many rural districts there are well-founded complaints of the low standard and the insufficiency of the accommodation available, and these complaints are echoed and emphasized in towns owing to the increasing rents that have to be paid. Although the expense of "housing" is thus often an increasing charge upon wages, the healthiness and conveniences of dwellings are also often increasing, both through the competition of owners and through the exercise of greater administrative care. It cannot, therefore, be asserted, without qualification, that even as regards rent charges real wages are declining. In many great centres of population, moreover, the problem of housing is being met to a growing and an unforeseen extent by the provision of greater facilities for locomotion. The census returns for London in 1901 reflected these various influences, showing as they did that the larger tenements had increased during the decade twice as quickly as the smaller ones, and that the one-room tenements had declined during the same period from 172,502 to 149,524.

Meanwhile, the population of the country has increased, the general health of the community has improved, the average age at death has risen, and there are many additional proofs that there is a considerable net increase in earnings. The following table will illustrate several of the points to which reference has been made:—

Year.	Proportion of Total of Imports and Exports per Head of Population of United Kingdom.	Index Numbers (Sauerbeck's) showing Variation in Wholesale Prices (1867–77=100).		Prices—			Consumption per Head of Population of United Kingdom.			Post Office Savings Bank.	
				Of Bacon imported (per cwt.).	Of Tea (per lb).	Of Tobacco, unmanufactured (per lb).	Bacon and Hams, imported.	Tea.	Tobacco.	Amounts due to Depositors in United Kingdom.	No. of Accounts open at End of Year.
	£ s. d.	Food.	Total.	s. d.	d.	d.	lb.	lb.	lb.	£1000.	000's.
1881	19 17 2	91	85	45 10	12·82	6·85	13·92	4·58	1·41	36,194	2607
1886	19 17 0	72	69	37 9	11·77	7·23	12·98	4·92	1·44	50,874	3731
1891	19 14 0	77	72	37 10	10·70	8·60	13·11	5·36	1·61	71,608	5118
1896	18 14 1	62	61	34 6	9·55	6·02	16·90	5·77	1·73	108,098	6961
1900	21 9 0	60	75	41 9	8·58	7·16	19·02	6·11	1·96	135,549	8439

The following table has been compiled from the 1900 report of the Labour Department on changes in rates of wages in the United Kingdom:—

Changes in Rates of Wages.

Years.	Trades.	Gross Aggregate Nos. of Individuals Affected.		Total Amount of Changes per Week.	
		Increases.	Decreases.	Increases.	Decreases.
				£ s.	£ s.
1893–97	Building	209,207	4,646	25,160 5	273 5
"	Mining and quarrying	441,693	1,003,426	27,559 14	99,221 19
"	Metal, engineering, and shipbuilding	459,808	181,905	36,521 10	11,921 17
1898–1900	Building	210,830	8,097	21,929 14	191 4
"	Mining and quarrying	2,041,012	4,018	290,457 6	294 6
"	Metal, engineering, and shipbuilding	456,768	10,642	50,378 13	1,292 17
1893–97	All trades[1]	1,340,778	1,277,937	103,395 16	106,172 5
1898–1900	All trades[1]	3,290,418	36,097	364,[illegible] 0	3,712 13

[1] Exclusive of agricultural labourers, railway servants, and seamen.

The net result per head of all the changes recorded in the above table in the years 1893–97 is practically *nil*, the figures showing a decrease of only a fraction of a penny per head per week of all persons affected. During the years 1898–1900, on the other hand, the total weekly advances were considerable, being equivalent in the aggregate, and assuming regular employment, to an

increase of nearly £20,000,000 in the yearly wages bill of the United Kingdom. During 1901 there was a slight set-back from the conditions of exceptional and in some directions inflated prosperity of the early months of 1900.

The figures relating to the hours of labour tell of a much more continuous movement than do those relating to wages, and show that for the organized trades of the country the recognized working week is getting steadily shorter. From the Parliamentary Return (1890) giving "the average number of hours worked as a week's work in the chief trade centres" in the years 1850, 1860, 1870, 1880, and 1890, we find, on analysis of the 1121 returns (962 from employers and 159 from trade unions), that in 1890, as compared with 1880, there were only 73 cases of a lengthened working week, as compared with 363 cases in which it was shortened. Of the 73 cases, 56 are reported from various branches of the building trades. The value of these returns is considerably diminished by the omission of all numbers of those affected by the changes recorded, but the great preponderance of the cases of a shortened working week is significant. The particulars furnished in later years by the Labour Department are much more precise, and show the following results for the years 1893–1900. By the cases of which full particulars have been received, again exclusive of agricultural labourers, railway servants, and seamen, 446,169 wage-earners were affected, and of these only 82,367 had their working day lengthened. Not only has a much larger number secured a decrease, but the gain of time per head has been much greater than the loss; for while 76,663, or nearly the whole of those whose average working week was increased, submitted to an increase of less than one hour per week, the average time in each year by which the working week was shortened for the trades reported on was 2·81 hours.

But while there is much detailed evidence of somewhat greater leisure and of considerably increased wages, and still more general evidence of a rising standard of comfort, other considerations point to less satisfactory conclusions. Female labour is, it is true, being gradually still further withdrawn from those occupations for which it is physically least fitted, and is widely protected by legislation, especially as regards the hours of work, in ways that would be inexpedient for adult males; but it still remains subject to many special disadvantages, both as regards conditions of employment and as regards wages. This inferiority is largely due to disorganization and to non-organization; to the disadvantages that the woman still labours under of being regarded as a supplementary wage-earner; and, frequently, to the aggravation of the normal sources of her economic weakness through the conditions of home employment. As regards the poorly-paid and unhappily-conditioned classes of female labour, as also of inefficient, disorganized, and degraded labour generally, both of men and women, Mr Charles Booth's conclusion has to be borne in mind, that some 30 per cent. of the people of London are to be classed as "poor," either through the lowness of the rate at which they are paid, through the irregularity of their employment, or through the general precariousness of their means of subsistence. Moreover, the figures for overcrowding for England and Wales have to be considered. According to the returns for 1891, in which "ordinary tenements which have more than two occupants per room, bedrooms and sitting-rooms included," are regarded as overcrowded, it appears that, in the urban districts, 2,572,413 persons were found to be living in one, two, three, or four rooms in such conditions, and in the rural districts, 685,631 persons—the two totals representing in the aggregate more than 11 per cent. out of a total population of something over 29 millions. Many people are doubtless housed beneath their earnings, the margin saved in rent and in keeping up the home standard being diverted into other channels and often wasted. But it may be broadly stated that accommodation is a rough index not only to the standard of comfort of the household, but also to the economic status of the householder. The two sets of figures given above may therefore be usefully put side by side with the indications of progress already given, in order to indicate the serious limitations of such improvement in material conditions as has taken place.

Influence of Combination.—The legal position of the Trade Unions (*q.v.*) was settled in 1876, and since that date, in spite of some uncertainty as to the nature of lawful and unlawful picketing, and, in this connexion, as to the financial liability of the societies in the case of actionable conduct on the part of a member, they have been comparatively free to concentrate attention upon internal management, and upon the task of making combination effective. From 1880 to 1888 a large number of new societies were started, but those in which any rapid augmentation of strength took place were exceptional—for instance, among the older societies, in the Boiler Makers and, to some extent, in the Amalgamated Society of Engineers. Trade unionism still represented skill, and for the most part afforded additional protection to those classes of workers whose own economic position was already strong. The trade union mind of these years, when the depression and financial strain of 1879 and the immediately succeeding years had been left behind, is reflected in the first Report on Trade Unions prepared in 1887 by the Labour Correspondent of the Board of Trade. Writing of the complete emancipation in the eyes of the law that the societies had obtained, he continued: "There can be no doubt that the freedom which in this respect they now enjoy tends to make them the most contented industrial community in the world." At this date the total membership throughout the United Kingdom was estimated at something over 600,000. In 1889 a great change took place. The apparently successful issue of what has come to be known as "the great dock strike" of that year in London appeared suddenly to open up a new era for trade unionism. The discovery seemed to be made, not, it is true, for the first time, that the unskilled could be organized no less than the skilled. New combinations were formed up and down the country. Even more important than this, the older societies were led to bestir themselves more actively. The figures relating to the annual Trade Union Congresses reflect the inflation and the enthusiasm of 1890. In 1889 there had been only 209 delegates present, representing 145 societies and less than 700,000 members, but in the following year there were 454 delegates, representing 268 societies and nearly 1,600,000 members. From 1891 until 1895 the total of the trade unionists in the United Kingdom appears somewhat to have declined, mainly owing to the falling-off in the membership of general labourers, agricultural labourers, and transport employés (other than railway men). This was the period of declining trade, and also of readjustment, following on the years of excitement that had preceded, but since 1895 a steady advance has been made. The trade unionists of the United Kingdom in 1900 were put down at 1,905,116, an increase of nearly half a million on the total given for 1895, and may be roughly estimated to include something under one in four of the class of men from whom members are drawn. The total number of unions at the end of 1900 was 1272, about 57 per cent. of which had been formed from 1880

onwards, and about 38 per cent. from 1890 onwards. A slight tendency towards consolidation is observable, but very many of the societies are still small, local, and unimportant, there being 815 of them with less than 300 members each, and with an average membership of only a little over 100. About three-fifths of the membership belong to the societies designated by the Labour Department as "the hundred principal trade unions," the position and importance of which will be best seen from the following particulars taken from the Report on Trade Unions, 1900:—Total income for the year, £1,974,611; total funds in hand, £3,766,625, equivalent to £3, 5s. 0d. per member; dispute pay, £150,283; unemployed benefit, £265,328; sick and accident benefit, £323,231; superannuation, £190,039; funeral benefit, £98,682. From 1892–1900 these 100 societies expended upwards of 13½ million pounds, in the following proportions:—Dispute benefit, 20·2 per cent.; working expenses, 19·5 per cent.; and for friendly benefits of various kinds, no less than 60·3 per cent.

The primary object of every trade union must be a protective one, but the figures and percentages quoted above, showing the large expenditure on friendly benefits, prove the importance of the incidental benevolent work of the societies. The experience of the last decade of the 19th century, in spite of the heavy financial burden imposed, afforded further proofs of the necessity of combining the benevolent with the more militant objects, in order that the bond of a permanent and obvious material gain to members may be provided. The usefulness of the trade unions in providing, on the side of the wage-earner, the general machinery for the maintenance of organized relationships between "capital and labour," a machinery that is as potent in the preservation of industrial peace as it is for entering upon industrial conflict; the statistical value of the returns of the societies, as throwing considerable light not only on the state of employment in particular trades, but to some extent on more general conditions; and the means which the societies provide for the expression of representative working-class opinion, when this exists, are among the various advantages both to the community at large and to the wage-earning classes in particular that the stability of these organizations ensures. It must be observed, however, that the Trade Union Congress, the most representative organization of the trade unions, has declined in importance. This has been largely due to the division that has made itself felt on questions of political action and principle, and to the more or less veiled conflict that has arisen between the Socialistic and the non-Socialistic elements at the Congress; while another source of weakness, to some extent arrested by recent improvements in procedure, has been the multitude of questions that are brought before the meetings. The increasing strength and scope of the employers' associations that has taken place, *pari passu* with the growth and consolidation of the trade unions, has been a marked and significant feature of recent years.

One of the most definite ways in which trade union influence has shown itself in recent years has been in the conditions under which labour has been employed by public authorities, and in the extent to which a "fair wages clause," in some form or another, has been inserted in public contracts. Exclusive of London, where the County Council and many of the boroughs have adopted stringent clauses, it is noteworthy that in the Government Return (1898) of Urban Sanitary Districts showing whether contracts entered into "specify any conditions as to the wages to be paid by the contractor, or other conditions with respect to the persons employed by him," no fewer than forty-eight of the county boroughs are found to have adopted some such conditions, as against sixteen in which no conditions are directly enforced. The conditions specified vary considerably in stringency; and while some deal simply with the question of competency, and a few even insist on the employment of local labour, the great majority enforce the payment of not less than "the current local standard rates of wages," and the observance of the hours and other conditions of employment recognized. Inasmuch as these clauses involve the public recognition of a standard and a groping after fairness, their extended adoption perhaps represents one of the most far-reaching effects of trade unionism. In general, however, it may be said that the societies are much more successful in securing the adoption of shorter hours, or of other conditions affecting the convenience, healthiness, and safety of labour, than in enforcing higher wages. They can more easily introduce a uniform wage than increase the aggregate of earnings, the amount, and even the rate, of the latter being determined by more general influences than the presence or absence of combination. In one special direction, namely, among workmen employed by local bodies, especially all forms of unskilled labour (street-sweeping, &c.), the increase in wages has coincided with a rise in the standard of the requirements for what used to be regarded as the inferior services demanded by the community, employers, be they municipal or private, tending inevitably to secure the most efficient labour that is willing to take the wage offered. Thus the man who is handicapped in any way, be it by the infirmity of age or by any other physical cause, is finding it increasingly difficult to secure employment in directions to which, in years gone by, he had naturally turned. Analogous effects are discernible in many fields of employment in which the trade unions have been able to enforce the payment of not less than a fixed minimum wage. This is indeed one of the difficulties that the community at large is having to face at this era of partial organization, coinciding as it necessarily does with the existence of a large amount of labour that is, through lack of training, through deterioration, through infirmity, or from some other cause, below the average and inefficient, and thus, though not unemployable, often unemployed. (E. A*.)

Societies, Art. See Art Societies.

Society Islands. See Tahiti.

Sociology.—In the most inclusive sense sociology may be defined as the science of human society, in the same manner that biology may be taken to imply the science of life. The fact that sociology is treated in these new volumes of the *Encyclopaedia Britannica* for the first time under a separate heading is indicative of a certain tendency in the development of the subject, the bearing of which will be referred to later. The word sociology (*Sociologie*) was first used by Comte in 1839 as an equivalent of the expression social physics previously in use, and was introduced, he said, to describe by a single term that part of natural philosophy which relates to the positive study of the fundamental laws of social phenomena. Although the word is a hybrid, compounded from both Latin and Greek terms, its use has been defended, and is now generally accepted; none of the terms, such as politics, social economy, social philosophy, and social science, which have been suggested instead of it having succeeded in taking its place. There has been in the past a certain hesitation, especially in England, to admit sociology as the title of a particular science in itself until it was made clear what the subject must be considered to cover. In certain quarters sociology is often spoken of as if it implied the practical equivalent of the science of politics. Henry Sidgwick considered the word as usually

employed in this sense, and while he recognized that sociology must have a wider scope than politics, he thought that in practice "the difference between the two subjects is not indeed great" (*Elements of Politics*). In other quarters the word is often used as no more than a covering term for subjects which are fully treated in various subdivisions of social science. In others, again, a certain distinction is made, and sociology is used as an ordinal term to include the general principles of a subject of which the details are treated in subdivisions. Thus when the science of society is distinguished from the special social sciences which fall within its general purview, it may be considered, says Lester F. Ward, that "we may range the next most general departments as so many genera, each with its appropriate species. That is, the classification of the sciences may be made strictly synoptical. When this is done it will be possible for philosophers, like good systematists, to avoid making their ordinal characters include any properly generic ones, or their generic characters include any that are only specific. Thus understood, sociology is freed from the unnecessary embarrassment of having hanging about it in more or less disorder a burden of complicated details, in a great variety of attitudes which make it next to impossible to secure due attention to the fundamental principles of so vast a science. These details are classified and assigned each to its proper place (genus or species), and the field is cleared for the calm contemplation of the central problem of determining the facts, the law, and the principles of human association" (*Outlines of Sociology*). This definition, good as it is in many respects, does not, however, in practice make clear to the mind whether the principles of sociology involve more than the generalized total of the principles of the subordinate sciences which it is said to include. Finally, in England Herbert Spencer, who has been one of the principal writers identified with the subject in a period of transition, has placed his *Principles of Sociology* between his *Principles of Psychology* and *Principles of Ethics*. In practice, however, ethics, as Sir Frederick Pollock has pointed out, must be classed as a department of sociology. For "whatever may be thought of the existence of absolute or purely self-regarding duties, or of the possibility of a moral sense, arising otherwise than in society, it is understood that the great bulk of moral duties have regard to other persons" (*History of Science of Politics*). Psychology, on the other hand, which Mr Spencer places before sociology, cannot nowadays be fully, or even in any real sense scientifically, discussed apart from sociological principles, once it is accepted that the evolution of society is proceeding under the influence of natural selection, and that therefore the social factor is always in the ascendant—in the development of the human mind no less than in the development of human conduct.

It would appear, therefore, that if sociology is to be admitted as a true science in itself, it must be regarded rather as a science occupied more particularly with the general fundamental principles which underlie human society considered as in a condition of change. In this sense, if its claim be established, it must be possible to show that while the conclusions of sociology cannot be fully stated in relation to the phenomena dealt with in any of the divisions of social science, they must be taken as implying more than the sum total of the results obtained in all of them, and therefore as involving governing principles to which the phenomena of all of them stand in controlled and subordinate relationship.

The fathers of the science of society may be said to be the Greek philosophers, and in particular Plato and Aristotle. The *Laws* and the *Republic* of the former and the *Ethics* and *Politics* of the latter have, down to modern times, and notwithstanding the great difference in the standpoint of the world and the change in social and political conditions, exercised a considerable influence on the development of the theory of society.

Among the Greeks.

To the Greeks the science of society presented itself briefly as the science of the best method of attaining the most perfect life within the consciousness of the associated life of the State. "In this ideal of the State," says Bluntschli, "are combined and mingled all the efforts of the Greeks in religion and in law, in morals and social life, in art and science, in the acquisition and management of wealth, in trade and industry. The individual requires the State to give him a legal existence: apart from the State he has neither safety nor freedom. The barbarian is a natural enemy, and conquered enemies become slaves. . . . The Hellenic State, like the ancient State in general . . . was all in all. The citizen was nothing except as a member of the State. His whole existence depended on and was subject to the State . . . The State knew neither moral nor legal limits to its power" (*Theory of the State*).

It was within the limits of this conception that most of the Greek theories of society were constructed. The fundamental conception of the Roman writers was not essentially different, although the opportunism of the Roman State, when it became a universal power embracing the social and religious systems of many peoples, in some degree modified it; so that with the growth of *jus gentium* outside the *jus civile*, the later writers of the Empire brought into view an aspect of the State in which law began to be to some extent distinguished from morality.

In Christian Europe.

With the rise and spread of Christianity in Western Europe there commenced a stage in which the social structure, and with it the theory of society, underwent profound modifications. These changes are still in progress, and the period over which they extend has produced a great and increasing number of writers on the science of society. The conceptions of each period have been intimately related to the character of the influences controlling development at the time. The writers up to the 14th century are nearly all absorbed in the great controversy between the spiritual and temporal power which was defining itself during this stage in Western history. In the period of the Renaissance and the Reformation the modern development of the theory of society may be said to begin. Machiavelli is the first great name in this period. Bodin with other writers up to the time of Montesquieu carry the development forward in France. The Dutch writer Grotius, although chiefly recognized at the time as an authority on international law, had much influence in bringing into view principles which mark more directly the transition to the modern period, his *De Jure Belli et Pacis*, issued in 1625, being in many respects an important contribution to the theory of society. Hobbes and Locke are the principal representatives of the influential school of writers on the principles of society which the period of the political and religious upheaval of the 17th century produced in England. The ideas of Locke, in particular, exercised a considerable influence on the subsequent development of the theory of the State in Western thought. From the 17th century forward it may be said, strictly speaking, that all the leading contributions to the general body of Western philosophy have been contributions to the development of the science of society. At the time of Locke, and to a large extent in Locke's writings, there may be distinguished three distinct tendencies in the prevailing theory of society. Each of these has since become more definite, and has progressed along a particular line of

development. There is first the empirical tendency, which is to be followed through the philosophy of Hume down to the present day, in what may be called—to borrow an idea from Huxley—the physiological method in the modern study of the science of society. A second tendency—which developed through the critical philosophy of Kant, the idealism of Hegel, and the historical methods of Savigny in the field of jurisprudence and of the school of Schmoller in the domain of economics—finds its current expression in the more characteristically German conception of the organic nature of the modern State. A third tendency—which is to be followed through the writings of Rousseau, Diderot, d'Alembert, and the literature of the French Revolution—found its most influential form of expression in the 19th century in the theories of the English Utilitarians, from Bentham to John Stuart Mill. In this development it is a theory of the utilitarian State which is principally in view. In its latest phase it has progressed to the expression which it has reached in the theories of Marxian Socialism, in which the corresponding conception of the ascendancy of the economic factor in history may now be said to be the characteristic feature. All of these developments must be considered to have contributed towards the foundation of modern sociology. The definition of the relations to each other of the positions which they have severally brought into view is not unlikely to be the first important work of the new science.

Comte. At the period between 1830 and 1842, when Comte published the *Philosophie Positive*, the conditions were not ready for a science of society to be instituted. The Darwinian doctrine of evolution by natural selection had not yet been enunciated, and knowledge of social phenomena was limited and very imperfect. As an instance of the character of the change that has since been in progress, it may be mentioned that one of Comte's main positions—that, indeed, to which most of the characteristic conceptions of his system of philosophy were related—was that "the anatomical and physiological study of individual man" should precede the theory of the human mind and of human society. It is probable, however, that it must now be considered that no really fundamental or far-reaching principle of human development can be formulated as the result of such a position. For with the application of the doctrine of evolution to society a position is becoming defined which is almost the reverse of it, namely, that the development of the individual, and to a large extent of the human mind itself, must be regarded as the correlative of the social process in evolution. The study of the principles of the process of social evolution would therefore in this sense tend to come before the complete study of the individual, and even to precede the construction of a system of pyschology scientific in the highest sense. Comte, apart from his want of mastery of the historical method in dealing with sociological development, possessed, on the whole, little insight into the meaning of the characteristic problem in which the human mind is involved in its social evolution, and to the definition of which not only the processes of Western history, but the positions successively developed in Western thought, must all be considered as contributing. His great merit was the perception of the importance of the biological method in the science of society, the comprehension of the fact that there can be no science of society if its divisions are studied apart from each other; and finally, and although it led at the time to the formulation of no important principle of human development, the intuition that sociology was not simply a theory of the state, but the science of what he called the associated life of humanity.

It has to be observed, that preceding the application of the doctrine of evolution to society most of the contributions to social science have a certain aspect in which they resemble each other. While in later theories society tends to be presented as evolving inevitably, under stress of natural selection, towards efficiency, the earlier contributions tend to become theories of the meaning and object of society regarded simply as a medium for the conscious realization of human desires along the line of least effort in the associated state.

Influence of Greek conceptions of the State. In this presentation of the subject the influence of the Greek conception of the State upon modern sociology may be traced down to the present day. At the beginning of the modern period it reappears in Machiavelli (*Titus Livius*, i., iii., and *The Prince*). It is represented in modified form in Hobbes (*Leviathan*), and in Locke (*Two Treatises of Government*), each of whom conceived man as desiring to leave the state of nature and as founding civilized society, "in order that he might obtain the benefits of government" in the associated state. It is continued in Rousseau and the writers of the French Revolution, who similarly imagined the individual voluntarily leaving an earlier state of freedom to put "his person and his power under the direction of the general will" (*Social Contract*). It is characteristic of Jeremy Bentham (*e.g., Principles of Morals and Legislation*, i.) and of J. S. Mill (*e.g., Utilitarianism and Political Economy*, iv., vi.). Finally, it survives in Herbert Spencer, who in like manner sees man originating society and submitting to political subordination in the associated state "through experience of the increased satisfaction derived under it" (*Data of Ethics*). It continues at the present day to be characteristic of many Continental and some American writers on sociology, who have been influenced both by Spencer and the Latin theory of the State, and who therefore, conceiving sociology not so much as a science of social evolution as a theory of association, proceed to consider the progress of human association as the development of a process "of catering to human desire for satisfactions of varying degrees of complexity" (Small). With the application of the theory of natural selection to human development this conception may be observed as tending to be replaced by that already mentioned, which is different both in character and implication.

Result of doctrine of evolution. In the later view, while the positions involved in the first conception of society are not lost sight of, the development of human society is regarded rather as the product of a process of stress, in which progress results from natural selection along the line, not of least effort in realizing human desire, but of the highest social efficiency in the struggle for existence of the materials of which society is composed. In the intensity of this process society, evolving towards higher efficiency, tends to become increasingly organic, the distinctive feature being the growing subordination of the individual to the social process. All the tendencies of development—political, ethical, and psychological—and the contents of the human mind itself, would therefore have to be regarded as having ultimate relations to the governing principles of the process as a whole. The science of social evolution would, in short, have to be considered, according to this view, as the science of the causes and principles subordinating the individual to a process developing by inherent necessity towards social efficiency, and therefore as ultimately over-ruling all desires and interests in the individual towards the highest social potentiality of the materials of which society is composed. The conflict between these two conceptions may be distinguished to an increasing degree as the scope of modern sociology has gradually become defined; and the opposing principles and ideas of each may be observed to be sometimes represented and blended, in varying degrees of complexity, in one and the same writer.

It was natural that one of the first ideas to be held by theorists, as soon as sociology began to make progress to the position of a real science, was that society must be considered to be organic. An increasing number of writers from Comte onwards have been concerned with this aspect of the subject, and in connexion with it there is brought into view the nature of the situation towards which the conflict referred to has gradually developed. Comte conceived social organization as more or less mechanical. Writers like Herbert Spencer (*Sociology*) and Schäffle, who was for a time Minister of Commerce for Austria (*Bau und Leben des Socialen Körpers*) have instituted lengthy comparisons between the social organism considered as the State and the living individual organism. These efforts may be said to have reached their most characteristic current expression in the work of the sociologists who have followed Simmel in lengthy and ingenious attempts at classifying associations, considering them "as organizations for catering to human desire." In all these attempts the Greek theory of society may be said to be still vigorously represented, although, as has been said, the old is often blended with the new in one and the same writer. In their later phases they may be recognized to be, to a considerable extent, characteristic of the work of sociologists in countries where the influence of Roman law is still strong, and where, consequently, the Latin conception of the State associated with it tends to influence all theories of society as soon as the attempt is made to place them on a scientific basis. The sterilizing effect which the example has produced on the study of sociology in certain directions in America has, however, to be noted. It is exemplified in ingenious attempts which are made, in dealing with the principles of sociology, to construct long categories of human associations, ranging from those based on mental abnormality to those that result in joint participation in choral music. There is to be distinguished an increasing conviction that none of the comparisons of this kind that have hitherto been made have contributed in any marked degree to the elucidation of the principles of modern society. Paul Leroy Beaulieu's criticism of Schäffle's effort at comparisons—anatomical, physiological, biological, and psychological—between society and the human individual is that "the mind sinks overwhelmed under the weight of all these analogies, these endless divisions and subdivisions to which they give rise. . . . The result is not in proportion to the effort" (*L'État moderne et ses fonctions*).

Society as an organism.

In tracing the direction of this conflict between the newer and older tendencies in modern sociology, it is probably in Herbert Spencer's writings that the student will find presented in clearest definition the characteristic difficulty with which the old view has tended to be confronted, as the attempt has continued to be made to enunciate the principles of human development from the standpoint that society is to be considered as a "social organism." With the application of the doctrine of natural selection to society considered as an organism, a position has been brought into view of considerable interest. It is evident that a fundamental principle involved in considering society as an organism, is that the efficiency of the social organism must always be taken to be greater than the sum total of the efficiencies of all the members that comprise it, acting as individuals. The inference which follows from this, is that if natural selection is to be considered as operating in society along the line of highest efficiency, it must reach the individual through society. That is to say, his development and his interests as an individual must be regarded as having ceased to be the controlling factor in social evolution. It is the principles subordinating him to the efficiency of society in its corporate aspect which must ultimately control both, and, therefore, all theories whatever of human association. Mr Spencer, in an elaborate comparison which he has made (*Essays*, vol. i., and *Principles of Sociology*) between the social organism and the living individual organism, has insisted on a reservation which brings into view, in connexion with this fact, a position the relation of which to present tendencies in sociology is probably fundamental. In comparing the social with the individual organism he proceeds, after noting the various aspects in which a close analogy between the two can be established, to make, as regards modern society, an important distinction by which the nature of the difficulty in which he is involved is immediately made apparent. While in an individual organism, he points out, it is necessary that the lives of all the parts should be merged in the life of the whole, because the whole has a corporate consciousness capable of happiness or misery, it is not so with society. For in society, he adds, the "living units do not and cannot lose individual consciousness, since the community as a whole has no corporate consciousness." Mr Spencer proceeds, therefore, to emphasize the conclusion that "This is an everlasting reason why the welfare of citizens cannot rightly be sacrificed to some supposed benefit of the State; but why, on the other hand, the State is to be maintained solely for the benefit of citizens. The corporate life must here be subservient to the lives of the parts, instead of the lives of the parts being subservient to the corporate life." The position to which this conception of Mr Spencer—in which the State is conceived to be the "social organism"—gave rise, as the doctrine of evolution continued to be applied to society, was defined in the prefatory essay to vol. xxix. of the present edition of the *Encyclopædia Britannica*. Briefly stated, the characteristic difficulty which presented itself was that: If natural selection is conceived as operating on society, and therefore as tending to produce the highest efficiency out of the materials that comprise it, it must produce the subordination of the interests of the units to that higher efficiency of society, which is greater than the sum total of the efficiencies of the component members. But one of only two conclusions could therefore result from Mr Spencer's position. In regarding the "social organism" as an organism in which the corporate life must be subservient to the lives of the parts, instead of the lives of the parts being subservient to the corporate life, it must be necessary to conceive that the individual had succeeded in arresting the characteristic effects of natural selection on society. Or else, the result just mentioned being scarcely conceivable, natural selection, whether the individual be conscious of it or not, must be subordinating individual interests in society to a larger meaning in the evolutionary process. Society must, in short, be subject to principles which reach farther than Mr Spencer conceived: it must be organic in some different and wider sense than he imagined, and the analogy of the "social organism" as confined within the consciousness of ascendant interests in the political State must be considered to be a false one.

Herbert Spencer.

In the essay in question the gradual *reductio ad absurdum* which has taken place, with the application of the doctrine of evolution to society, of the conception that natural selection tends to be suspended in the social process, was dealt with and may be there followed in detail. It remains here to consider the relation to the position in modern sociology of the other alternative, namely, that society must be considered to be organic in some wider sense than the principles of the State would imply. The position reached in Mr Spencer's sociology may be said to

Further extension to sociology of the evolutionary principle.

represent the science of society in a state of transition. It represents it, that is to say, in a stage at which the Greek theory of society has become influenced by the doctrine of evolution applied to modern conceptions, but while as yet no synthesis has been achieved between the conflicting and even mutually exclusive ideas which are apparently involved. The Greek theory of society is represented in Mr Spencer in his practical identification of "the social organism" with the State. The idea, however, which carries him beyond the principles of Greek society—as these principles were summarized, for instance, in the passage already quoted from Bluntschli—is clearly in evidence. It may be observed to be expressed in the recognition of a principle resident in modern society which in some manner projects the individual's rights outside and beyond the whole theory and meaning of the State. In other words, in society as Mr Spencer now conceives it, "the welfare of citizens cannot rightly be sacrificed to some supposed benefit of the State"; whereas, according to the Greek theory and the theory of Roman law, "the citizen was nothing, except as a member of the State. His whole existence depended on and was subject to the State. The State knew neither moral nor legal limits to its power." If, however, it be considered that modern society has made progress beyond the Greek, and if it be accepted that the theory of evolution involves the conclusion that society progresses towards increased efficiency in a more organic type, there follows from the foregoing an important inference. This is that it would then become the task of modern sociology, as a true science, to show that the principle in modern civilization which distinguishes it from society of the Greek period—namely, that principle which Mr Spencer rightly recognizes as rendering the life of the individuals as no longer subservient to the corporate life of the State—is itself a principle identified with the increasing subordination of the individual to a more organic type of society. It must, in short, remain for the evolutionist, working by the historical method scientifically applied, to present the intervening process in history—including the whole modern movement towards liberty and enfranchisement, towards equality of conditions, of rights, and of economic opportunities—as a process of progress towards a more advanced and organic stage of social subordination than has prevailed in the world before.

It is at this point that the wide scope of modern sociology comes into view, and that the advanced character of the studies which must form its basis may be realized. It is not, it would appear, only the facts of primitive society, the general theory of the political State, and the principles of economic society, that come within its purview. The developments of history and the positions successively defined in human thought and in human belief must, it would seem, all fall to be considered in a strictly scientific sense as constituting the phenomenology of a process in which, with the evolution of society towards higher efficiency, the individual is being gradually subordinated to principles rendering society increasingly organic.

Hitherto, in the development of sociological theory, the tendency which has led to the identification of the social organism with the State has been productive of certain more or less characteristic results. In the first place, by the considerable number of writers who have, as stated, tended to consider sociology as the study of associations for realizing human desires, beginning with those of primitive society and rising to the economic wants of the modern State, attention has necessarily been given to institutions of custom and legality, to civil and economic phenomena, and, in the study of modern society, to statistical methods and quantitive measurements in connexion with facts relating to such subjects as wealth, industry, health, crime, education, and forms of economic activity. In sociology thus considered, the legal and economic aspects of society, and the theory of the State as constituting the social organism, have tended to be kept in view. An incidental but by no means unimportant result has, however, been that, as Mr Lester Ward has pointed out, sociologists have been hitherto recruited mainly from students of economics or of subdivisions of economic science. While such studies must always continue to constitute an important part of the science of society, it must be considered that the tendency in the past to give them so prominent a place, as constituting the subject-matter of the science, has hitherto unduly restricted the outlook in sociological study. The conception of sociology as occupied with the general fundamental principles which underlie society considered in a condition of change, and therefore as involving governing principles to which the phenomena of all departments of social science stand in controlled and subordinate relationship, renders it necessary that the science should cover the subjects of a wide field of advanced study. When society is considered as an organism developing under the influence of natural selection along the line of the causes which contribute to its highest potential efficiency, and therefore tending to have the mean centre of its organic processes projected farther and farther into the future, it is evident that it must be the principles and ideas which most effectively subordinate over long periods of time the interests and the capacities of the individuals of which it is composed to the efficiency of the whole which will play the leading part in social evolution. The position of sociology, therefore, follows, as the most advanced of all the theoretical sciences. With the application of the doctrine of evolution to the social process in history, it must necessarily be concerned with all the subjects included under the old philosophy of history; while, on the other hand, when the contents of the individual mind are viewed as the correlative of the evolutionary process in society, the ultimate problems of ethics and psychology are also seen to be involved. The foundations of the science of society cannot, in short, be firmly or permanently laid with the comparatively limited outfit with which the sociologist has often been content to work in the past.

The basis of modern sociology.

A consideration of the general outlines of the process in which society must be considered as developing towards a higher organic efficiency under the operation of natural selection brings into view the scope of the studies which are thus likely to form the basis of sociology as a science in the modern sense, while it gives at the same time some general impression of the character of the results by which it is possible that a synthesis of the later with the older views may in time be attained. Beginning with primitive society, it must be considered that the first rudiments of social organization arose, not so much from conscious regard to expediency or "increased satisfactions," as from fitness in the struggle for existence. "The first organized societies must have been developed, like any other advantage, under the sternest conditions of natural selection. In the flux and change of life the members of those groups of men which in favourable conditions first showed any tendency to social organization became possessed of a great advantage over their fellows, and those societies grew up simply because they possessed elements of strength which led to the disappearance before them of other groups of men with which they came into competition. Such societies continued to flourish, until they in their turn had to give way before other associations of men of higher social efficiency" (*Social Evolution*, ii.). In the social process at this stage all the customs, habits, institutions, and beliefs

contributing to produce a higher organic efficiency of society would be naturally selected, developed, and perpetuated. It is in connexion with this fact that the clue must be sought to the evolution of those institutions and beliefs of early society which have been treated of at length in researches like those of M'Lennan, Tylor, Lubbock, Waitz, Letourneau, Quatrefages, Frazer, and others of equal importance. For a long period in the first stages the highest potentiality of the social organization would be closely associated with military efficiency. For in the evolution of the social organism, as has been said, while the mean centre of the processes involving its organic identity would tend to be projected into the future, it would at the same time always be necessary to maintain efficiency in current environment in competition with rival types of lower future potentiality. Amongst primitive peoples, where a great chief, law-giver, and military leader appeared, the efficiency of organized society resting on military efficiency would, as a matter of course, make itself felt in the struggle for existence. Yet as such societies would often be resolved into their component elements on the death of the leader, the overruling importance—in the next stage of the advance towards a more organic type—of ideas which would permanently subordinate the materials of society to the efficiency of the whole would make itself felt. Social systems of the type in which authority was perpetuated by ancestor-worship—in which all the members were therefore held to be joined in an exclusive religious citizenship founded on blood relationship to the deities who were worshipped, and in which all outsiders were accordingly treated as natural enemies, whom it would be a kind of sacrilege to admit to the rights of the State—would contain the elements of the highest military potentiality. The universal mark which ancestor-worship has left on human institutions in a certain stage of social development is doubtless closely associated with this fact. The new and the older tendencies in sociology are here also in contrast; for whereas Herbert Spencer has been content to explain ancestor-worship as arising from an introspective and comparatively trivial process of thought assumed to have taken place in the mind of early man in relation to a supposed belief in ghosts (*Principles of Sociology*, 68–207), the newer tendency is to consider science as concerned with it in its relation to the characteristic principles through which the efficiency of the social organization expressed itself in its surroundings. The social, political, and religious institutions disclosed in the study of the earliest civilizations within the purview of history must be considered to be all intimately related to the ruling principles of this military stage. The wide reach and significance of the causes governing the process of social evolution throughout the whole of this period may be gathered from treatises like Seebohm's *Structure of Greek Tribal Society*, Maine's *Ancient Law*, *History of Institutions*, and *Early Law and Custom*, Fowler's *City-State of the Greeks and Romans*, and in a special sense from the comparative study of Roman law, first of all as it is presented in the period of the Twelve Tables, then as the *jus civile* begins to be influenced by the *jus gentium*, and lastly as its principles are contrasted with those of English common law in the modern period. In most of the philosophical writings of the Greeks, and in particular in the *Ethics* and *Politics* of Aristotle, and in many of the *Dialogues* of Plato, the spirit of the principles upon which society was constructed in this stage may be perceived as soon as progress has been made with comparative studies in other directions.

Where, however, all human institutions, as in this stage, rested ultimately on force; where outsiders were regarded as natural enemies, and conquered enemies became slaves; where, as throughout all this phase of social evolution, a rule of religion was a rule of law identified with the principles of the State (Maine, *Ancient Law*); where the State itself was absolute as against the individual, knowing "neither moral nor legal limits to its power"; and where all the moral, intellectual, and industrial life of the community rested on a basis of slavery—the full limits of the organic principle in society would in time be reached. The conditions would be inherent in which all social institutions would tend to become closed absolutisms organized round the conception of men's desires in the present. And the highest outward expression in which the tendencies in ethics, in politics, and in religion must necessarily culminate would be the military State, bounded in its energies only by the resistance of others, necessarily acknowledging no complete end short of absolute dominion, and therefore staying its course before no ideal short of universal conquest.

As society continued to be impelled to develop towards a still more organic type, the greatly higher potentiality of a state of social order which, while preserving the ideal of the highly organized State and the current efficiency of society in competition with lower types, would be influenced by conceptions that would dissolve all those closed absolutisms, and release human energies into a free conflict of forces by projecting the principles of human responsibility outside the State, would be apparent. The conditions in which such a stage has in some degree tended to be attained in Western history were exemplified in the Prefatory Essay to vol. xxix. In many of the religions of the East such conceptions are to be found in all stages of development. But no Eastern people has, down to the present time, been able to provide for them the permanent military *milieu* in history in which alone their potentiality in the evolutionary process could be realized. The significance, therefore, of the culmination of the military epoch in the ancient classic civilizations of the Western world which preceded the opening of the era in which we are living, and of the fact that the peoples of the same descent who were destined to carry on the civilization of the existing era represent the supreme military stock by natural selection, not only of the entire world, but of the evolutionary process itself in human history, will be evident. With the spread, accordingly, amongst peoples of this origin, and in such a *milieu* in history, of a new conviction of responsibility to principles extending beyond the consciousness of the political State, there would begin a further and more organic stage of the evolutionary process in society. The gradual dissolution in the era in which we are living of all the closed absolutisms within the State, in which human action and ideas had hitherto been confined, is apparently the characteristic phenomenon of this stage. Progress is towards such a free and tolerant, but intense and efficient, conflict of forces as was not possible in the world before. It is, it would appear, in this light that we must regard the slow dissolution of the basis of ideas upon which slavery rested; the disintegration of the conceptions which supported the absolute position of the occupying classes in the State; the undermining of the ideas by which opinion was supported by the civil power of the State in the religious struggles of the Middle Ages; the growth of the conception that no power or opinion in the State can be considered as the representative of absolute truth; the consequent development of party government amongst the advanced peoples, with the acknowledgment of the right of every department of inquiry to carry results up to that utmost limit at which they are controlled only by the results obtained in other departments of activity with equal freedom; the growth of the conception, otherwise

absurd, of the native equality of men; the resulting claim, otherwise similarly indefensible, of men to equal voting power irrespective of status or possessions in the State, which has been behind the movement towards political enfranchisement; and, finally, the development of that conviction which is behind the existing challenge to all absolute tendencies in economic conditions in the modern world—namely, that the distribution of wealth in a well-ordered State should aim at realizing political justice. These are all the features of an integrating process in modern history. They must be considered as all related to a controlling principle which has rendered the evolutionary process in society more organic than in any past stage: namely, the projection of the sense of human responsibility outside the limits of all the creeds and interests which had in previous stages embodied it in the State (*Principles of Western Civilization*, x., xi.).

In thus regarding the social process in Western history, the projected efficiency of which, now after many centuries of development, begins to realize itself to an increasing degree in determining competition with other types of society throughout the world, it may be observed that the results by which a synthesis of the older and later views may be attained is already in some measure in sight. It was pointed out that if the principle which Mr Spencer rightly recognized in modern society as rendering the life of the individual no longer subservient to the corporate life of the State was to be accepted as a principle of progress distinguishing modern civilization from that of the Greek period, it would be necessary for the scientific sociologist to exhibit it not as indicating the larger independence of the individual, but as a principle identified with the increasing subordination of the individual to a more organic type of society. Here, therefore, this result is apparently in process of accomplishment. The intervening process in history—including the whole modern movement towards liberty and enfranchisement, towards equality of conditions, of rights, and of economic opportunities—is presented "as a process of progress towards a more advanced and organic stage of social subordination than has prevailed in the world before (*Principles of Western Civilization*, xi.). In this light, also, it may be observed how the claim of sociology to be the most advanced of all the theoretical sciences is justified. For if the historical process in the civilization of the era in which we are living is thus to be regarded as a process implying the increasing subordination of the individual to a more organic type of society, then the study of sociology as embracing the principles of the process must evidently involve the perception and comparison of the meaning of the fundamental positions disclosed in the history of political progress, of the problems with which the human mind has successively struggled in the phases of religious development, and, lastly, of the positions with which the intellect has been confronted as the stages of the subordinating process have gradually come to define themselves in history. The positions outlined in the developments already referred to which have come down through Hume and Huxley, through Kant and Hegel, through Grotius and Savigny, through Roscher and Schmoller, through the expression which English utilitarianism has reached in Herbert Spencer as influenced by the English theory of the rights of the individual on the one hand, and in Marxian Socialism as influenced by the Latin conception of the omnipotence of the State on the other, have thus all their place, meaning, and scientific relations in the modern study of sociology. It must be considered that the theory of organic evolution by natural selection and the historical method will continue in an increasing degree to influence the science of society. In the future, in the study of man, to make use of words employed by Sidgwick shortly before his death: "Owing to the overwhelming importance of the social factor [in the formation of a normal human individual], the methods of psychology and sociology blend in the inquiry, and the method of sociology dominates" (*Philosophy, its Scope and Relations*).

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Söderhamn, a seaport town of Sweden, county of Gefleborg, on a bay of the Gulf of Bothnia, 71 miles north

of Gefle by rail. It has saw-mills, planing-mills, iron-works, breweries, and wood-pulp factories, and exports timber (16,500,000 cubic feet annually), with iron and wood-pulp. In 1900 the exports amounted to about £1,000,000 in value, and the imports to £70,000. The port is cleared by some 400 to 500 vessels of 200,000 to 300,000 tons annually. In 1897 a new fairway was opened, giving access to vessels drawing 15 feet, *i.e.*, to the loading place at Branthäll. The port is, however, usually closed for the first four months of the year. The town, a straggling place with wide streets, was given municipal privileges by Gustavus Adolphus in 1620, and was rebuilt after fires in 1860 and 1865. Population (1880), 7937; (1900), 11,258.

Södertelge, a town of Sweden, county of Stockholm, stands on the Södertelge canal ($1\frac{1}{4}$ mile long; 10 feet deep on sill at low water; opened in 1819), which connects Lake Mälar with an inlet of the Baltic, 23 miles by rail west-south-west of Stockholm, of which it is indeed a suburb. It is frequented also as a summer resort, having mineral springs and baths. Its church is reputed to date from about 1100. There are engineering shops, jute spinning and weaving mills, match and joinery factories. Population (1880), 3510; (1900), 8207.

Soest, a town and episcopal see of Prussia, province of Westphalia, 33 miles by rail east of Dortmund. In front of the town hall (1701), which possesses valuable archives, stands a bronze statue of the Emperor William I. (1888). There are a teachers' seminary, a deaf and dumb and a blind asylum. Sugar is now manufactured. Population (1885), 14,846; (1900), 16,724.

Sofia, the capital of Bulgaria, finely situated on a high rolling plain 2000 feet above the sea and encompassed by the Balkan mountains, and at the terminus of the Sofia–Varna line (325 miles) opened in 1899, 300 miles west-north-west of Constantinople by rail, 206 miles south-east of Belgrade. By a branch line from Rustchuk joining the Sofia–Varna line near Tirnovo, improved means of communication is obtained with Berlin and north-east Germany, &c. The city is lighted by electricity, and there is an electric car system. Notwithstanding the bad harvests of several years, the commercial importance of the city is steadily increasing. It has breweries, tanneries, tobacco factories, and cloth and silk factories, and exports skins, cloth, cocoons, cereals, attar of roses, dried fruit, &c. The town was almost completely renovated during the last twenty years of the 19th century, the old town to the west, still partly inhabited by Turks, having been practically rebuilt in the European fashion. The houses are mainly brick encased in stucco, and the new town to the east dates entirely from 1878. A university was founded in 1888 (409 students in 1900), and there are colleges for boys and girls, a *real-schule*, a military school, and a military college. Near the cathedral in the old town is the mausoleum containing the remains of Prince Alexander of Battenberg. The Bujak-jami mosque is now occupied by the national library and the museum. Between the old and new town is the modern St Alexander Church, a magnificent structure in the Byzantine style, erected to commemorate the deliverance of Bulgaria. In the new town are the theatre, the fine university buildings, including the national printing establishment, the Chamber of Deputies, and monuments to the patriot Levski, to Russia, and to the Emperor Alexander II. of Russia. Population (1892), 46,593; (1900), 67,920, of whom two-thirds were Bulgarians and about one-sixth Jews.

Soignies, a town of Belgium, in the province of Hainaut, 11 miles north-east of Mons by rail. There are important freestone quarries in its vicinity, and sugar factories and tanneries. Population (1880), 8144; (1900), 10,124.

Sokota. See ABYSSINIA.

Sokoto, an important native state of the Central Sudan, now included in the British protectorate of Nigeria. The kingdom of Sokoto is the remnant of the great Fulbe kingdom established early in the 19th century by the leader Othman, but it has long been losing its importance as a military power, though the industrious and enterprising habits of the Hausas, who form the great bulk of its population, render it one of the most hopeful regions for the introduction of civilizing influences by Europeans. King Omar, under whose rule the power of the empire reached its lowest level, died in 1891, and was succeeded by Abderrahman, who has done something to restore the influence of the central power, especially by the reduction of the rebellious king of Argungu; but the once tributary states of Adamawa and Gando can no longer be considered as part of the kingdom. Adamawa itself is now split up into several quasi-independent sultanates, and its former capital, Yola, was taken by a British military expedition in 1901. The relations of Abderrahman with the British authorities have been somewhat doubtful, for though professing friendship, the king has shown himself unwilling to acknowledge the British protectorate; and in 1900 the expedition of Bishop Tugwell, though entirely non-political, was forced to retire from the great commercial centre of Kano owing to the suspicion of the native authorities. Under the administration, however, of Sir F. Lugard, the High Commissioner of Northern Nigeria, survey expeditions under Colonel Morland and other officers have reached Zaria, a strong walled town with an estimated population of 60,000 to 70,000, ruled by one of the most powerful vassals of the Sokoto kingdom, meeting with a cordial reception. By the Anglo-French agreement of 1898 the British "sphere of influence" is bounded, north of Sokoto, by a line leaving the Niger in about 11° 45′ N. and following the course of the Dallol Mauri to its intersection by the arc of a circle drawn from the town of Sokoto as a centre, with a radius of 100 miles. This is followed to its second intersection with the parallel 14° N., which then becomes the frontier for 70 miles, the line afterwards running south to 13° 20′ N. and east along this parallel for 250 miles, or beyond the limits of the Sokoto kingdom.

See MONTEIL, *De Saint-Louis à Tripoli par le lac Tchad*, Paris, 1895.—LUGARD. "Northern Nigeria," *Colonial Reports—Annual*, No. 346, 1902; and other works referred to under art. NIGERIA.

Sokotra.—This island is the largest and most easterly of a small group rising from a coral bank in the North Indian Ocean, of which Abd-el-Kuri, the Brothers (Kal Far'un, Semha, and Darzi), and Saboynea are the other members. An investigation of the island was undertaken by Professor Bayley Balfour in 1880, and subsequent expeditions were headed by Drs Riebeck and Schweinfurth in 1881, by Mr Theodore Bent in 1897, and by Dr H. O. Forbes and Mr Ogilvie-Grant (who also visited Abd-el-Kuri) in 1898–99. Simultaneously with the latter, a further expedition, conducted by Professor D. H. Müller, under the auspices of the Imperial Academy of Sciences of Vienna, visited Sokotra, Abd-el-Kuri, and some of the other islets of the group specially to investigate their geology and languages, but their report had not yet been published in 1902.

From the sea the island has an imposing appearance. The centre culminates in a series of rugged pinnacles—the Haghier mountains, which attain an altitude of nearly 5000 feet, rising out of and above a high (1500 feet) abutting and undulating limestone plateau, deeply channelled by valleys. At many parts of the

north coast the edges of this plateau reach the shore in precipitous cliffs, but in others low plains, dotted with bushes and date-palms, front the heights behind. The southern shore is bordered for nearly its entire length by a belt of drifted sand, forming the Nuget plain. Along this side of the island there are few villages and but one or two possible anchoring grounds, and these only during the north-east monsoon. On the north coast there are no harbours; but fairly safe anchorages, even in the north-east winds, are available off Hadibu or under Haulaf, a few miles distant, and at Kallansayia, at the north-west extremity of the island. Kállansayia, Khadup, and Hadibu, all small villages, are the only places of importance in Sokotra. The latter, the capital, is pleasantly situated amid date-palms in a semicircular plain enclosed by spurs of the Haghier mountains. As to the geology of the island, its fundamental rocks are gneisses, through which cut the felspathic granites which form the Haghier *massif*. Through these, again, pierce other granites in dykes or lava flows, and overlying the whole are limestones of Cretaceous and Tertiary age, themselves cut through by later volcanic eruptions. "In the Haghier hills," to quote Professor Bonney, "we have probably a fragment of a continental area of great antiquity, and of a land surface which may have been an 'ark of refuge' to a terrestrial fauna and flora from one of the very earliest periods of this world's history."

From October to May the weather is almost rainless, except in the mountains, where there are nightly showers and heavy mists. During this season the rivers, which are roaring torrents throughout the monsoon, are almost all lost in the dry, absorbent plains before reaching the sea. The temperature of the coastal area varies from 65° F. in the night to 85° F. in the day—in the hot season it may reach 95° F.; and on the mountains (3500 feet), from 52° F. to 72° F. In the low grounds fever of an acute and hematuric form is very prevalent.

Sokotra has claims to be reckoned one of the most ancient incense-supplying countries. Among the "harbours of incense" exploited by various Pharaohs during some twenty-five centuries, it is impossible to believe that the island could be missed by the Egyptian galleys on their way to the "Land of Punt," now identified with Somaliland; nor that, though the roadsteads of the African coast were perhaps oftener frequented, and for other freights besides myrrh and frankincense, the estuaries of Sokotra were neglected, by such ardent explorers as those, for instance, of Queen Hatasu of the 18th dynasty. They would have found on the island, which is probably referred to under the name "Terraces of Incense" (from its step-like contours), the precious "auta trees"—whose divine dew, for use in the service of their gods, was their special quest—in greater abundance and in a larger number of species than any other country.

The ancient trade of Sokotra—aloes, myrrh, frankincense, and dragon's-blood—has greatly declined. It consists now chiefly of *ghi*, or clarified butter from the milk of the large herds of goats and cows domesticated all over the island. It is exported to Zanzibar, Arabia, and Bombay. With the exception of a few patches of millet, tobacco, and cotton, cultivation is unknown. The country forms part of the sultanate of Kishin, in South Arabia. Its governor (usually also called sultan) exercises a mild authority beyond collecting the revenue obtained by a tax on all products. The people live mainly on milk and dates, diversified occasionally by flesh. The population, which may (with some hesitation) be given at about 10,000, is composed of two, if not more, elements. On the coast the people are modern Arabs mixed with negro, Indian, and other blood; in the mountains live the true Sokotri, the indigenes of the island, supposed to be originally immigrants from Arabia, who have been isolated here from time immemorial. Some of them are as light-skinned as Europeans, tall, robust, thin-lipped, straight-nosed, with straight black hair; others are shorter and darker in complexion, with round heads, long noses, thick lips, and scraggy limbs, indicating perhaps the commingling of more than one Semitic people. Their manner of life is rude and simple in the extreme. Their dwellings are circular, rubble-built, flat, clay-topped houses, or caves in the limestone rocks. They are bigoted Mahommedans, yet they rarely or never perform any devotions, and though generally harmless and inoffensive, are disinclined to have dealings with "Kafirs." They speak a language allied to the Mahra of the opposite coast of Arabia. Both Mahra and Sokotri are, according to Dr H. Müller, daughter-tongues of the old Sabæan and Minæan, standing in the same relation to the speech of the old inscriptions as Coptic does to that of the hieroglyphics. The Sokotran tongue has been, he believes, derived from the Mahra countries, but it has become so differentiated from the Mahra that the two peoples can understand each other only with difficulty. Sokotri is the older of the two languages, and retains the ancient form, which in the Mahran has been modified by Arabic and other influences.

The biology of Sokotra has now been sufficiently well investigated to give a correct idea of its relationships. The fauna contains no indigenous mammals. A wild ass which roams the eastern plains, perhaps its oldest denizen, is probably of Nubian origin; while the domestic cattle, a peculiar, unhumped, small, shapely, Alderney-like breed, may be a race gradually developed from cattle imported at a distant period from Sind or Farther India. There are 67 species of birds known from Sokotra, of which 15 are endemic; of 22 reptiles, 3 genera and 14 species are peculiar; and of the land and fresh-water shells, to whose distribution great importance attaches, 44 species out of 47 are confined to the island. Among the other invertebrate groups there is also a large proportion of endemic species. The flora is even more peculiar than the fauna. Aloes, dragon's-blood (*Dracæna*), myrrh, frankincense, pomegranate, and cucumber (*Dendrocycios*) trees are its most famous species. The phanerogams number 570, apportioned to 314 genera, and of these over 220 species and 98 genera are unknown elsewhere. The flora and also (though to a less degree) the fauna present not only Asian and Central African affinities, but, what is more interesting, Mascarene, South African, and Antipodean-American relationships, indicating a very different distribution of land and water and necessitating other bridges of communication than now exist. The history of Sokotra, unravelled by the study of its geology and biology, has been summarized by Professor Balfour as follows: "During the Carboniferous epoch there was in the region of Sokotra a shallow sea, in which was deposited, on the top of the fundamental gneisses of this spot, . . . the sandstone of which we have such a large development in Nubia. . . . During the Permian Sokotra may have been a land surface, forming part of the great mass of land which probably existed in this region at that epoch, and gave the wide area for the western migration of life which presently took place, and by which the eastern affinities in Sokotra may be explained. In early and middle Tertiary times, when the Indian peninsula was an island, and the sea which stretched into Europe washed the base of the Himalayan hills, Sokotra was in great part submerged and the great mass of limestone was deposited; but its higher peaks were still above water, and formed an island, peopled mainly by African species—the plants being the fragmentary remains of the old African flora—but with an admixture of eastern and other Asian forms. Thereafter it gradually rose, undergoing violent volcanic disturbance."

By this elevation "Madagascar would join the Seychelles, which in turn . . . would run into the larger Mascarene Islands. In this way, then, Africa would have an irregular coast-line, prolonged greatly south of the equator into the Indian Ocean, and running up with an advance upon the present line until it reached its north-west limit outside and south of Sokotra. Thence an advanced land surface of Asia would extend across the Arabian Sea into the Indian peninsula." Sokotra thus "again became part of the mainland, though it is likely for only a short period, and during this union the life of the adjacent continent covered its plains and filled its valleys. Subsequently it reverted to its insular condition, in which state it has remained." The Antipodean American element in the Sokotran flora probably arrived *viâ* the Mascarene Islands or South Africa from a former Antarctic continent.

AUTHORITIES.—JAMES JACKSON. "Sokotra: Notes Bibliographiques," in *La Revue de Géographie*, Paris, 1892, gives a very complete bibliography up to that date. *Bulletin of the Liverpool Museums*, vols. ii. and iii., 1899 1900. *Geographical Journ.*, London, 1899, vol. xiii. pp. 633, 638. (H. O. F.)

Soleure, one of the Swiss cantons. Its area is 305½ square miles. Of this, 298 square miles are reckoned as "productive," 112½ square miles being covered by forests, and ·3 square miles by vineyards, the remaining 185·2 square miles being arable or meadow land. The population was 80,362 in 1880 and 85,621 in 1888, while in 1900 it was 100,762. In 1900 there were 352 inhabitants per square mile. The people are mainly German-speaking, a comparatively few speaking French and still fewer Italian. Roman Catholics are in a decided majority, their proportions to Protestants being roughly as 3 to 1.

In 1897 the cantonal revenue was 2,265,087 francs (a rise of 39 per cent. since 1885) and the expenditure 2,258,339 francs (a rise of 31⅔ per cent. since 1885), while in 1898 the surplus was 11,182 francs. In 1897 the public debt was 9,813,000 francs. The existing political constitution dates from 1887, while in 1895 proportional representation was introduced as regards the elections to the cantonal legislature. The principal changes are that the executive is now elected direct by the people, while both its members and those of the legislature hold office for four years only. The "Obligatory Referendum" and the "Initiative" as regards laws date from 1875, and the Initiative as to amendment of the cantonal constitution from 1856. The canton is divided into 5 administrative districts. In 1888 the capital, Soleure, had 8317 inhabitants (of whom 5612 were Roman Catholics, a number

increased in 1900 to 10,095; while Olten in 1888 had 4899 (3009 Roman Catholics), and in 1899, 6996. In 1896 the pastures of the canton were 209, of an estimated capital value of 2,395,215 francs and capable of supporting 4179 cows.

AUTHORITIES.—AMIET. *Das St Ursus Pfarr-Stift d. Stadt S.* 6 parts. Soleure, 1878–90.—BLOCH. *Bilder aus d. Ambassadorenherrschaft in S. (1554–1791).* Biel, 1898.—SCHUPPLI. *Geschichte d. Stadtverfassung von S.* Basel, 1897.—STROHMEIER. *Der Kant. S.* St Gall and Bern, 1836.—STRÜBY. *Die Weidewirthschaft im Kant. S.* Soleure, 1896. (W. A. B. C.)

Solingen, a town of Prussia, in the Rhine province, 20 miles north-north-east of Cologne by rail. It is the centre of the cutlery manufacture of Germany. Dorp was incorporated with it in 1889. Population (1885), 31,926; (1900), 45,249.

Solola, chief town of a department of Guatemala, Central America, picturesquely situated on a lofty plateau on the northern shore of Lake Atitlan, 46 miles west-north-west of Guatemala. It is the ancient capital of the Cakchiquel Indians, whose descendants are still its chief inhabitants. It has manufactures of cloth and potteries. Population, 12,000.

Somaliland, a country of East Africa, so named from its Somal inhabitants. It is also known as the "Eastern Horn of Africa," because it projects somewhat sharply eastwards into the Indian Ocean, and is the only section of the continent which can be at all spoken of as a peninsula. In general outline it presents the appearance of an irregular triangle, with apex at Cape Guardafui, which is the easternmost point of the continent, and is continued seawards through a line of reefs and rocks to the island of Sokotra. From the apex the north side extends for over 600 miles along the south shore of the Gulf of Aden westwards to Tajura Bay, and the east side skirts the Indian Ocean for about 1400 miles south-westwards to the mouth of the Juba river at the equator, while the less clearly marked base merges gradually landwards in the Ethiopian uplands between the equator and Tajura Bay. The vast triangular space thus roughly outlined has a total area which is approximately estimated at over 400,000 square miles, with a population of about 1,250,000, and has (1884–97) been partitioned by various international agreements between Great Britain, Italy, France, and Abyssinia as under:—

	Area in Square Miles.	Population.
British Somaliland:		
1. North Coast Protectorate .	68,000	200,000
2. South Somaliland attached to British East Africa .	100,000	250,000
French Somaliland . . .	50,000	100,000
Italian Somaliland . . .	100,000	400,000
Abyssinian Somaliland . .	100,000	300,000
Total . . .	418,000	1,250,000

Although the country had been visited at various points by a few travellers, such as Speke, Burton, Cruttenden, Révoil, and van der Decken, it was still practically an unknown land until the early 'eighties. But its systematic exploration, begun in 1883 by James Aylmer and Lort Phillips, has since made steady progress, and before the close of the 19th century the whole region had been traversed in several directions by Bottego, Ruspoli, Swaine, Cavendish, Donaldson Smith, Parkinson, Pease, Wickenburg, and Léontieff. Much no doubt remains to be done, and extensive tracts, especially west of the lower Juba, have not yet been even visited. But nothing of importance is left to be discovered by future travellers: the course of all the large rivers has been fairly accurately determined; many points in the interior have been astronomically fixed, and the main geographical features of the land clearly mapped out.

Physical features.

From the rough surveys made in various places, it appears that the whole region is characterized by a remarkable degree of physical uniformity, and may be broadly described as a vast plateau of moderate elevation, which is enclosed westwards by the Ethiopian highlands and northwards by an inner and an outer coast range, skirting the south side of the Gulf of Aden in its entire length from the Harrar uplands to Cape Guardafui. In the interior the plateau is nowhere traversed by any great mountain ranges, and everywhere presents the same monotonous aspect of a boundless steppe clothed with a scanty vegetation of scrubby plants and herbaceous growths.

The incline is uniformly in the direction of the south-east, and apart from the few coast streams that reach the Gulf of Aden during the rains, all the running waters are collected in three fluvial arteries—the Nogal in the north, the Webi Shebeli in the centre, and the Juba in the south—which have a parallel south-easterly direction towards the Indian Ocean. But so slight is the precipitation, the mean annual rainfall scarcely exceeding 8 or 10 inches, that the Juba alone has a permanent discharge seawards. The Nogal sends down a turbulent stream during the freshets, while the Shebeli, notwithstanding the far greater extent of its basin, never reaches the sea at all. At a distance of about 12 miles from the coast it is intercepted by a long line of dunes, which it fails to pierce and is thus deflected southwards, flowing in this direction for nearly 170 miles parallel with the coast, and then running out in a swampy depression before reaching the Juba estuary. The plateau appears to consist technically of a huge mass of Archæan rocks, mainly gneisses and schists, on the profoundly eroded surface of which have been deposited extensive sedimentary beds of Cainozoic age and eruptive matter of various dates, but all post-Jurassic. Limestones and sandstones prevail in many places, and the limestones of the lower Juba valley are believed to be part of a band which once extended from the Jurassics of British and German East Africa to those of Abyssinia. The Somali gneisses are similarly connected with the typical Archæan series of East Africa. The continuity of these geological systems was probably interrupted in Jurassic times, when the Somaliland plateau, without having ever been below the sea, was sufficiently depressed to allow the marine waters to penetrate, as a strait, far inland between the Eastern Horn and the Mau tableland to the south-east of Lake Rudolf. For details of climate, natural history, and other features, see British and Italian Somalilands below; and for the general characteristics and social institutions of the inhabitants, see article SOMÂLI in the ninth edition.

Inhabitants.

From the explorations of Mr Seton-Karr and others, Somaliland would appear to have been undoubtedly inhabited by primitive man of the early Stone period. His rude flint implements, of the same types as those occurring in Egypt, Mauritania, and Europe, have been found in various parts of the British protectorate, and according to some observers their manufacture has survived down to comparatively recent times. Other, but much later, remains are the round tumuli of undressed stone, generally 10 feet in circuit and 10 feet high, which are locally called "Galla graves," although also met with in the Beja country north of Abyssinia, where no Gallas are known to have ranged. Whether the present inhabitants of the land are the direct descendants of the forgotten race by which these monuments were erected it is impossible to say. But in any case they may claim a very long pedigree, for they have been identified beyond reasonable doubt with the people of Punt already known to the Egyptians of the early dynasties. They were in fact ethnically allied to those historic Egyptians, both being members of the vast Hamitic family, which may be regarded as the absolutely indigenous element in the whole of Africa north of the Negro domain. Together with the kindred Gallas, Afars (Danakil), Agaus, Bejas, and Egyptians, the Somali constitute the Eastern or Ethiopic branch of the Hamitic stock, and their languag is shown to be a

branch of the widespread Hamitic linguistic family. (See AFRICA: *Ethnology*.) But the present Somali peoples are not pure Hamites by any means, and the physical characters vary considerably according as the race has in course of ages been affected by contact at different points with the surrounding populations—Arabs, Abyssinians, Afars, Gallas, Bantus, and Negroes. Nevertheless, viewed as a whole, and despite a distinctly dark complexion everywhere conspicuous though varying in degree, they may be fairly described as one of the very finest groups of Caucasic man, tall of stature, with graceful pliant figures, regular and often extremely handsome features far above the average European type.

The Somali have no kind of political or even social cohesion, and are still divided into a multiplicity of *rers* or *fakidas* (tribes, clans), which are further complicated by manufactured genealogies, vague traditions, and legendary matter often inspired by the vanity or ambition of powerful chiefs. Hence all attempts at classification have hitherto failed; and even the schemes prepared by Major Abud, although possessing semi-official sanction, are not only very incomplete, but also in places untrustworthy. Three main divisions, however, have been clearly determined, and these are important both on political and ethnical grounds:—I. The HASHIYA (Abud's *Asha*), with two great subdivisions: *Daroda*, with the powerful Mijertins, War-Sengeli, Dolbohanti, and others; and *Ishak*, including the Gadibursi, Issa (Aissa), Habr-Awal, Habr-Tol, Habr-Yuni, Babilli, Bertiri. All these claim descent from a chief "Arab" by name, a member of the Hashim branch of the Koreish (Mahommed's tribe), who came over in the 12th century and founded a powerful but evanescent empire, with capital at Meit, in the Zeila district. All are Sunnites, and, although still speaking their Somali national tongue, betray a large infusion of Arab blood in their oval face, somewhat light skin, and remarkably regular features. Their domain comprises the whole of the British North Coast, and probably most of the Italian East Coast, Protectorates. II. The HAWIYA, with numerous sub-groups, such as the Habr-Jalet, Habr-Gader, Rer-Dollol, Daji, Karanlé, Badbadan Kunli, Bajimal, and Ugass-Elmi; mostly fanatical Mahommedans forming the powerful Tarika sect, whose influence, like that of the Wahabites formerly in Arabia, is felt throughout all the central and eastern parts of Somaliland. The Hawiya domain comprises the Ogaden plateau and the region generally between the Webi-Shebeli and Juba rivers. Here contact has been chiefly with the eastern Galla tribes, with whom political alliances have even been contracted. III. The RAHANWIN, with numerous but little known sub-groups, including, however, the powerful and warlike Abgals, Barawas, Gobrons, Tuni, Jidus, and Kalallas, occupy a vast domain extending from the Juba to the Tana, where they have long been in contact, mostly hostile, with the Wa-Pokomo and other Bantu peoples of the East Africa Protectorate. Hence of all the Somali divisions the Rahanwin betray the largest infusion of negroid blood, as shown in their flat features, small nose, and very dark complexion.

SOMALILAND, BRITISH.—For some years before the Mahdist revolt the whole of the North Somali coastlands had been included in the khedival possessions. Several stations, such as Zeila, Bulhar, and Berbera, as well as Harrar, at the converging point of the Abyssinian, Galla, and Somal territories, were held by Egyptian garrisons. But in 1884 all these garrisons had to be withdrawn, being needed for the defence of the Egyptian frontiers already threatened by the Mahdi's forces. It was then that Great Britain interfered, and, partly to save the country from relapsing into barbarism, partly to prevent its occupation by other Powers, by which the overland route to the East might be menaced, took possession of the vacated stations along the north coast nearly as far as Cape Guardafui. Thus was constituted the present "Somali Coast Protectorate," which was recognized by all the other interested Powers, and delimited by various international conventions, such as the Anglo-French agreement of 1888, the Anglo-Italian treaties of 1891 and 1894, and the arrangement of 1897 with Abyssinia, full details of which are given below under *French* and *Italian* SOMALILAND, and also under ABYSSINIA. It is important to notice that under the Italian treaty of 1894 Great Britain reserved the southern section of the Somali seaboard between the Juba and the Tana rivers, but included that region which extends inland as far as Logh on the Juba, not in the Somali Coast Protectorate, but in the East Africa Protectorate between Uganda and the Indian Ocean. Thus is explained the statement that the whole of the Somal territory under British rule, for which there is no collective official name, is very much larger than the northern section known as the Coast Protectorate. Before 1897 this protectorate had a total area of only 75,000 square miles, and was further reduced to 68,000 square miles when certain western tracts were ceded to Abyssinia in that year. The north-western boundary no longer reaches Gildessa, near Harrar, as formerly, but is marked in this direction by the Somadu heights, on the Anglo-French frontier. The vast central plateau of Ogaden is also ceded to Abyssinia, which, however, has hitherto failed to maintain order amongst the fanatical Moslem natives of this region, as shown by the outbreak of 1901, which had to be suppressed by a British force ascending the river Juba from the East Africa Protectorate. On the north side the Somali Coast Protectorate extends along the Gulf of Aden for a distance of about 400 miles from the Lahadu Wells, near Jibuti, in the west, to Bandar Ziyada, 4 9° E., some miles west of Cape Guardafui, and stretches from the coast inland for a mean breadth of perhaps 200 miles. A considerable number of the inhabitants (about 50,000) are settled in the coast towns, and as all the rest are pure nomads, with camping-grounds but scarcely any permanent inland stations, the total population would appear to fall short of 250,000.

Physical features.

Physically the protectorate has a distinctive character, and may be described as almost mountainous in contrast with the somewhat monotonous plains of the interior. Between the Harrar plateau and Cape Guardafui the coast ranges maintain a mean altitude of from 4000 to 5000 feet, and fall generally in steep escarpments down to the narrow strip of sandy lowlands skirting the Gulf of Aden. At some points the rugged cliffs, furrowed by deep ravines, approach close to the sea; elsewhere the hills recede abruptly inland, leaving a considerable maritime plain between their base and the shore line. South of Berbera, which faces Aden on the opposite side of the gulf, are developed two ranges which run nearly parallel with the coast, and increase in elevation landwards, culminating in the inner and loftier range in the Gan Libash ("Lion's Paw"), about 9500 feet high. Southwards the slopes fall somewhat gently towards the central plains, which are at first dotted with a few clumps of mimosa, and farther on present the aspect of an interminable treeless steppe. Eastwards the mountain system maintains the same general character as far as Bandar Gori, where the precipitous northern cliffs approach to within 200 or 300 yards of the gulf, their bare brown rocks and clays presenting the same uninviting appearance as the light brown hills skirting the Red Sea. But in the valleys between the two parallel ridges, which here stand at an altitude of from 6000 to 7000 feet, the dreary aspect of the coast scenery is succeeded by a relatively rich vegetation of bush, jungle, and herbage, with a luxuriant growth of gummiferous and aromatic plants. Low trees and jungle range to a considerable height above the valleys on the northern slopes of the inner range, which here falls in a series of terraces down to the Wady Nogal. The prevailing formations appear to be granites which are veined with white quartz, and underlie old sedimentary brown sandstone and limestone formations. There are no traces of recent igneous disturbances, but old erupted matter occurs at intervals, and the volcanic heights, as well as the general character of the ranges, resemble those of the South Arabian uplands on the opposite side of the gulf.

Climate, flora, fauna.

The climate also is much the same—dry and hot, with but slight changes from season to season. Thus on the coast the winter temperature ranges from 75° to 80° F., while that of summer rarely exceeds 86° F., the extreme deviation for the whole year being little more than about 20° F. Although the protectorate lies within the track of the north-east monsoons dominant from October to March, the currents are so frequently deflected from their normal course by changes of barometric pressure or temperature that the winter rains are seldom copious. But the summer monsoons prevalent from April to July or August are often accompanied by fierce hurricanes and tremendous downpours, by which the sparse vegetation is revived, while the usually waterless wadys are for the time transformed to raging coast torrents. But the mean annual rainfall, thus unevenly distributed, probably falls below 30 inches, and is also largely confined to the slopes of the ranges by which the moisture-bearing clouds are intercepted. As in South Arabia, these slopes are the proper home of the aromatic flora which yields the myrrh and frankincense of commerce, and for which these

regions have been famous throughout historic times. Highly characteristic are the *Olibanum*, a member of the *Boswellia* genus, from which are obtained odoriferous resins in abundance, and the *Balsamodendron Myrrha*, which exudes a gum resin in round masses called "tears," varying in size from small grains to lumps as large as an egg, and of a semi-transparent reddish-brown colour. On the plains, which receive a minimum supply of moisture, little flourishes except a poor scrubby flora of thorny acacias and mimosas scattered thinly over wide areas. The coast districts have been so frequently visited by sportsmen in recent years that most of the characteristic wild fauna have withdrawn farther inland. Nevertheless lions, leopards, hyænas, wild asses, gazelle and other antelopes, jackals, the dog-faced ape, and even elephants, are still met in the more remote districts. Hares and other rodents are common on the coastlands, which are also enlivened by the jumping-shrews, which at a little distance look exactly like diminutive kangaroos hopping about in search of the insects on which they prey. The lizard family is represented by the *Agama Rüppellii*, which changes colour when pursued, and by the still more curious *Uromastix batilliferus*, another species of Agama which disappears in the clefts of the rocks, leaving nothing to be seized except the tip of a tail bristling with sharp spines. The Somali have little knowledge of the horse, which appears to be of recent introduction, and their chief domestic animals are the camel and the ass, both of prime stock. The camels make excellent mounts, swift and hardy; and the extensive caravan trade is everywhere carried on exclusively by means of these pack-animals, the natives being too proud to be treated as beasts of burden, like their Bantu and Negro neighbours.

Chief towns.

In the northern coastlands most of the Hashíya "sultans" have already accepted the British protectorate, which affords them the best security for the stability of their power. They are beginning to call themselves "British subjects," and show a growing disposition to submit their incessant tribal wranglings to the British authorities at Berbera. This place, which is said to have been founded by the Ptolemies amongst the "Barbari" of the surrounding coastlands, is the capital and chief seaport of the protectorate. It is by far the largest centre of trade and population in the whole of Somaliland, with a population in the trading season of about 30,000. Berbera stands at the head of a deep inlet, which forms the only sheltered haven on the south side of the Gulf of Aden. Recently extensive harbour works have been completed, and there are now two lighthouses, piers, warehouses, a strong fort, hospital, barracks, and an aqueduct seven miles long, which supplies the town with a copious stream from the neighbouring hills. About 45 miles farther west is the exposed port of Búlhar, which, however, is conveniently situated for the caravan trade. It has a permanent population of 12,000, and the district yields an abundance of good pasture. Close to the French frontier on the same coast stands the flourishing seaport of Zeila, with a present population of 15,000. It has been proposed to construct a railway from this place, or from Búlhar, through Harrar to Abyssinia. But these projects seem to have been suspended by the rapid execution of the line running from Jibuti through French territory in the same direction.

The protectorate, which since 1884 had been attached for administrative purposes to the government of Bombay, was constituted a Crown colony in October 1898. In 1900 the revenue and expenditure were Rs.3,85,884 and Rs.3,40,092 respectively; the imports (Berbera and Búlhar) Rs.33,15,651, (Zeila) Rs.34,71,904; the exports from same places, Rs.28,71,902 and Rs.30,12,712. The imports are chiefly rice, piece-goods, shirtings, and dates; the exports skins and hides, ostrich feathers, gums, civet, cattle, and sheep.

AUTHORITIES.—Prince NICOLAS DE GHIKA. *Cinq Mois au Pays des Somalis.* Geneva, 1898.—F. B. PEARCE. *Rambles in Lion Land: Three Months in Somaliland.* London, 1898.—C. V. A. PEEL. *Somaliland.* London, 1899.—Count J. POTOCKI. *Sport in Somaliland.* (Trans. from the Polish.) London, 1899.—H. G. C. SWAYNE. *Seventeen Trips through Somaliland.* London, 1895. (A. H. K.)

SOMALILAND, FRENCH, a possession of France on the Gulf of Aden, at the entrance to the Red Sea. Its limits are Ras Doumeira, on the strait of Bab el Mandeb, and Ras Goumarlé, between Zeila and the Gulf of Tajura. This coast is arid, and on the south is bordered with plains 500 feet high, but inland there are some cultivated spots on marshy ground. The territory is about 40 miles long and 125 broad, with a population estimated at about 22,000. The climate is very hot. The port of Obock, one of the centres of this possession, was bought from Turkey in 1855 for £2000 by M. Lambert, then French consul at Aden. The acquisition was ratified in 1861, after a journey by Admiral Fleuriot de Langle. A French factory was erected at the port in 1881, and depôts for victuals and coal for war-vessels were installed in 1883. In that year Sagallo was ceded to France; in 1884, Tajura; and in 1885, Ambabo. In 1887 the territory was delimited by agreement with Great Britain; and in 1888 a port was created at Jibuti, whither the administrative services were transferred, and the commencement of the works on the railway to Harrar conferred real importance on the place. The expenditure of France on the Somali coast (budget of 1900) was 337,500 francs. The local budget for 1899 balanced at 650,000 francs. The colony of Obock, together with the protectorates of other districts, is administered by a governor, who resides at Jibuti. The centres of population are Jibuti (15,000 inhabitants, of whom 2500 are Europeans), Obock, Sagallo, Tajura (2000), Ambabo, and Gobad. The native population is either of the Danakil or of the Galla race. The produce of the soil is almost *nil*. On the coast, turtle and mother-of-pearl fishing are carried on. The country exports mother-of-pearl, gum, coffee, emery, hides, ivory, and gold. The prosperity of Jibuti is due to its position at the head of the best route towards Harrar and Addis Ababa, but it will not be real until the railway is completed. In January 1902 the first 125 miles of the railway from Jibuti to Harrar were open for traffic. At the distance of 340 miles north of Obock, on the Red Sea, is the Bay of Adulis, ceded to France under the Second Empire by Tigre, but not occupied.

AUTHORITIES.—*L'Année Coloniale*, 1900.—HENRIQUE. *Les Colonies Françaises (Obock).* Paris, 1889.—SOLEILLET. *Obock.* Paris, 1886.—DE SALMA. *Obock.* Paris, 1893.—HAMY. *La Mission Revoil au Pays Somali.* Paris, 1882. (P. L.)

SOMALILAND, ITALIAN.—By various arrangements with native sultans in 1889 the African coast as far as Cape Guardafui to the north, and as far as Bandar-Siyada (49° E.) on the Gulf of Aden, fell within the Italian sphere of influence. On 19th November 1899 the Italian Government notified the Powers that it had assumed the protectorate over the East African coast from the northern limit of the territory of Kismayu (0° 14′ 30″ S., 42° 38′ 50″ E.) to 2° 30′ N. for the stretches recognized as intermediate between the stations belonging to the Sultan of Zanzibar. Finally, by a treaty dated 12th August 1892, the Sultan of Zanzibar made over to Italy for a term of fifty years, and in exchange for an annual payment of Rs.160,000 (subsequently reduced to Rs.120,000), all his rights over the ports of Barava, Marka, Mukdishu, and Warsheikh. In pursuance of this treaty and of the Anglo-Italian protocol dated 24th March 1891, the East African littoral from the Juba valley to Bandar-Siyada was recognized as an Italian sphere of influence, under the name of Italian Somaliland. Towards the interior the boundary of this sphere followed the course of the Juba as far as 6° N., and thence coincides with that parallel as far as 35° E., and with the 35th meridian up to the point where it intersects the Blue Nile. On the Gulf of Aden the internal frontier is marked by a line which, starting from Gildessa and proceeding towards 8° N., follows the north-eastern limits of the Girri, Bertiri, and Rea Ali territories, including in the Italian sphere the villages of Yaldessa, Darmi, Gig-Giga, and Milmil. On reaching 8° N. the line coincides with that parallel as far as 48° E., whence it turns north-east to the point of intersection of the 9th parallel N. with the 49th meridian E. and follows the latter meridian to the sea at Bandar-Siyada (Anglo-Italian protocol of 5th May 1894). By the same protocol the port of Zeila and the station and territory of Kismayu were recognized as belonging to Great Britain, but equality of rights and treatment for British and Italian subjects was established. The

Italo-Abyssinian treaty, signed at Addis Abbaba in the summer of 1897, stipulated that the interior of Italian Somaliland should belong to Abyssinia up to within forty miles from the coast, and that the station of Lugh should be made over to the Negus.

Information concerning the interior of Italian Somaliland is scarce and uncertain. To the north it is inhabited by the Ogaden Somali, and to the south by the Arusi and the Boran, which are more properly classified as Galla tribes. The soil, which rises rapidly in successive plateaux from the sea, is considered especially fertile in the great valleys of the Juba (Ganana), Webbi, and Wady Nogal, which, descending from the Ethiopian Alps, traverse the country from north-west to south-east. In other districts lack of water impedes cultivation, though after the rains pasturage is abundant, and resinous plants are so varied and numerous as to justify the ancient name. The climate on the plateaux is temperate and healthy, but near the streams malaria and enteric fever prevail. The temperature in the interior oscillates between 60° and 86° Fahr., but along the coast rises to 104°. Continual breezes, however, render this temperature tolerable for Europeans. Along the coast live a number of Arabs and several tribes of mixed Arabo-Somali blood, of which the Amaran tribe is the principal. These Arabs are a residuum of the dominion of the Imam of Muskat, which lasted from 1698 to 1856. The languages spoken in Italian Somaliland are Arab, Somali, and Suaheli. The Somali profess the Mussulman religion, but do not strictly interpret the injunctions of the Koran.

The chief towns of Italian Somaliland are: *Brava*, with about 4000 inhabitants, belonging for the most part to tribes of the interior. It was destroyed in 1840 by Ibrahim of Bardera and repeopled by Sheikh Yusuf, who in 1843 invaded Bardera, razing it to the ground and putting its inhabitants to the sword.

Marka (Merca), situated at 1° 42′ 05″ N., 44° 53′ 50″ E., with about 5000 inhabitants, and a trade from the interior in cotton, coffee, maize, butter, and skins.

Mukdishu (Mogadishu), 2° 01′ 50″ N., 45° 24′ 40″ E., is formed of the villages of Shangani and Hamerain, which together number 6000 inhabitants. An ancient tower recalls Portuguese rule (1529–1698). In the neighbourhood gold and silver objects have been found, together with money and domestic utensils, which bear witness to an ancient civilization long since swept away.

Warsheikh, 2° 19′ 45″ N., 45° 53′ 50″ E., has about 3000 inhabitants. A natural channel allows ships of all sizes to approach to within 700 or 800 yards of the coast, but the bay is only practicable during the north-east monsoon.

Itala, a station established by Captain Filonardi, in the belief that it was a good port, but subsequently abandoned.

Obbia, 5° 22′ N., 48° 30′ E., residence of Sultan Yusuf Ali Yusuf, and *Alula*, residence of the Sultan Osman Mahmud, are two large villages, well kept, and inhabited by tribes which are distinguished from other Somalis by the mildness of their disposition. Considerable trade in ostrich feathers is carried on.

Along the coast are to be noted the minor villages of Coriale, Gondersha, Gellib, Akari, Galwin, Gelidi, Torre, Munghia, &c., and the station of Yub (Yumbo), at the mouth of the Juba. In the interior is situated *Lugh*, a populous city on the left bank of the Ganana, about 240 miles from the coast; visited for the first time by Captain Bòttego in 1893. The Sultan of Lugh applied for Italian protection in June 1895, but the city and territory are still a subject of contention between Italy and Abyssinia. For the time being Italians and Abyssinians enjoy parity of treatment there.

Benadir Company. The part of Italian Somaliland known as *El Benadir* (the ports), comprising Yub, Brava, Marka, Mukdishu, and Warsheikh, was ceded for three years to the Filonardi Commercial Company by way of experiment. In 1896 the Italian Benadir Trading Company Limited (Società Anonima Commerciale Italiana del Benadir), formed at Milan with £40,000 capital, should have replaced the Filonardi Society in the administration of the Benadir coast; but on 26th November 1896 the Italian consul, Captain Cecchi, who was preparing to inaugurate the new régime, was killed in an ambush at Lafolè, and the consequent disturbances hindered for a time the installation of the new company. On 1st May 1898 the Italian Government, however, concluded a convention with the Benadir Company, granting to it the administration of the Benadir ports until 16th July 1946, with a subsidy of £16,000 annually for the first twelve years, and of £14,000 from 1910 until the expiry of the convention. The Government retained the option of denouncing the convention on 16th July 1921, subject to two years' notice. The company was given the right to collect taxes and customs, to exploit mines, to occupy territories in Italian possession, to obtain from Government arsenals at cost price the arms and munitions of war necessary for the safety of the colony, and to enjoy in the port of Kismayu all the facilities specified in the Anglo-Italian protocol of 24th March 1891 (Art. 3). The company for its part, undertook to develop the colony; to pay to the Sultan of Zanzibar an annual tribute of 120,000 rupees; to maintain at least 600 guards for the protection of the stations; to administer justice, respect existing laws and treaties, apply the provisions of the Berlin and Brussels Conventions, and to assume the postal service. The Italian Government explicitly declined to guarantee any operations of credit entered into by the company, or to consent that the convention with the company, or the privileges therein specified, be ceded to any third party. During the year 1896–97 the total value of the Benadir trade was £120,000, and since then it has continually increased. The chief imports are petroleum, rice, and textile fabrics; the exports are ivory, cattle, butter, cotton, dhurra, gum, myrrh, and skins.

See *L'Omo: Viaggio di esplorazione nell' Africa orientale, narrato da L. Vanutelli e C. Citerni.* Milan, 1899. (L. Me.)

Somersetshire, a south-western maritime county of England, is bounded on the E. by Wilts, on the N.E. by Gloucester, on the N. and N.W. by the Severn and the Bristol Channel, on the W. and S.W. by Devon, and on the S.E. by Dorset.

Area and Population.—The area of the ancient county is 1,043,485 acres, or 1630 square miles, with a population in 1881 of 469,109; in 1891 of 484,337, of whom 225,754 were males and 258,583 females; and in 1901 of 508,104; the number of persons per square mile being 312, and of acres to a person 2·05. The area of the administrative county, as given in the census returns of 1891, was 1,039,106 acres, with a population of 386,866, or, including the county borough of Bath, 1,042,488 acres, with a population of 438,760; but since then certain changes have been made in the administrative area. In 1895 the parishes of Goathill, Poyntington, Sandford Orcas, Seaborough, and Trent were transferred from Somerset to Dorset, the parts of the parishes of Maiden Bradley with Yarnfield and Stourton with Gaspar in Somerset to Wilts, and the parish of Wambrook from Dorset to Somerset; and in 1896 the parish of Church-Stanton was transferred from Devon to Somerset, and the parish of Kilmington from Somerset to Wilts. The area of the registration county is 1,061,614 acres, with a population in 1891 of 510,076, of whom 219,021 were urban and 291,055 rural, and in 1901 of 466,126, of whom 215,693 were males and 250,433 females. Within the registration area the percentage of increase between 1881 and 1891 was 3·84. The excess of births over deaths between 1881 and 1891 was 59,729, and the actual increase of population was 18,851. The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	3163	15,033	8935	359	327
1890	3269	14,114	8909	252	265
1898	3686	14,064	8167	225	234

In 1899 the number of marriages was 3226, of births 11,386, and of deaths 7823.

The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years:—

	1870-79.	1880.	1880-89.	1890.	1888-97.	1898.
Marriage-rate	13·3	12·9	13·0	12·9	13·4	14·1
Birth-rate	30·9	30·6	29·6	27·7	27·8	26·9
Death-rate	19·4	18·2	17·4	17·5	16·5	15·6
Percentage of illegitimacy	4·7	4·6	4·3	3·7	3·7	3·3

The birth- and death-rates and the percentage of illegitimacy are all below the average. In 1891 there were in the county 1484 natives of Scotland, 2234 natives of Ireland, and 1049 foreigners.

Constitution and Government.—The parliamentary and judicial arrangements remain as stated in the earlier article on the county. The administrative county includes seven municipal boroughs: the city of Bath (49,817 in 1901), Bridgwater (15,209), Chard (4437), Glastonbury (4016), Taunton (21,078), Wells (4849), and Yeovil (9838). Bath is a county borough. The following are urban districts: Burnham (2897), Clevedon (5898), Crewkerne (4226), Frome (11,055), Highbridge (2234), Ilminster (2287), Midsomer Norton (5811), Minehead (2511), Portishead (2544), Radstock (3365), Shepton Mallet (5238), Street (4018), Wellington (7282), Weston-super-Mare (19,047), and Wiveliscombe (1417). The ancient county, which corresponds closely with the diocese of

Bath and Wells, contains 501 ecclesiastical parishes and districts and parts of 3 others.

Education.—At Wellington there is a board school for blind children. The total number of elementary schools in the county on 31st August 1898 was 552, of which 106 were board and 446 voluntary schools, the latter including 410 National Church of England schools, 8 Wesleyan, 6 Roman Catholic, and 22 "British and other." The average attendance at board schools was 17,268, and at voluntary schools 46,224. The total school board receipts for the year ended 29th September 1898 were £67,590. The income under the Agricultural Rates Act was over £3576.

Agriculture.—Nearly five-sixths of the total area of the county is under cultivation, but about three-fourths of this is in permanent pasture, an exceptionally large number of cattle, especially cows, being kept, while many sheep are also grazed both on the lower grounds and the hill pasture, of which there are over 50,000 acres. Orchards, chiefly of apple-trees for cider, occupy 25,000 acres, and over 45,000 are under woods. The Exmoor district is still tenanted by wild deer, and there is also a special breed of ponies peculiar to the district. The acreage under corn crops has within recent years largely decreased. Wheat occupies about five-twelfths of this acreage, and barley and oats usually about one-fourth each, oats having the largest acreage of the two, Of the acreage under green crops, about one-half is occupied by turnips and swedes, about one-fourth by mangold, and about one-tenth by potatoes.

The following table gives the larger main divisions of the cultivated area at intervals from 1885 :—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1900	867,469	115,005	61,650	58,863	625,957	5434
1885	868,721	109,607	55,639	53,567	643,937	5112
1890	860,649	94,628	52,116	54,486	653,435	5045
1895	854,538	97,333	49,111	50,139	654,659	2615

The following table gives the numbers of the principal live stock for the same years :—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1885	34,848	236,899	110,068	601,020	111,719
1890	34,895	235,742	107,513	596,637	137,849
1895	37,693	221,117	104,111	538,757	140,857
1900	35,981	239,663	106,210	519,670	118,884

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 37,164, as compared with 34,975 in 1896. Of these 4687 were employed in textile factories, woollen and worsted industries employing 1791, and linen, &c. (at Crewkerne, Taunton, and Shepton Mallet), 1096 ; there is now a considerable lace manufacture, chiefly at Chard. Non-textile factories employed 25,281 persons, the percentage of increase between 1895 and 1896 being 7·5, while between 1896 and 1897 it was 9·2. Of these, 2770 were employed in the manufacture of paper, &c., 8324 in clothing industries, 2553 in the manufacture of machines, &c. (including carriages, agricultural implements, spades, shovels, and edge tools), 2023 in tobacco and snuff industries, 1446 in clay and stone industries (including bricks, drain tiles, and the well-known bathbrick), 1227 in wood industries, and 1121 in drink industries. Of the 7196 persons employed in workshops, 3582 were employed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1899 was 6864. The same year 480,158 tons of limestone were raised, 178,153 tons of clay, 58,910 tons of sandstone, 5970 tons of gravel and sand, 9866 tons of ochre, 5875 tons of gypsum, 1750 tons of slate, 475 tons of sulphate of strontia, and 9866 tons of manganese ore. Lead mining has now almost ceased. 921,870 tons of coal, valued at £464,776, were raised in 1890 ; 983,973 tons, valued at £541,185, in 1899.

The Bristol Channel and Bridgwater Bay abound in varieties of white and shell fish, and salmon and herring fishing are also carried on, the principal fishing stations being Porlock, Minehead, and Watchet ; but since in the return relating to sea fisheries they are not included amongst the fishing ports at which fish are landed, no statistics are available.

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Somersworth, a city of Strafford county, New Hampshire, U.S.A. It is situated in the south-eastern part of the state, on Salmon Falls river, which separates it from the state of Maine, and on the Boston and Maine Railroad. It has an excellent water-power in Salmon Falls river, and this is turned to account in extensive manufactures. Population (1890), 6207 ; (1900), 7023, of whom 3166 were foreign-born.

Somerville, a city of Middlesex county, Massachusetts, U.S.A. It is situated in 42° 22′ N., 71° 05′ W., on the river Mystic, adjoining Boston, of which it is a suburb, and with which it is connected by many lines of steam and trolley railways. Its streets are macadamized or gravelled. It is an active manufacturing city; the census of 1900 showed that it contained 378 manufacturing establishments, with a total capital of $10,131,596. They employed 4342 hands, and the product was valued at $21,776,511. Its assessed valuation in 1900 was $52,578,200, the net debt was $1,828,000, and the rate of taxation was $16 per $1000. Population (1890), 40,152; (1900), 61,643, of whom 17,232 were foreign-born and 140 negroes. Of 18,148 males 21 years of age and over, 490 were illiterate (unable to write).

Somme, a department on the north coast of France, taking its name from the river running through it from south-east to north-west.

Area, 2423 square miles. The population, 550,837 in 1881, numbered only 534,101 in 1901. The births in 1899 were 11,670, of which 1715 were illegitimate ; deaths, 12,832 ; marriages, 3989. With 1437 schools accommodating 78,000 pupils, primary grade, in 1896, 5 per cent. of the population was illiterate. The land under cultivation in 1896 measured 1,411,605 acres, of which 1,143,610 acres were arable. There are no vines in the agricultural returns of this department. The soil is considerably productive. Its wheat crop of 1898 amounted to the value of £1,540,000 ; meslin, £94,000 ; rye, £88,000 ; barley, £128,000 ; oats, £1,120,000 ; potatoes, £318,500 ; mangold-wurzel, £114,800 ; green crop (trefoil, lucern, and sainfoin), £401,800 ; apples, £43,500 ; garden-poppy, £43,500. Its beetroot produce was valued at £911,000. The live stock comprised (1899) 76,500 horses, 165,800 cattle, 380,900 sheep, 85,300 pigs, and 14,550 goats. Peat-cutting in 1898 amounted to 37,300 metric tons. The industry in metals produced only 3005 tons of iron, valued at £23,500. The thriving industries are the spinning and weaving of linen, hemp, and cotton. The velvets of Amiens are in good repute. Sugar-refining yielded (1899) 2,048,000 cwt. The product of the distilleries amounted to 5,830,000 gallons of alcohol. Amiens, the capital, had (1901) 90,038 inhabitants.

Sonderburg, a seaport and seaside resort of Prussia, province of Schleswig-Holstein, on the south-west coast of the island of Alsen, of which it is the chief town, and 17 miles by steamboat north-east from Flensburg. There is a castle, now used as barracks. The town, which existed in the middle of the 13th century, was burnt down in 1864 during the assault by the Prussians upon the Düppler trenches (on the mainland). Population (1900), 5522.

Sondershausen, a town of Germany, capital of principality Schwarzburg-Sondershausen, 37 miles by rail north of Erfurt. It possesses a castle, with natural history and antiquarian collections, and a parish church (restored 1891), with the mausoleum (1892) of the reigning princes. The people make pins and woollens. Population (1900), 7053.

Sondrio, capital of the province of Sondrio, Lombardy, Italy, amongst the Southern Alps, on the river Adda, 26 miles east of Lake Como, and 83 miles by rail

north-east of Milan. It is visited by tourists in spring and autumn, and has active silk industries and manufacture of stone pottery (*lavez*). There are a technical school and an industrial institute. Population (1901), 8700. In the Masino valley, 12 miles north-west of Sondrio, there are, at Ardenno, saline baths and springs, with a temperature of 86° Fahr.

Song-Koi, or Red River. See Indo-China.

Sonneberg, a town of Germany, duchy of Saxe-Meiningen, situated in a narrow valley of the Thuringian Forest, 13 miles by rail north-east of Coburg. It is famous for its manufacture of toys, papier-maché, mirrors, &c.; it has also tanneries, dyeworks, and slate works. The town possesses a fine Gothic church, a hydropathic, and a monument to the philologist Schleicher (1821–68). Population (1885), 10,247; (1900), 13,317.

Sonnino, Sidney, Baron (1847——), Italian statesman and financier, was born at Florence on 11th March 1847. Entering the diplomatic service at an early age, he was appointed successively to the legations of Madrid, Vienna, Berlin, and Versailles, but in 1871 returned to Italy, to devote himself to political and social studies. On his own initiative he conducted exhaustive inquiries into the conditions of the Sicilian peasants and of the Tuscan *métayers*. In 1878 he founded a weekly economic review, *La Rassegna Settimanale*, which four years later he converted into a political daily journal. Elected deputy in 1880, he distinguished himself by trenchant criticism of Magliani's finance, and upon the fall of Magliani was for some months, in 1889, Under-Secretary of State for the Treasury. In view of the severe monetary crisis of 1893, he was entrusted by Crispi with the portfolio of Finance (December 1893), and in spite of determined opposition, dealt energetically and successfully with the deficit of more than £6,000,000 then existing in the exchequer. By abolishing the illusory pensions fund, by applying and amending the Bank Laws, effecting economies, and increasing taxation upon corn, incomes from consolidated stock, salt, and matches, he averted national bankruptcy, and placed Italian finance upon a sounder basis than at any time since the fall of the Right. Though averse from the policy of unlimited colonial expansion, he provided by a loan for the cost of the Abyssinian war in which the tactics of General Baratieri had involved the Crispi Cabinet, but fell with Crispi after the disaster at Adowa (March 1896). Assuming then the leadership of the constitutional Opposition, he combated the alliance between the Rudini Cabinet and the subversive parties, criticized the financial schemes of the Treasury Minister, Luzzatti, and opposed the "democratic" finance of the first Pelloux administration as likely to endanger financial stability. After the modification of the Pelloux Cabinet (May 1899) he became leader of the ministerial majority, and bore the brunt of the struggle against Socialist obstruction in connexion with the Public Safety Bill. Upon the formation of the Zanardelli Cabinet (February 1901) he once more became leader of the constitutional Opposition, and in the autumn of the year founded a daily organ, *Il Giornale d'Italia*, the better to propagate Moderate Liberal ideas.

Sonora, a state of Mexico, bounded on the N. by the United States, on the E. by Chihuahua, on the W. by the Gulf of California, and on the S. by Sinaloa. Area, 76,922 square miles, being only exceeded by the state of Chihuahua (87,820). Population (1879), 115,424; (1900), 220,553. The principal agricultural products are cereals, tobacco, cotton, sugar-cane, fruits, &c. The annual value of the exports of minerals is from $10,000,000 to $12,000,000 (silver). The Guaymas and Nogales Railway connects the state with the Southern Pacific Railroad. The capital, Hermosillo, has 8474 inhabitants. Other towns include Alamos (6197), Guaymas, an important commercial port connected by rail with Nogales on the United States frontier, the terminal point of the Sonora Railway, Moctezuma or Oposura, Arizpe, Ures.

Sonpur, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 906 square miles. Population (1881), 178,701; (1891), 195,245; (1901), 170,633, showing a decrease of 13 per cent., due to the results of famine. Estimated revenue, Rs.1,06,000; tribute, Rs.9000. The chief is a rajput of the Patna line. Rice and timber are exported, and iron ore is said to abound. The town of Sonpur is on the Mahanadi river, just above the point where it enters Orissa.

Sonthal (or Santal) **Parganas, The,** a district of British India, in the Bhagalpur division of Bengal. It stretches south from the Ganges at Rajmahal to Chota Nagpur, and consists mostly of a rolling, forest-clad plateau. Area, 5469 square miles. Population (1881), 1,567,966; (1891), 1,754,196, showing an increase of 12 per cent., partly due to more accurate enumeration; average density, 321 persons per square mile. In 1901 the population was 1,807.286, showing an increase of 3 per cent.

Classified according to religion, Hindus in 1891 numbered 900,399; Mahommedans, 121,086; Christians, 5943, of whom 196 were Europeans; aborigines, 726,284; "others," 481. The land revenue and rates in 1897–98 were Rs.3,31,744; number of police, 388; boys at school (1896–97), 20,667, being 15·7 per cent. of the male population of school-going age; registered death-rate (1897), 29 per thousand. The Sonthals, who give their name to the district, are the most numerous aboriginal tribe in Bengal, who work the coal-mines of Raniganj and Karharbari and migrate to the tea-gardens of Assam. According to the linguistic classification of the census of 1891, the total number of persons in India speaking Sonthali was 1,709,680. The Church Missionary Society and the Scandinavian Sonthal Home Mission have been very successful among them, especially in promoting education. The district is traversed by both the chord and loop lines of the East Indian Railway. It comprises the old Mahommedan city of Rajmahal and the modern commercial mart of Sahibganj, both on the Ganges; and also the Hindu place of pilgrimage of Deogarh, which is important enough to have a branch railway. Coal-mines yield about 1800 tons a year.

Soochow, or Suchau, the capital of the province of Kiangsu, China. It was opened to foreign trade by the Japanese treaty of 1895, but the privilege has not been largely utilized. Indeed, the value of the trade has steadily declined from an aggregate of 1,473,560 H. taels in 1897 to 1,176,616 H. taels in 1900. The only importance of the port is as a centre of distribution for foreign goods subordinate to Shanghai, with which it is connected by a canal 80 miles in length. The trade is entirely in native hands. A cotton spinning mill and two or three silk filatures have been erected, two of the latter in native hands, the others in part under European management. The principal industry in Soochow is silk-weaving. The fabrics produced are of extreme elegance and low price, and are chiefly intended for the domestic market in China; but there is a large and increasing demand for export (value of silk export in 1900, £72,000). In the ninth edition of this work Soochow was credited with a population of 500,000, but a more recent estimate would give about 350,000.

Sopron (Oedenburg), a municipal town in Hungary, capital of the county of the same name, 40 miles south by east of Vienna, with a population in 1891 of 29,543, and in 1901 of 33,478. It contains an evangelical school, 3 gymnasia, 2 upper *real*-schools, 2 training institutes for teachers, a commercial academy, several orphanages, &c.

Amongst its manufactures are bell-founding and machinery, besides sugar, beer, vinegar, soap, and a flourishing wine trade. The electric light and tramways are in operation.

Sorau, a town of Prussia, on the Sorebach, near the frontier of Silesia, 55 miles south-south-east of Frankfurt-on-Oder by rail. There are 7 churches and several schools, including a technical and a weaving school. The industries include cloth and linen factories. Population (1885), 13,668; (1900), 15,945.

Sorel, a city and port of entry of Quebec, Canada, capital of Richelieu county, 42 miles north-east of Montreal, at the confluence of the Richelieu and St Lawrence. It is a station on the Quebec Southern and South Shore railways, and is a port of call for the Montreal and Quebec river steamers. It contains iron and leather manufactories, and shipbuilding is carried on. It occupies the site of a fort built in 1665 by M. de Tracy to guard the route by way of the Richelieu to Lake Champlain and the Hudson. Population (1891), 6669; (1901), 7057.

Soria, a province of Spain, in Old Castile. Area, 3836 square miles. Population, 151,530 in 1887, 147,787 in 1897. The birth-rate is 3·84 per cent., the death-rate 3·39 per cent., and the proportion of illegitimate births 1·29 per cent., being one of the lowest in Spain. The province is divided into five districts and 345 *ayuntamientos* or parishes. Three railways run through the province. The only really important industries are connected with agriculture and the rearing of cattle. The exports are mostly timber, wool, salt, leather, and cheese. About 400,000 acres of the soil, chiefly in the mountains, are covered with forest; 1,450,000 acres are cultivated, and about 350,000 are reserved for pasture. Out of the cultivated area in 1897, 103,292 acres were covered with wheat crops, 199,135 with oats, rye, barley, maize, 13,000 with pod fruit, 12,000 with vines. The live stock in 1897 consisted of 3550 horses, 16,502 mules, 11,724 asses, 16,875 cattle, 487,109 sheep, 25,395 goats, and 14,695 pigs. There are only two salt mines and one bed of asphaltic rock actually worked in Soria.

Soria, capital of the above province, on the Douro, station at Alcuneza on the Madrid–Saragossa line. Population, 7784 in 1887, 7290 in 1897. Soria has a provincial institute, normal schools for teachers of both sexes, many primary schools, savings banks, two hospitals, barracks, a theatre, and the usual bull-ring. Near the Douro are the ruins of the old castle of Soria, and in many places the remains of the walls of the city are yet standing. The more modern streets are clean and well paved. The bridge across the Douro is a solid and massive structure, which formerly had a tower in the centre.

Soroki, a district town of South Russia, in the government of Bessarabia, 117 miles north-north-west of Kishineff and 36 miles from the nearest railway station, built in a narrow ravine on the right bank of the Dnieper. It is an important river port for the export of corn, wool, fruit, wine, and cattle, and had in 1897 a population of 15,800, half of whom were Jews. Formerly it was the old Genoese colony of Olhionia, and has still the ruins of a 13th century Genoese castle. In the 15th century the Moldavians erected here a fort, Saraki, which the Poles took in the 17th century. Peter I. conquered it in 1711, but it was returned to the Turks, and was only definitely annexed to Russia in 1812.

Sothern, Edward Askew (1826–1881), English actor, was born at Liverpool, 1st April 1826, his father being a merchant. He began acting as an amateur, and drifted into a professional engagement with a dramatic company in Jersey in 1849. Between then and 1858 he played in various capacities with no particular success in Birmingham and in America, where he went in 1852. In 1858 Tom Taylor's *Our American Cousin*, a piece of no special merit, was brought out at New York, with Sothern in the small part of Lord Dundreary, a caricature of an English nobleman. He gradually worked up the humour of this part, so that in 1861, when the play was produced at the Haymarket Theatre in London, he made such a "hit" that his impersonation was on everybody's lips, and the piece ran for nearly five hundred nights: the "Dundreary whiskers" became the fashion, and Dundreary this, that, or the other made its appearance on every side. At various times Sothern revived the character, which retained its popularity in spite of all the extravagances to which he developed its amusing features; and his name will always be famous in connexion with this rôle. In T. W. Robertson's *David Garrick* (1864) Sothern also had a great success, his acting in the title-part, which he created, being wonderfully effective, but none of his many other parts was specially remarkable. Sothern was a born comedian, and off the stage he was a notorious practical joker. He was as much of a favourite in America as in the United Kingdom. He died in London, 21st January 1881.

Sotteville, a town, arrondissement of Rouen, department of Seine Inférieure, France, one mile south of Rouen, of which it is really a suburb, continuous with Sever, on the railway from Paris to Havre. There is a chapel of the 12th and 14th centuries. Cotton-spinning and the manufacture of calicoes are conducted on an extensive scale; hemp-spinning, cordage, varnish, and gelatine represent other branches of industry. The Western Railway Company have here an extensive group of manufacturing and repairing workshops. To the south of the town is the departmental lunatic asylum of Quatre Mares, attached to that of St Yon. Population (1881), 11,738; (1901), 18,535.

Soudan. See SUDAN.

Sounding (DEEP SEA).—Wire has now entirely superseded the hemp gear formerly used for this purpose. Its smooth surface and minute section, reducing friction to a minimum, gives a rapidity of descent of about 100 fathoms per minute, and this velocity is not materially diminished even at great depths. Reeling in may be accomplished at nearly the same rate. Soundings are thus obtained with a degree of accuracy not formerly possible. The apparatus is light, compact, and automatic in its action. Soundings with wire can be carried out at night with the same facility as in daytime, and in almost any circumstances of wind and weather short of a strong gale, against which the ship could not steam or face the sea. A sounding of 1000 fathoms may be obtained in twenty-five minutes from the time the weight is lowered to the time the order is given to put the ship on her course, or in half that time if sounding from astern and going ahead on getting bottom. 2000 fathoms will require forty-five minutes, and 3000 fathoms seventy-five minutes. Beyond that depth, much greater caution being required, the time occupied is correspondingly increased, and reeling in must then be done very deliberately. The deepest sounding hitherto obtained is 5269 fathoms. Soundings at such depths may occupy as long as five or six hours.

Lucas machine.

The latest pattern of Lucas machine carries nearly 6000 fathoms of 20-gauge wire, and is fitted with two brakes, one a screw brake for holding the reel when required, the other an automatic brake for stopping the reel when the weights strike the bottom. A guider for the purpose of winding the wire uniformly on to the reel is also attached, and is worked

by a small handle. After leaving the reel, the wire passes over a registering wheel, the dial of which indicates the amount of wire run out. Similar machines of smaller size are supplied for use in boats. The large machine is represented in Fig. 1.

Heaving in is accomplished by means of a hemp "swifter" or driving belt, which conveys the motion of the drum of a donkey engine to the drum carrying the wire of the sounding machine. It being impracticable to regulate the speed of the engine by hand according to the heave of the ship, in order to obviate the sudden and excessive strains on the wire so caused an ingenious mechanical arrangement has been fitted to machines of recent pattern, by which frictional discs, geared by cog-wheels and capable of adjustment, are interposed on the axle connecting the grooved wheel actuated by the hemp swifter and the revolving drum carrying the wire. By this arrangement the latter can be controlled as desired, both in speed and direction of motion, by means of a lever regulating a strap on the frictional discs, which may be set by experiment to act at any given tension of the wire. As the tension approaches this limit, the velocity of revolution of the drum is automatically checked; and if the tension further increases, the motion of the drum is actually reversed, thus causing the wire to run out, until the tension is relieved sufficiently to allow the frictional discs again to act in the direction of heaving in. The drum may be stopped instantly by moving the lever in the proper direction to throw the apparatus out of gear.

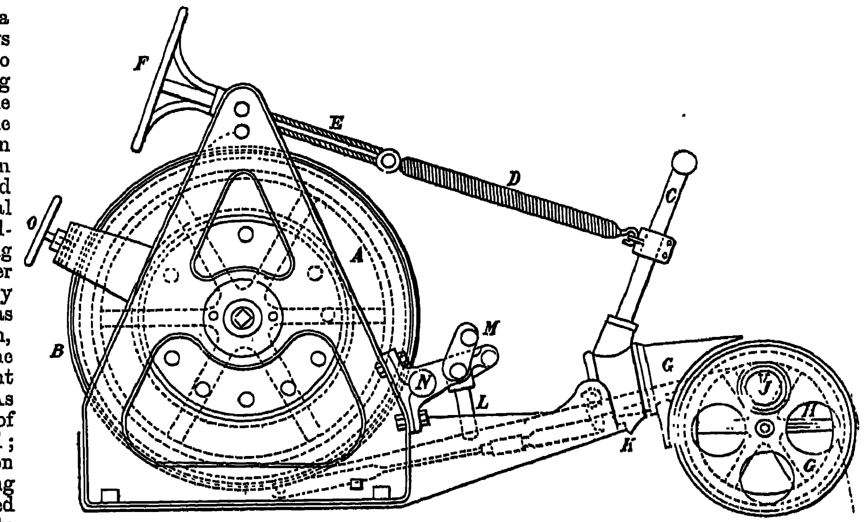

Fig. 1.—Lucas Machine (from Wharton's *Hydrographic Surveying*). A, Reel or drum; B, brake; C, brake lever; D, springs; E, regulating screw; F, hand wheel; G, swivelling frame; H, measuring wheel; J, indicator; K, stop; L, wire guiding roller; M, handle for working roller; N, bolt; O, screw brake.

Galvanized steel wire of 20-gauge and 21-gauge is supplied on drums in lengths of 5000 fathoms. The 20-gauge wire when new has a breaking strain of 240 ℔, and the smaller wire 190 ℔. The large machines now made will hold a sufficient quantity of the larger wire for the deepest soundings; there is therefore no longer any necessity for the smaller wire, and its use is not recommended. The zinc wears off to a considerable extent with constant use; it is necessary to pass the wire through an oily wad whenever soundings are suspended for a time, and the surface layers on the drum should be kept well coated with oil and covered over with oily waste. A fortnight's continuous use is about the limit to the trustworthiness of any piece of wire; no amount of care will prevent it from becoming brittle; and directly it can be snapped by twisting in the hand, it should be condemned and passed on to the boats' machines. A magnifying glass will assist in examining its condition. Taut and even winding on the reel from the drum is most important; otherwise, when heaving up after a sounding, the strain forces each layer as it comes in to sink down amongst the previous layers loosely reeled on, with the result that at the next sounding slack turns will suddenly develop on running out, to the great risk of the wire. The wire is liable to cut grooves in the interior of the swivelling frame; a file must constantly be applied to smooth them down, or they will rip the splices. A roller of hard steel, underneath which the wire passes, and placed in rear of the swivelling frame, obviates this to a great extent.

Splices are made about 5 feet in length, one wire being laid round the other in a long spiral of about one turn per inch. A seizing of fine wire is laid over each end and for two or three inches up the splice, no end being allowed to project, and solder is then applied the whole length of the splice. Three more seizings should be placed at intervals. Splices are the weakest parts of the wire, and their multiplication is to be avoided. They should be frequently examined and their position noted, so that in heaving in they may be eased round the wheel with the guider nearly in the centre, to avoid tearing.

Sounding rods and sinkers.

Under 1000 fathoms a lead of 30 to 40 ℔ weight can be recovered, and no detaching rod is necessary. At a little risk to the wire, when sounding from astern up to that depth, the ship may go ahead directly bottom is struck, increasing speed as the wire comes in; the great saving in time thus effected will often justify the increased risk of parting the wire. For greater depths the "Driver rod" is the best detaching apparatus for slipping the sinkers; its construction is easier than that of the "Baillie rod," and with a piece of gas piping cut to the proper length the ship's blacksmith can make one in a day. Both rods are fitted with tubes to bring up a specimen of the bottom, and the same sinkers fit them both.

The "Driver rod" is shown in Fig. 2. ABC is a tube about 2 feet in length, fitted at the top with a flap valve D, working on a hinge at E. The lower part of the tube C screws on and off, and contains a double flap valve to retain the bottom specimen. The sinkers WW, each 25 ℔ in weight, conical in form, and pierced with a cylindrical hole through which the Driver rod passes loosely, are slung by wire or cod line secured to a flat ring or grummet shown at L and passing over the stud G. A stud K on each side of the tube fits loosely into the slot H in the lower part of the slipping lever MH. The weight of the apparatus being taken by the sounding wire, the sinkers remain suspended; but on striking the bottom, the wire slackens, and the weight of the sinkers drags the slipping lever down till the stud K bears against the upper part of the slot H. By this action the point M of the slipping lever is brought to bear against the upper end of the standard EF, being thereby forced outwards sufficiently to ensure that the weight acting at the point G will tilt the slipping lever right over, and thus disengage the sling. The tube being then drawn up, the sinkers are left behind. In descending, the valves at top and bottom opening upwards, allow the water to pass through freely; but on drawing up they are closed, thus retaining the plug of mud with which the tube is filled. For water under 2000

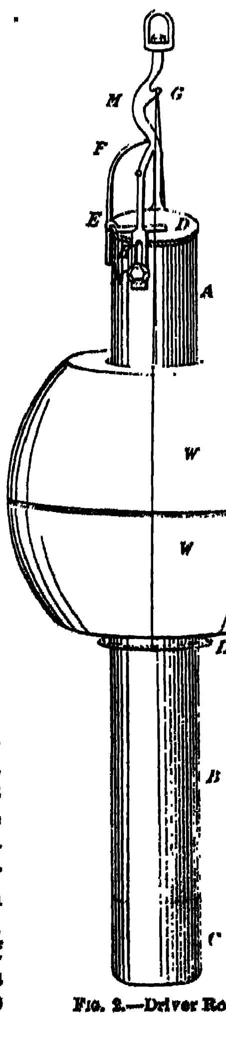

Fig. 2.—Driver Rod.

fathoms two conical weights are sufficient. In deeper water a third cylindrical weight of 20 ℔ should be put between them. It is important to interpose a piece of hemp line, some ten fathoms long, between the end of the wire (into which a thimble is seized) and the lead or rod. This tends to prevent the wire kinking on the lead striking the bottom. A piece of sheet lead about 2 ℔ in weight, wrapped round the hemp just below the junction, keeps the wire taut while the hemp slacks. Small brass screw stoppers, fitted with a hempen tail to secure to a cleat, hold the wire during the sounding if necessary to repair splices or clear slack turns. In heaving in, the springs are replaced with a spring balance, by which the amount of strain is seen and the deck engine worked accordingly. A system of signals is required by day and by night, by which the officer superintending the sounding can control the helm, main engines, and deck engine.

Method of Sounding.—The machine is placed on a projecting platform on the forecastle. An endless hemp swifter, led through blocks with large sheaves, connects the sounding machine and deck engine, and when heaving in is kept taut by a snatch block set up with a jigger. As the wire runs out, the regulating screw of the brake must be gradually screwed up, so as to increase the power of the brake in proportion to the amount of wire out. The regulating screw is marked for each 500 fathoms. In fairly smooth water the brake will at once act when the weight strikes the bottom and the reel stops. Under 3000 fathoms one spring only is sufficient, but beyond that depth two springs are required. If the ship is pitching heavily, the automatic brake must be assisted by the screw brake, to ensure the reel not overrunning. The marks on the regulating screw are only intended as a guide; the real test is that the brake is just on the balance so as to act when the strain lessens, which may be known by the swivelling frame being just lifted off the stop. As the wire weighs 7½ ℔ for each 500 fathoms, the 500-fathoms mark on the screw should be at the position in which the screw has to be to sustain a weight of 7½ ℔; the 1000-fathoms mark, 15 ℔; and so on. This can be tested, and the marks verified.

Handling the Ship.—Sounding from forward enables the ship to be handled with greater ease to keep the wire up and down, and especially so in a tide-way; but in very heavy weather soundings may be obtained from a machine mounted over the stern, when it would be quite impossible to work on the forecastle. The spanker must be set with the sheet to windward, unless a strong weather tide renders it undesirable; the ship's head must be kept in a direction which is the resultant of the direction and force of the wind and current, and this is arrived at by altering course while sounding, point by point, until the wire can be kept up and down by moving the engines slowly ahead as necessary. It should seldom, or never, be necessary to move the engines astern.

Observations of temperature. The temperature of the water is usually taken at intervals of 100 fathoms down to a depth of 1000 fathoms, and at closer intervals in the first 100 fathoms. If a second wire machine is available, the observations may be made from aft whilst the sounding is being taken forward. A 30-℔ sinker is attached to the end of the wire, and the thermometers are secured to the wire by the metal clips at the back of the cases, at the required intervals. Care must be taken to see that the indices are down before attaching the thermometers. To avoid heavy loss, not more than four thermometers should be on the wire at one time. When sounding, a thermometer is usually attached to the line a short distance above the lead.

Submarine sentry. *Submarine Sentry.*—The primary object of this machine is to supply an automatic warning of the approach of a ship to shallow water: it has been instrumental in discovering many unsuspected banks in imperfectly surveyed waters. By means of a single stout wire the sinker, an inverted kite, called the "sentry," can be towed steadily for any length of time, at any required vertical depth down to 40 fathoms with the red kite and 30 fathoms with the black kite; should it strike the bottom, through the water shallowing to less than the set depth, it will at once free itself and rise to the surface, simultaneously sounding an alarm on board, thus giving instant warning. The vertical depth at which the sentry sets itself when a given length of wire is paid out is not changed by any variation of speed between 5 and 13 knots, and is read off on the graduated dial-plate on the winch. One set of graduations on the dial indicates the amount of wire out; the other two sets refer to the red

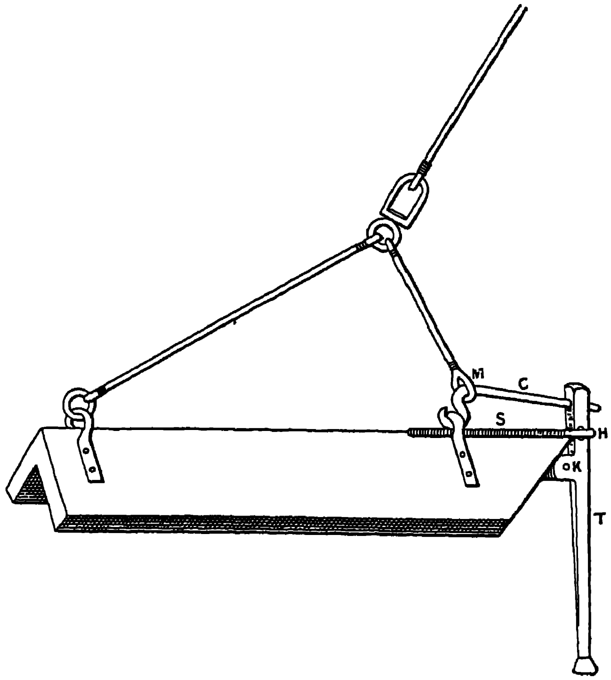

Fig. 3.—The Submarine Sentry.

and black kites respectively, and show the depth at which the sentry is towing. By this machine, single soundings down to 40 fathoms can be taken at any time while the ship is under way, the sentry being let down slowly. The gong will indicate when the bottom is touched, and the dial corresponding to the kite used will show at once the vertical depth at the place where the sentry struck.

By removing the kite and substituting a lead, with atmospheric sounder or other automatic depth gauge, flying single soundings up to 100 fathoms can be obtained in the ordinary manner without stopping the ship.

The winch is secured to the deck a short distance from the stern; the towing wire passes from the drum under a roller fairlead at the foot of the winch, thence through an iron block with sheave of large diameter, suspended from a short davit on the stern rail and secured to the sling of the sentry. The dial being set to zero with the sentry at the water's edge, the ship's speed is reduced to 8 or 9 knots, and the wire paid out freely until the kite is fairly in the water, when the brake should be applied steadily and without jerking, veering slowly until the required depth is attained, when the pawl is put on the ratchet wheel and the speed increased to 12 knots if desired when using the black kite, or 10 knots with the red kite.

The kite in its position when being towed is indicated in Fig. 3. The point of the catch C, passing through a thimble M in the short leg of the sling, is slipped into the hole at the top of trigger T, which is hinged at K and kept in its place by the spring S attached to the hook H. On the trigger striking the bottom the catch is released, the short leg of the sling slips off, and the sentry, which then rises to the surface, is left towing by the long leg. The winch is fitted with two handles for heaving in the wire; one gives great power and slow speed, and the other, acting on the drum spindle direct, winds in quickly. The wire supplied with the machine has a steady breaking strain of about 1000 ℔. Using the black kite at a speed of 7 knots, the strain on the wire is about 150 ℔, and at 10 knots about 300 ℔. The red kite increases the strain largely. (A. M. F*.)

SOUTH AFRICA.

I. Geography and Statistics.

General survey.

The expression "British South Africa"—which has obtained general currency, although it has no official sanction—came into use, or at least began to acquire a definite meaning, in the early 'eighties, when the first step towards the partition of the continent was taken by the German occupation of Namaqualand (1884). It then became at once evident that British interests could no longer be confined to the regions south of the Orange river and east of the Drakensberg range, and that the very existence of the two long-established colonies of the Cape and Natal would be imperilled unless practical measures were taken to keep open the "English road" to the interior of the continent, which had hitherto been mainly followed by missionaries, traders, and travellers. Thus arose the imperial idea of a "British South Africa," as a political domain destined in due course to embrace in one vast federation all existing colonies and all other settlements in process of development into free, self-governing states. But such a system must necessarily lack ideal completeness—such completeness as is enjoyed by the sister federations of Canada and Australia—so long as considerable tracts are held by foreign Powers on the western and eastern seaboards (German South-West Africa; Portuguese South-East Africa). In the interior, however, the unity of the system has been secured by the suppression of the late Boer states, while its borders have been enlarged by the settlement of Matabele and Mashona Lands (South Rhodesia), and by the extension of British rule, directly or indirectly, over the whole of Bechuanaland. Thus the expression British South Africa now covers the whole of the continent from the Zambezi to the Cape, the specified German and Portuguese territories alone excepted. Including these, South Africa has a total area of about 1,364,000 square miles, and a population approximately estimated (1900) at nearly 7,000,000, and is politically divided into five British colonies, two British protectorates, and two non-British colonies, with respective areas and populations as under:—

Political divisions.

Political Divisions.	Area in Square Miles.	Population (1891–1900).
Cape Colony, with Griqualand, South Bechuanaland, and Pondoland, all now incorporated . . .	277,000	1,766,000
Bechuanaland Protectorate . .	213,000	200,000
Basutoland	10,000	250,000
Natal, with Zululand and South Tongaland	50,000	1,026,000
Southern Rhodesia (Matabele and Mashona Lands) . . .	175,000	450,000
Orange River Colony . . .	48,000	207,000
Transvaal Colony	119,000	1,094,000
German South-West Africa . .	322,000	200,000
Portuguese territory south of the Zambezi (Delagoa Bay, &c.) .	150,000	1,750,000
Total . .	1,364,000	6,943,000

Physical features.

Africa south of the Zambezi forms a vast tableland which stands at a mean elevation of about 4000 feet above sea-level, and is buttressed seawards by a great mountain system disposed in concentric ranges roughly parallel with the contour lines of the continent, at distances of from 100 to 250 miles from the coast. The inner encircling range, which falls through secondary parallel chains, or through steeply scarped terraces, the so-called karoos, down to the seaboard, is continuous only on the south and east sides facing the Austral and Indian Oceans, and on the west as far north as the Oliphant river. Beyond this point the system loses the aspect of an unbroken rampart, the outer scarps have been greatly eroded, the coast ranges become more fragmentary, and at last entirely disappear at the broad estuary of the Orange river. Still farther north little is to be seen except low, rocky hills and ridges, almost lost amid the shifting dunes of the sandy Namaqualand plains. But in the direction of the east and north-east the rise is continuous through the Roggeveld, the Nieuwveld, the Sneeuwberg, and the Stormberg round to the Quathlamba (Drakensberg) range, where the whole system culminates in peaks from 10,000 to nearly 11,000 feet high at the converging frontiers of Basutoland, Natal, and the Orange River Colony. From these Alpine heights the Drakensberg is continued at a mean altitude of 8000 feet along the Natal frontier right into the Transvaal, broken only by a few difficult passes, such as Tintwa, Van Reenens, Botha's, and Lang's Nek at Majuba Hill. Beyond Natal the escarpments of the plateau again fall to 5000 or 6000 feet and assume a more broken character along the Transvaal frontier, where they have been subject to much weathering and erosion, presenting in places the appearance of marine headlands, whence the term *Kaap*, "Cape," applied to the cliffs in this auriferous district. Here the Randberg ("Border range"), as it is called, is flanked seawards by the less elevated Lobombo Coast range; and beyond the Mauchberg, culminating point of the Transvaal (8725 feet), the whole system gradually merges in a broad expanse of moderately elevated uplands, intersected transversely to the main range by the Zoutpansberg and Murchison Rand, between the Oliphant and Limpopo rivers. North of the Limpopo the eastern escarpments again assume a mountainous aspect between Portuguese territory and Southern Rhodesia, broadening out northwards in the Mashona highland, and developing in Matabeleland the historical Matoppo ridge, which forms the true water-parting between the Limpopo and the Zambezi rivers.

From the inner slopes of the encircling ranges, thus roughly outlined, the great continental plateau stretches away for interminable distances through the former Boer states and Bechuanaland from the Orange northwards to the Zambezi, and through the Kalahari desert westwards to the Atlantic Ocean. It has a total area of not less than 900,000 square miles; and the tilt of the land being westwards in the south and eastwards in the north, the drainage is almost entirely through the Orange to the Atlantic, and through the Limpopo, Sabi, Bosi, Pungwe, and Zambezi to the Indian Ocean. Lying between the low latitudes of 16° and 35° S., while also exposed to the moist monsoons and warm marine currents of the Indian Ocean, South Africa should be distinguished by a hot, wet, tropical or subtropical climate. But these conditions are fully realized only on the eastern seaboard between the Zambezi and the Cape, and are elsewhere profoundly modified by the great mean elevation of the land (4000 feet), by the cold marine and aërial currents setting from the Antarctic waters along the west coast, and by the great altitude of the eastern escarpments (Drakensberg, Randberg), by which, as in Australia, the rain-bearing oceanic trade winds are intercepted, leaving but a slight precipitation for the central and western regions. Hence in the direction of the east the

Climate.

increase of the rainfall is continuous, rising from 3 or 4 inches in Namaqualand and 8 to 16 in Bechuanaland to 24 at Pretoria and Bloemfontein, and 40 or even 50 in Natal. The temperature is much more uniform, the mean for the whole year lying almost everywhere between 60° and 70° F., while the mean of the extremes ranges from 40° to 91° at the Cape, 32° to 95° at Pietermaritzburg, 40° to 105° at Kimberley and Pretoria, 41° to 94° at Bloemfontein, and 40° to 106° at Bulawayo. But owing to the dryness of the atmosphere, this intense heat is far less oppressive than might be supposed, and many parts not only of the Cape but of the central plateau and the Rhodesian uplands are perfectly salubrious and well adapted to the European constitution. The prevailing complaints—enteric fever, ague, diarrhœa, and dysentery—are due either to the bad water or to long exposure and hardships, or else are confined to the low-lying swampy and riverside tracts. Elsewhere fever is almost unknown, while the Matabele and Mashona uplands, where white families are already established, are declared to be even more healthy than Natal and other parts of the long-settled seaboard. The generally salubrious nature of the climate is indeed placed beyond doubt by the persistence of the Boer race and of the English settlers, all noted for their longevity, robust physique, and vigorous offspring.

Flora and fauna.

On the plateau the deficient moisture is everywhere reflected in the poverty and general character of the vegetation, marked by the absence of woodlands and the great predominance of thorny scrub and herbaceous growths. Prickly acacias, euphorbias, and mimosas are characteristic of the high veld, where the eye sweeps over vast grassy plains or rolling steppes, and lights on nothing but a few clumps of low, shadeless trees, marking the sites of the Boer farmsteads dotted thinly over the steppe. The native grasses yield rich pasturage during the wet summer months, but mostly disappear in the dry winter season, and then the only visible vegetation is the so-called "bush," that is, the acacias, willows, mimosas, yellow-wood, iron-wood, and wild fig, by which the watercourses are often densely fringed. On the other hand, the soil is naturally rich, and where water is available some districts yield two annual crops of cereals, especially mealies (maize) and some of the finest wheat in the world. Tobacco, the vine, and most European fruits and vegetables thrive well, while sugar, coffee, cotton, and other colonial produce already grown in Natal might also be successfully cultivated in the Limpopo valley. But so far only a mere fraction of the available land has been brought under tillage; and although its agricultural resources are boundless, no great progress can be expected until some practical steps are taken to get rid of the locust pest and introduce the urgently-needed irrigation works in a large way. Meanwhile the boundless pastures support multitudes of horned cattle, horses, goats, merinos, and fat-tailed sheep. These more profitable domestic animals have to a large extent crowded out the beasts of prey and the game of all kinds which till recently abounded in prodigious multitudes. Formerly such characteristic members of the African fauna as the lion, leopard, hyæna, elephant, buffalo, zebra, quagga, giraffe, baboon, rhinoceros, gnu, eland, springbok, gazelle, and other antelopes in endless variety swarmed over the inland plateaux and the surrounding slopes, while the large streams were infested with the crocodile and hippopotamus. The early travellers speak of the hartebeest, gnu, and springbok scouring the plains and migrating in herds of ten or even fifteen thousand from pasture to pasture between the Cape and the then unknown northern wilderness beyond the mountains. But they are now seldom seen even in the wilderness itself, and to prevent their total extinction some species are sheltered in public or private preserves in the Cape and the Transvaal. The lion is said to have ceased to roar, though still lingering about the haunts of men; the quagga and white rhinoceros seem to have died out, and the hippopotamus has disappeared from most of the rivers.

Inhabitants.

The same fate has overtaken nearly all the Vaalpens, Bushmen, and Hottentots, who represent the true aboriginal element south of the Zambezi, and are described in separate articles. All the other natives, popularly called "Kaffres," are members of the widespread Bantu family (see BANTUS), of whom they here form three distinct branches: 1. The *Zulu-Xosas*, originally confined to the south-east seaboard between Delagoa Bay and the Great Fish river, but later (19th century) spread by conquest over Gazaland, parts of Transvaal, and Rhodesia (Matabeleland). 2. The *Bechuanas*, with the kindred *Basutos*, on the continental plateau from the Orange to the Zambezi, and ranging eastwards into the late Boer states and Basutoland, and westwards over the Kalahari desert and the Lake Ngami region. 3. The *Ova-Herero* and *Ova-Mpo*, confined to German South-West Africa between Walfish Bay and the Cunene river. All these mixed Bantu peoples, who all speak dialects of the extinct Bantu stock language, are immigrants at various periods from beyond the Zambezi. The Bechuanas, who still occupy by far the largest domain, and alone preserve the totemic tribal system in its integrity, were probably the first arrivals from the north or the north-east coastlands. There is reason to believe that they formed the bulk of the native populations when Austral Africa was reached, some two or three thousand years ago, by the ancient navigators who came hither, most probably from South Arabia, in quest of gold, and to whom the late Theodore Bent has rightly attributed the remarkable Zimbabwe monuments still extant near Victoria, in Southern Rhodesia (Matabeleland). These remains, with their lofty round tower, encircling walls and ramparts, all in well-dressed stone, display remarkable constructive skill, far beyond the power of any of the present or past rude inhabitants of the land. They comprise well-planned fortifications for the defence of the prehistoric gold mines, and temples with numerous carvings, emblems, and detached objects, which plainly point to ancient Semitic religious rites. No inscriptions have yet been discovered, but in the Malagasy language of the neighbouring island of Madagascar distinct elements still survive of the old Himyaritic speech which was current in South Arabia under the Sabæan and Minæan empires, and is not yet quite extinct. The inference seems therefore reasonable that the Zimbabwe monuments are the work of the ancient civilized inhabitants of South Arabia, perhaps co-operating with their Phœnician kindred, who were ever exploring the eastern seas in search of the gold and other treasures reported from the "land of Ophir."

The Zimbabwe ruins.

Gold and diamonds.

Gold, with diamonds of recent discovery, still constitutes the chief mineral wealth of South Africa, which in both of these respects may be regarded as unrivalled. Full details are given elsewhere (CAPE COLONY, TRANSVAAL), and here it will suffice to state that while the Kimberley output controls the diamond markets of the world, in 1898 the Transvaal gold harvest exceeded that of Australia, Siberia, and America. The diamantiferous blue clays ("pipes") are not confined to the Cape, and rich auriferous reefs range far beyond Transvaal into Southern Rhodesia. In other respects South Africa is well mineralized, and besides iron, copper, tin, and silver, extensive coal-fields occur in the Cape (Molteno district), in Natal and Zululand (Newcastle, Nougoma), in the Orange River Colony (Kroonstad), and in various parts of

the Transvaal and Rhodesia nearly up to the banks of the Zambezi.

Economic condition.

In the following table are brought together a few leading data showing the economic condition (1898–1900) of the various British South African colonies for which accurate returns are available :—

	Cape.	Natal.	Orange River.	Transvaal.	Basuto-land.
Imports	£19,207,000	£5,359,000	£1,191,000	£13,500,000	£85,500
Exports	23,660,000	1,325,000	1,924,000	..	134,000
Revenue	8,781,000	2,081,000	800,000	3,983,000	70,500
Expenditure . . .	8,190,000	1,915,000	957,000	3,971,000	60,000
Debt	31,410,000	9,019,000	30,000	2,660,000	..
Cattle	1,076,000	278,000	896,000	*Gold.*	321,000
Horses . . .	388,000	57,000	249,000	1890.	81,000
Sheep	1,264,000	600,000	6,620,000	£1,870,000	
Goats	5,573,000	450,000	858,000	1893.	
Wool crop . . .	37,180,000 lb.	*Tea.*		3,480,000	
Mohair	6,707,000 ,,	1,037,000 lb.		1895.	
Wheat	2,221,000 bush.	*Coal.*		8,570,000	
Mealies	2,858,000 ,,	388,000 tons		1898	
Oats	1,810,000 ,,	*Bark.*		16,044,000	
Ostrich feathers . .	278,000 lb.	£58,000		1884–98.	
Wine	4,826,000 gals.	*Sugar.*		69,845,000	
Brandy	1,107,000 ,,	£147,000		*Coal.*	
				1,908,000 tons	
Diamonds	£4,135,000	..	£1,508,000	£43,700	..
Railways	2300 miles	591 miles	392 miles	774 miles	..
White population . .	390,000	48,000	78,000	150,000	600
Coloured population .	1,400,000	513,000	130,000	712,000	25,000

From this table it appears that about 4000 miles of railways had been opened by 1900. In that year about 1000 additional miles were either in progress or projected; and when these are finished, the interior will enjoy the advantage of railway access to the coast and to the Zambezi at eight different points—Walfish Bay, Cape Town, Port Elizabeth, East London, Durban, Delagoa Bay, Beira, and some place on the Zambezi below the Victoria Falls. The main line from Cape Town northwards has already reached Bulawayo, a distance of 1360 miles; and this is now regarded as merely the southern section of a transcontinental "Cape-to-Cairo" line, which it is proposed to construct mainly through British territory, the northern section of which is also completed from the Mediterranean to Khartum, a distance of 1350 miles. As the total distance is 6610 miles, there is still left a central section of 3900 miles to complete the system by the route originally proposed. But recent exploration about the White Nile headwaters shows that considerable deflections may have to be made, to avoid the almost impassable swampy tracts north of the equatorial lakes; and there are other difficulties, which render the expectations of those who hope to see the undertaking out of hand within the first decade of the 20th century a little sanguine. But whenever the railway is completed, the results must be far-reaching, and must tend enormously to develop the material resources of British South Africa.

Railways: the Cape-to-Cairo scheme.

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(A. H. K.)

II. MODERN HISTORY.

For historical purposes South Africa may be taken to include that part of the African continent which lies to the south of the Congo State on the west and German East Africa on the east. Within it are situated Portuguese East and West Africa, Rhodesia, German South-West Africa, Cape Colony, Natal, Basutoland, Orange River Colony, and Transvaal. The European colonization of these territories has occurred step by step, the establishment of one colony or state leading on to the establishment of another. As it is through the European colonists that we have obtained such information as we possess with regard to the native races of the country, it will be most convenient to deal with colonization first in the order of its occurrence, and to consider the native races afterwards. The relations of the white and aboriginal races in the various colonies will also be dealt with.

European colonization.

What led to the discovery of America led also to the discovery, exploitation, and colonization of South Africa. In the 15th century the great Eastern trade with Europe was carried on by the Venetian Republic—Venice was the gate from West to East, and her fleets, richly laden with goods brought down to the shores of the Mediterranean in caravans, supplied Europe with the luxuries of the Orient. It was in that century that Portugal rose to prominence as a maritime power; and being anxious to enjoy at first hand some of the commerce which had brought such prosperity to Venice, Portugal determined to seek out an ocean pathway to the Indies. It was with this intention that Columbus sailed westward and discovered America, and that Bartholomew Diaz, sailing southwards, discovered the Cape of Good Hope. The story of these early voyages is full of gallant adventure, hardihood, and romance. It is sufficient here to record that in 1486 Diaz, having rounded the Cape, entered Algoa Bay, and landing upon a small island, erected a cross as a token that he had taken possession of the country for the king of Portugal. Returning, he sighted the Cape in heavy weather, and christened it the Cape of Storms. This name was subsequently changed by the Portuguese king into that of the Cape of Good Hope. In 1500, while on another voyage to the Indies, the brave Portuguese explorer Diaz went down with his ship in the Atlantic. Eleven years after the first expedition of Diaz another Portuguese expedition was fitted out under Vasco de Gama. De Gama entered Table Bay, but did not land. From here he pushed on round the coast, landed in Mossel Bay, then sailing up the south-east coast, he sighted land again on 25th December 1497, and named it in honour of the day, Natal. Still proceeding northwards, he fell in with coast pilots, and eventually reached the coast of Malabar, in the island of Java.

The Portuguese.

For a hundred years subsequent to this date Africa represented merely an inconvenient promontory to be rounded on the voyage to the Indies. Ships stopped at different ports, or rather at such few natural harbours as the inhospitable coast offered, from time to time, but no attempt was made by the Portuguese to colonize the southern end of the continent. They did, however, in course of time establish ports, and through them small settlements, on the eastern and western sides of South Africa, and these to-day are represented by Portuguese East and West Africa.

English East India Company.

The first Europeans to follow in the wake of the Portuguese Indian voyagers were the English. In 1601 the English East India Company fitted out a small fleet of five vessels, which sailed from Torbay. After four months at sea they dropped their anchors in Table Bay, where they landed and remained for seven weeks before proceeding eastwards. From that time forward Table Bay was used as an occasional port of call for British ships, and in 1620 two English captains formally took possession of the Cape in the name of James I. This patriotic act

was not, however, sufficiently appreciated by either King James I. or the English East India Company to evoke any official confirmation on their part. Meanwhile the Dutch East India Company had been formed in Holland, and the Dutch had entered keenly into the competition for the glittering prizes of Eastern commerce. In 1648 one of their ships was stranded in Table Bay, and the shipwrecked crew were left to forage for themselves on shore for several months. They were so pleased with the resources of the country that on their return to Holland they represented to the directors of the company the great advantages that would accrue to the Dutch Eastern trade from a properly provided and fortified station of call at the Cape. The result was that in 1652 a fort and vegetable gardens were laid out at Table Bay by a Dutch expedition sent for the purpose under a surgeon named van Riebeek.

Dutch East India Company.

In 1657 a few soldiers and sailors, discharged by the Dutch East India Company, had farms allotted them, and these men constituted the first so-called "free burghers." By this step the station became a plantation or settlement. More settlers were landed from time to time from the passing Dutch ships, and in 1688 180 French Huguenots were added to the original settlers. The little settlement grew slowly, but gradually spread eastwards until in 1778 the Great Fish river was declared the boundary of the Cape of Good Hope. All through the latter half of the 17th, and the whole of the 18th, century troubles arose from time to time between the colonists and the Government. The administration of the Dutch East India Company was of an extremely despotic character. The most interesting and complete account of the company's tenure and government of the Cape was written in 1857 by Mr E. B. Watermeyer, a Cape colonist of Dutch descent residing in Cape Town. He points out that it was after failing to find a route by the north-east to China and Japan that the Dutch turned their eyes to the Cape route. The Cape of Good Hope subsequently "became not a colony of the Republic of the United Provinces, but a dependency of the 'Netherlands Chartered General East India Company' for mercantile purposes; and to this fact principally can be traced the slow progress, in all but extension of territory, of a country which was settled by Europeans within thirty years of the time when the Pilgrim Fathers, the founders of a mighty empire, landed at Plymouth to plant democratic institutions and European civilization in the West."

On the settlement under van Riebeek, and the position in it which the so-called "free burghers" enjoyed, this candid Dutch writer, whose lectures are now out of print, throws an interesting light.

"The people," he says, "who came here with Riebeek himself were not colonists intending permanently to settle at the Cape. All were paid servants of the company: the men, in course of time, to be removed to other stations; the officers, especially the commandant, who, after the first year, urgently pressed his claim for promotion, expecting to be transferred to more lucrative posts in India. A watering and cattle station of the company, under the charge of the servants of the company, was all that was intended by the occupation of 1652. The proposition that any freemen or burghers, not in the pay of the company, should be encouraged to cultivate the ground was first made about three years after Riebeek's arrival. Accordingly, some discharged sailors and soldiers, who received, on certain conditions, plots of ground, extending from the Fresh River to the Liesbeek, were the first free burghers of the colony. . . . Here it is sufficient to say that, generally, the term 'free burgher' was a complete misnomer. The first burghers were, in truth, a mere change from paid to unpaid servants of the company. They thought, in obtaining their discharge, that they had much improved their condition, but they soon discovered the reverse to be the fact. And henceforward to the end of the last century, we find the constantly repeated and well-founded complaint, that the company and its officers possessed every advantage, while the freemen were not allowed even the fruit of their own toil. Traffic with the natives, at first permitted on stringent conditions, was soon prohibited, lest thereby prices should become too high for the company when inclined to purchase. The 'free burghers' might buy nothing except from the company, at the company's store and price. They were prohibited, according to the caprice of the governors, from fishing in the bays. They might not supply strange ships, for strangers were to be discouraged. Twenty years after the establishment of the settlement, Commissioner Verburg examined into the state of the colony for the information of the home authorities, and thus reports:—'The Dutch colonists at the Cape of Good Hope bear the name of freemen; but they are so trammelled and confined in all things that the absence of any freedom is but too manifest. The orders and proclamations from time to time issued are so rigid that it would be impossible to carry out the penalties therein, except with the utter ruin of the burghers.' The natural effect of this narrow and tyrannous rule was discontent, amounting often to disaffection. After a time every endeavour was made to escape beyond the immediate control of the authorities. Thus the 'trekking' system, with its attendant evils, the bane of South Africa, was born. By their illiberal spirit, which sought but temporary commercial advantage in connexion with the Eastern trade, the Dutch authorities themselves, although generally humanely disposed towards the natives, created the system which caused their oppression and extermination."

When it is borne in mind that the Dutch at the Cape were for one hundred and forty-three years under the rule of the Dutch East India Company, *i.e.*, for considerably more than half the period of their entire residence in that country, the importance of a correct appreciation of the nature of that rule to any student of South African history is obvious. No modern writer — not even the South African historian Dr Theal—approaches Watermeyer either in the completeness of his facts or the severity of his indictment. Referring to the policy of the company, Watermeyer says:—

"The Dutch colonial system as exemplified at the Cape of Good Hope, or rather the system of the Dutch East India Company (for the nation should not wholly suffer under the condemnation justly incurred by a trading association that sought only pecuniary profit), was almost without one redeeming feature, and was a dishonour to the Netherlands' national name. In all things political, it was purely despotic; in all things commercial, it was purely monopolist. The Dutch East India Company cared nought for the progress of the colony—provided only that they had a refreshment station for their richly laden fleets, and that the English, French, Danes, and Portuguese had not. Whatever tended to infringe in the slightest degree on their darling monopoly was visited with the severest penalties, whether the culprit chanced to be high in rank or low. An instance of this, ludicrous while grossly tyrannical, is preserved in the records. Commander van Quælbergen, the third of the Dutch governors of the colony, was dismissed from the government in 1667, and expelled the service of the company, because he had interchanged civilities with a French governor bound eastwards, the United Provinces being then at peace with France. 'Not only,' so the despatch appointing Quælbergen's successor complained, 'had he ventured to give the French a kindly reception ashore, but he had quitted his post in the fort, and had proceeded on board of the French ship, a most inexcusable fault, for which the Chamber of XVII. felt bound to express their grievous displeasure, as subversive of all military discipline.'

"Of this nature was the foreign policy of the Dutch company at the Cape of Good Hope; modified, indeed, in some degree from time to time, but governed by principles of jealous, stringent monopoly until the surrender of the colony by Commissioner Sluysken in 1795. The internal government of the colonists for the entire duration of the East India Company's rule was always tyrannical, often oppressive in the extreme. With proclamations, placaats, and statutes abundantly filling huge tomes, the caprice of the governor was in truth the law. The excesses and enormities of van der Stell at a comparatively early period of our history, of van Plettenberg and a despotic functionary, the 'Independent Fiscal' Boers, towards the close of the last century, and of many intervening petty tyrants, are in truth almost incredible to us, who, called freemen, enjoy the rights of freemen, and who would fain believe that those who bore this name in our country in the olden time were privileged, as we are, to know the blessings of liberty. A mockery of popular institutions, under the name of a Burgher Council, indeed existed; but this was a mere delusion, and must not be confounded with the system of local government by means

of district Burgher Councils which that most able man, Commissioner de Mist, sought to establish during the brief government of the Batavian Republic from 1803 to 1806, when the Dutch nation, convinced and ashamed of the false policy by which they had permitted a mere money-making association to disgrace the Batavian name, and to entail degradation on what might have been a free and prosperous colony, sought to redeem their error by making this country a national colonial possession, instead of a slavish property, to be neglected, oppressed, or ruined, as the caprice or avarice of its merchant owners might dictate."

From time to time servants in the direct employment of the company were endowed with the right of "free burghers." One of the documents conferring this privilege was brought to light by the researches of Watermeyer. It is a quaint instrument, and will illustrate better than anything else can the attitude of the Government to the colonists:—

"Joachim van Plettenberg, Governor of the Cape of Good Hope and its dependencies, greeting; Whereas Johan Hendrik Gans, of Lippolsberg, who arrived here in the year 1770 with the ship *Veldhoen*, as soldier at the pay of nine guilders per month, hath by petition particularly requested of us to be discharged from the service of the Honourable Company and to be appointed (aangesteld) as burgher, having duly served the Honourable Company.

"Wherefore, we graciously grant his request to earn his livelihood here, or elsewhere within the colony, with his handicraft as a tailor; but that he shall not be allowed to abandon the same, or to adopt any other mode of living, unless he shall first have obtained special permission thereto from this Council, and that he shall not petition for any grant of land from the Honourable Company, which specially reserves the right and power, at any time when it may be deemed necessary, or whenever his conduct shall not be proper, to take him back into service in his old capacity and pay, and to transport him hence, if thought fit; further submitting him to all such placaats as have already, or may in future be enacted regarding freemen.

"Done at the Castle of Good Hope, 5th September 1780.

"J. VAN PLETTENBERG.

"O. M. BERGH, *Secretary*."

"This right to enforce into servitude those who might incur the displeasure of the governor or other high officers was not only exercised with reference to the individuals themselves who had received this conditional freedom: it was claimed by the Government to be applicable likewise to the children of all such."

The Trek Boers. The effect of this tyranny was inevitable: it drove men to desperation. They fled from oppression; and thus trekking began, not in 1837, as is generally stated, but before the commencement of 1700. From 1720 to 1780 trekking had gone steadily forwards. In 1780 van Plettenberg, the governor, proclaimed the Sneeuwbergen the boundary of the colony, expressing "the anxious hope that no more extension should take place, and with heavy penalties forbidding the rambling peasants to wander beyond." In 1789 so strong had feeling amongst the burghers become that delegates were sent from the Cape to interview the authorities at Amsterdam. After this deputation some nominal reforms were granted; but in 1795, after a further period of disaffection at the Cape, a number of burghers settled in the Swellendam and Graaff Reinet districts drove out the officials of the company and established independent governments. This rebellion was accompanied by an assertion of rights on the part of the burghers or freemen, and this same declaration contained the following clause, from the spirit of which the Trek Boers never really departed:—

"That every Bushman or Hottentot, male or female, whether made prisoner by commanders or caught by individuals, as well in time past as in future, shall for life be the lawful property of such burghers as may possess them, and serve in bondage from generation to generation. And if such Hottentots should escape, the owner shall be entitled to follow them up and to punish them, according to their merits in his discretion.

"And as to the ordinary Hottentots, already in service, brought up at the places of Christians, the children of these shall be compelled to serve until their twenty-fifth year, and may not go into the service of any other save with their master's consent; that no Hottentot, in future, deserting his service shall be entitled to refuge or protection in any part of the colony, but that the authorities throughout the country shall immediately, whatever be the alleged cause of desertion, send back the fugitive to his master."

After one hundred and forty-three years the rule of the Dutch East India Company came to an end at the Cape. What its principles were we have already seen. Watermeyer recapitulates its effects as follows:—

"The effects of this pseudo-colonization were that the Dutch, as a commercial nation, destroyed commerce. The most industrious race of Europe, they repressed industry. One of the freest states in the world, they encouraged a despotic misrule in which falsely-called free citizens were enslaved. These men, in their turn, became tyrants. Utter anarchy was the result. Some national feeling may have lingered; but, substantially, every man in the country, of every hue, was benefited when the incubus of the tyranny of the Dutch East India Company was removed. Since then the advancement of the colony, both under an English and a brief Dutch administration (1803 to 1806), has been as rapid as that of any in the world. So great has been the progress, so utterly different is the condition of the inhabitants, so much has in the intermediate sixty years been effected, that it is with incredulity, and with some effort, that we are compelled to accept the fact that affairs within so short a period were in the state which our history describes."

To this one further note must be added. The Trek Boers of the 19th century were the lineal descendants of the Trek Boers of the 18th. What they had learnt of government from the Dutch East India Company they carried into the wilderness with them. The end of the 19th century saw a revival of this same tyrannical monopolist policy in the Transvaal. If Watermeyer's formula, "In all things political, purely despotic; in all things commercial, purely monopolist," was true of the government of the Dutch East India Company in the 18th century, it was equally true of Mr Kruger's government in the latter part of the 19th.

The British at the Cape. In 1806, as one of the results of war, France and Holland being united against Great Britain, the Cape was seized by a British force. In 1814, at the close of the war with Holland, Great Britain surrendered to her all colonies seized during the war, with the exception of the Cape and portions of what are now British Guiana. In consideration of retaining these territories Great Britain paid to Holland £6,000,000. The British title to Cape Colony is thus based upon conquest, treaty, and purchase. The population at that time was estimated at 26,700 Europeans, 17,650 free Hottentots, and 29,000 slaves. We have now dealt with the introduction of Portuguese, Dutch, and British to South Africa. Germany did not enter upon the scene until 1883, when the German flag was hoisted in Damaraland, on the south-west coast.

The native races. Before tracing the development and history of the country during the 19th century, and endeavouring to estimate the part that the European races have played, it is necessary to consider the native races of South Africa. The natives first encountered by the early voyagers and the Dutch settlers at the Cape were the Hottentots. They at this time occupied the Cape peninsula and surrounding country, and in the early days of the settlement caused the colonists a considerable amount of trouble. An extract from the diary of van Riebeek in 1659 will best illustrate the nature of the relations existing between colonists and natives at that time:—

"*3rd June.*—Wet weather as before, to the prevention of our operations. Our people who are out against the plundering Hottentots, can effect nothing, neither can they effect anything against us; thus during the whole week they have been vainly trying to get at our cattle, and we have been trying vainly to get at their persons; but we will hope that we may once fall in

with them in fine weather, and that the Lord God will be with us."

The Hottentots, like the other negroid races of Africa, lived in clans or tribes and occupied kraals or villages. They tilled the soil to a limited extent, and possessed flocks and herds. A study of their ethnology, language, &c., will be found under HOTTENTOTS (see also under AFRICA: *Ethnology*). Throughout Cape Colony to-day the Hottentots chiefly reside as servants on farms, although in Namaqualand the Namaquas and Korannas are both Hottentot tribes, and still live in a state of semi-tribal independence. The Bushmen resemble the Hottentots to some extent in appearance. They are a race of pigmies (see BUSHMEN). Between the Bushmen and Hottentots in the early days an inveterate hostility usually existed. Yet occasionally a party of Bushmen would be attached as hunters and scouts to a Hottentot tribe. For the most part, however, both among black and white races, the Bushmen's hand has been against every man and every man's hand against him. To-day the Bushmen have almost disappeared from Cape Colony, though the abundant evidence of their deserted caves and old habitations attest that they once resided there in considerable numbers. When first known to the early colonists, they were inveterate stock thieves, and were treated by the Boers as wild animals, to be shot whenever an opportunity occurred. The habitat of these pigmy races is a wide one, and extends from the Libyan deserts of Herodotus through the regions of Central Africa to the Cape. To-day such Bushmen as are left in South Africa are to be found chiefly in the deserts of the south-west. Such opposition as Hottentots and Bushmen were able to offer to colonization was not difficult to overcome. The feuds of the early days with the Hottentots soon came to an end, and the Bushmen, who lived in small communities, were hunted like wild game. The formidable native power of the great Bantu tribes was not encountered until later in the 18th century, when the boundary of the colony was extended to the Fish river (see BANTU). The first of the Kaffre wars, of which a long series occurred in the 19th century, was in 1811, when the Kaffres crossed the Fish river and occupied neutral territory to the south of it. The Bantu, like the Europeans, were invaders of South Africa, and while the European tide of immigration flowed in from the south, the Bantu came in successive migrations from the north down the east coast of South Africa. The meeting of these rival invaders on the Kaffre frontier was the scene of many bloody conflicts. In 1819 the Kaffres again crossed the Fish river, and, headed by Mahana, a prophet, they penetrated through the dense bush country lying to the south of the Fish river, and attacked in large numbers the fort and settlement at Grahamstown, which was defended by only 320 men. The Kaffres were finally driven off; but this last invasion convinced Lord Charles Somerset, then governor of the colony, of the necessity for a line of frontier forts and a more numerous settlement of colonists. Representations on the matter in England, coupled with assurances from Somerset as to the fertility of the district, induced the British Government to vote £50,000 for the purpose of sending out a number of emigrants. Applications were called for, and no less than 90,000 were received. Of these, only 4000 were selected and shipped to South Africa. They were landed in 1820, in Algoa Bay, where they founded Port Elizabeth and the Albany settlement. Among these settlers were a number of married men with families. They were recruited from England, Ireland, and Scotland, and came from all grades of society. Among them were cadets of old families, retired officers, professional men, farmers, tradesmen, mechanics, and labourers. They encountered many difficulties and some suffering in their early days, but on the whole they throve and prospered. Their descendants, the Atherstones, Bowkers, Barbers, Woods, Whites, Turveys, and a number of other well-known frontier families, are to-day the backbone of the eastern province, and furnish the largest portion of the progressive element in Cape Colony. Among them was a gifted Scotsman named Thomas Pringle. His poem entitled "Afar in the desert I love to ride" and other poems have depicted the scenes of those early days in glowing and eloquent lines. The vast spaces of the veld, the silence of the solitudes, the marvellous varied and abundant animal life, the savage half-weird character of the natives, and the wild adventure of the early colonists have been caught with a true spirit of genius. Since his day no one, unless it be Olive Schreiner in *The Story of an African Farm*, has so vividly painted the life and the atmosphere of that vast continent lying to the south of the Zambezi. Pringle did more than write poetry: he opposed the somewhat despotic rule of Lord Charles Somerset, and gallantly stood up for the causes of liberty of the press and education in the colony. In 1826 he returned to England and threw himself into the anti-slavery agitation. He became secretary of the Society for the Abolition of Slavery, and heartily co-operated in the great work it had undertaken. He was the author of the lines, at one time famous—

British settlers of 1820.

> "Oppression, I have seen thee face to face,
> And met thy cruel eye and clouded brow."

Emancipation of slaves.

In 1834 occurred another terrible Kaffre invasion. Many Europeans were massacred, farmhouses burnt, and an enormous quantity of stock taken from the colonists, before the Kaffres were eventually driven back across the Keiskamma river. In the same year the Slave Emancipation Act, emancipating all slaves throughout the British Empire, came into force. The slaves in Cape Colony, who consisted chiefly of imported negroes from the West Coast of Africa and of Hottentots, were estimated at the time at 36,000. These slaves were valued at the Cape at £2,000,000. The sum actually voted by the British Government to slave-owners in Cape Colony, out of a total compensation paid of £20,000,000, was £1,250,000. This money was unfortunately only made payable in London, and the farmers were compelled to sell their claims for compensation to agents, who frequently paid a merely nominal price for them. In many instances farmers found themselves quite unable to obtain native labour for a considerable time subsequent to the emancipation, and in some cases, no doubt, ruin was the result. The feeling created among the Dutch colonists was very bitter. Many of the farmers, who had parted with their claims to compensation for a trifling sum, found themselves without labour or means of paying for it. At the same time, of the soundness of the general principle of the Act of Emancipation there cannot be a shadow of question.

Quite apart from the actual tyranny exercised over the natives, from which they suffered heavily, there was a still more disastrous result of slavery in South Africa. The ownership of native women led to a numerous bastard offspring, some of whom were in due course themselves sold as slaves. The influence upon the owners of such a practice as this was degrading to a degree. The intimate contact, lasting now for two centuries, between the Dutch and the natives, has exercised a marked influence upon Boer character. The liberation

of the slaves doubtless diminished the evil effect of this influence, but among the Boers of the Transvaal a system of apprenticeship hardly less rigid than slavery has existed down to the present day. In justice to the Dutch, it is only fair to say that the question of the relationship between white master and black servant has always been a difficult one. The difficulties were greatly enhanced where master and servants lived on distant farms, two or three days' journey from a magistrate or field cornet. A system of punishment applicable on the spot was a necessity, and summary justice was often administered long after slavery ceased to exist. If the Boers have erred by undue harshness to the natives, colonists of British origin must not be entirely acquitted. And the fact must not be lost sight of that the native is not infrequently a most untrustworthy and lazy servant, as well as an inveterate drunkard if he can obtain access to alcohol.

The missionaries.

Foremost in championing the natives were the missionaries. The missionaries have been attacked not only by Dutch but by British colonists. Their zeal, it is certain, has frequently outrun their discretion. Their success in making converts, at least among the Bantu tribes, has been limited. Moreover, a longer experience of all the African negroid races has led to a considerable modification in the views originally held in regard to them. The black man is not simply a morally and intellectually undeveloped European, and education, except in rare instances, does not put him on a par with the European. There is a tendency in all the negroid races for mental development to cease at a much earlier age than in the European. But after all has been said against the extreme attitude of some of the missionaries, no unprejudiced man will deny that their work on the whole has been a good one. The fair fame of Great Britain has more than once been upheld in South Africa at the instigation and by the conduct of these intrepid pioneers. Moffat and Livingstone among the Bechuanas, Cassalis among the Basutos, Dr Stewart in Cape Colony, have all had a beneficent influence upon the natives around them. They have opposed the sale of alcohol, denounced inhumanity from the farmers, encouraged the men to labour and taught them mechanical arts. To-day technical education is still further taking the place of doctrinal discourse, and the effect is an excellent one.

Limits of British jurisdiction.

In 1836 an Act was passed which set a limit to the jurisdiction of the Cape Government in South Africa. It was entitled the Cape of Good Hope Punishment Act, and under it the Cape colonial courts were empowered to deal with the offences committed by British subjects in any part of South Africa up to the latitude of 25 degrees. The importance of the Act lies chiefly in the limit given to British powers at an early date. On the strength of it, the Boers who subsequently trekked away from the colonies were warned that by so trekking they did not pass out of the limits of British jurisdiction.

The Great Trek.

From 1836 to 1840 what is known as the Great Trek occurred. A number of the more turbulent spirits among the Boers, impatient of British rule, emigrated from Cape Colony into the great plains beyond the Orange river, and across them again to the fastnesses of the Zoutspanberg, in the northern part of the Transvaal. Various reasons for this trek have been assigned. Among the Boers of the Graaff Reinet and other frontier districts the tradition of rebellion against every form of civilized government had existed since the days of their first revolt against the East India Company. They now protested against what they considered the misrepresentation by the missionaries of their attitude towards the natives. They further objected that the wars on the Kaffre frontier were of a ruinous and disastrous character, and were not sufficiently dealt with by the Cape Government. Finally, what exasperated them beyond everything was the abolition of slavery. In relation to this trek, it is as well that the cause advanced by their leader Piet Retief in 1837 should be put on record. The manifesto dealt with various points, but the one in reference to the abolition of slavery ran as follows:—"We complain of the severe losses we have been forced to sustain by the emancipation of our slaves, and the vexatious laws which have been enacted respecting them." It was estimated that during the four years in which the trek lasted no less than 7000 persons took part in it. Sir Benjamin D'Urban, who was governor at the time, desired to stop the trek, but could find no means of doing so; and when urged by the colonial authorities to take some steps in the matter, he replied that he could see no means "of stopping the emigration except by persuasion and attention to the wants and necessities of the farmers."

At the outset misfortune appeared to dog the footsteps of these pioneers. They had no sooner crossed the Vaal river than they encountered the Matabele under Moselekatze. After an initial defeat at his hands, and the loss of much of their stock, they were eventually victorious, and in 1838 drove Moselekatze out of the country. Moselekatze having been defeated, the Boers, under Piet Retief, turned their attention to Natal, and marched towards the coast. Under the Drakensberg, while interviewing a chief of the Zulus named Dingaan, some sixty-five Boers under Retief were treacherously murdered by him. Other trekkers followed in the wake of Retief, and attacking Dingaan, avenged the massacre, although not before a number of Boers—men, women, and children—had been massacred by the natives at Weenen (the Place of Weeping). In July 1838 the British Government announced that they could not allow the establishment of an independent state by "any of Her Majesty's subjects, which the emigrant farmers continued to be." Sir George Napier, who had then been appointed governor, issued a proclamation warning the trekkers to return to the colony, and also stating that he should take immediate possession of Natal at an early date. Meanwhile the emigrant farmers had established what they called the Republic of Natalia, elected a Volksraad, and founded the town of Pietermaritzburg.

In 1841 the Volksraad of the "Natalia Republic" requested "that a free and independent state in the closest alliance with the British Government" might be recognized. In reply to this Sir George Napier wrote saying that "Her Majesty could not acknowledge the independence of her own subjects, but that the trade of the emigrant farmers would be placed on the same footing as that of any other British settlement upon their receiving a military force to exclude the interference with or possession of the country by any other European Power." To this the Volksraad in Natal replied that they had asserted and maintained their independence ever since leaving the colony, and they could not surrender it. Troops were then sent to the country, and several skirmishes occurred between the Boers and the British forces. At the conclusion of these a settlement was proposed by Mr Cloete, the British Commissioner, and eventually those Boers who had come down from beyond the Drakensberg withdrew, returning to their homes. Those remaining behind in the territories of Natal accepted the constitution of a British colony.

A feature in the policy of the British authorities at this time in South Africa, and one which arose out of the

Native treaty states.

strong representations of the missionaries, was the establishment of what were known as treaty states, in which the territory and rights of certain natives were defined. The first of these was made between Cape Colony and the chief of the Griquas, Andries Waterboer, in 1834. This treaty alleged that Waterboer was the "friend and ally" of the colony, and it also defined his boundary extending along the Orange river. It further agreed to supply him with a certain quantity of muskets and ammunition. Waterboer was the chief of some three or four thousand Griquas, a bastard race which had sprung up from the intercourse between Boers and native (principally slave) women. In 1843 two more of these treaty states were established, one under Adam Kok and the other under Moshesh. Adam Kok had under him a small number of Griquas, who dwelt in the country east of that occupied by Waterboer. And east of this country again was a tract of territory occupied by Basutos under Moshesh. In the same way Pondoland was established as a treaty state in 1844. At a later date it was found that in the country allotted to Adam Kok and his Griquas there were settled some thousand emigrant Boers. Thus the arrangement with Adam Kok naturally gave rise to a good deal of bitterness on the part of the Boers. They said it was not their intention to drive the coloured people from their dwellings, but it was their wish that they also should have their rights respected. Skirmishing between Boers and Griquas occurred, and eventually a force of 200 British troops was sent to the scene of disturbance. The result of this expedition was that Kok's territory was divided into two districts, one being retained exclusively for the natives, and the other for white men as well as natives. The government of both these territories was for a time under a British Resident. From the small station at which this agreement was drawn up the town of Bloemfontein eventually developed, and subsequently became the capital of the Free State. Difficulties arose at this time also in Basutoland with the natives, and Major Warden defined the Basutoland boundary. This boundary, known as the "Warden line," divided the Basutos from the emigrant Boers. Its definition did not by any means terminate the strife between Basuto and Boer.

Orange River Sovereignty.

In 1848 Sir Harry Smith proclaimed the country between the Vaal and Orange rivers British territory, under the name of the "Orange River Sovereignty." The battle of Boomplaats followed, in which Sir Harry Smith routed the Boers. Meanwhile the Boers were having considerable trouble amongst themselves on the northern side of the Transvaal, arranging for the government of their country. They eventually evolved a very unsatisfactory system, which was practically one of district governments. The result and extent of this system will be found described under TRANSVAAL. Sir Harry Smith, who was one of the most energetic, enterprising, and brave governors that South Africa ever had, and who had been responsible for the founding of the Orange River Sovereignty, was shortly after the establishment of the sovereignty reprimanded, and eventually recalled.

The Transvaal.

In 1852 the Boers, claiming complete supremacy in the district, turned back an Englishman who was travelling through Bechuanaland towards the interior (see BECHUANALAND). Livingstone's protest at this time was an important one, and his testimony as to the cruelty of the Boers towards the natives is of interest. The Boers plundered his house, destroying his books and taking away his goods. In 1852 the Sand River Convention was signed, which guaranteed to the Transvaal Boers the independence of their state.

Orange Free State.

In 1853 the Bloemfontein Convention was arranged by Sir George Russell Clark, on behalf of the British Government, with the Free State. Under this convention the Orange River Sovereignty was handed over to delegates appointed to receive it. Both in the Sand River and Bloemfontein Conventions clauses were inserted stating that Great Britain had no alliance whatever with any native chiefs or tribes to the north of the Orange and Vaal rivers, with the exception of the Griqua chief Adam Kok. It was further stipulated that neither the Transvaal nor the Orange River Government should permit slavery or trade in slaves in their territory. Numerous protests were made at the time, from many of the inhabitants of the Orange River Sovereignty, against the abandonment of it by the British Government, but the Duke of Newcastle, who was then in office, replied that the decision was inevitable, as British responsibilities in South Africa required restricting rather than extending, especially (he added) "as Cape Town and part of Table Bay were all she [England] really required in South Africa" (see ORANGE RIVER COLONY). The abandonment of the Orange River Sovereignty in the territory north of the Orange river, against the wishes at the time of many of the emigrant Boers, was the first great blunder made by the British Government in their dealings with the emigrants.

Sir George Grey.

When the Great Trek occurred, two courses obviously lay before the British authorities: either to let the Trek Boers go, and give them their blessing and liberty, or to repudiate and discourage the trek from the outset. The action taken by the British authorities was one of vacillation between these two courses. In the words of Mr Paul Botha, a Boer writer, England first blew hot and then blew cold. In 1854 Sir George Grey was sent to the Cape as governor. He had no sooner arrived than he addressed himself with energy and diligence to the great problems awaiting him. He at once resolved that in dealing with the natives the policy of continually fighting was not altogether satisfactory. Up to the time of his arrival little or nothing had been done in the matter of education, and he now determined, to the utmost of his ability, to encourage the dissemination of knowledge among the natives. He visited the kraals in British Kaffraria, and thoroughly acquainted himself with the peculiarities of the Bantu tribes. He then addressed himself to the missionaries of various denominations, and offered pecuniary aid in the establishment of large industrial schools, in which the boys should learn not only to read and write, but to work as mechanics, and where they should be trained in industrial habits. These societies and schools continued for some time, but were discontinued at a later date when the grant was curtailed. The school at Lovedale, however, still exists, and has continued to do good work. The plan of technical education among the Kaffres has recently been reintroduced, and is now received with more general favour.

In 1858 Sir George Grey, who had acquainted himself thoroughly with the South African Boers, proposed confederation between the various South African states. In making this proposition to Sir E. B. Lytton, he wrote at the time: "Experience has shown that the views which led to the dismemberment of South Africa were mistaken ones. In point of fact, her Majesty's possessions here are of great and yearly increasing value to the trade and commerce of Great Britain." As if to justify the sanguine prediction of Sir George Grey, the Free State, in December of the same year, having found that independence had brought numerous troubles in its train, and being weary of native wars, wrote to Sir George Grey,

conveying a resolution of their Volksraad in favour of federation with the Cape Colony. Sir George Grey was highly pleased to receive this communication, and urged the home authorities to adopt it. Unfortunately, his views with regard to federation and the reconciliation of the Dutch at this early stage did not meet with the approval of the British Government, and the proposition fell through. Sir George Grey had the mortification of seeing nearly every proposition he made rejected. In a despatch to the Colonial Office, on the 20th July 1859, he wrote as follows:—"With regard to any necessity which might exist for my removal on the ground of not holding the same views upon essential points of policy as her Majesty's Government hold, I can only make the general remark that during the five years which have elapsed since I was appointed to my present office there have been at least seven Secretaries of State for the Colonial Department, each of whom held different views upon some important points of policy connected with this country."

The request of the Free State Boers for federation with Cape Colony having been rejected, the inhabitants of the two republics were now left to develop their own institutions and government to the best of their ability. The Free Staters, owing chiefly to their acquiring at an early stage a most enlightened and liberal leader in President Brand, were fairly successful. The turbulence and continued unrest of the Transvaal Boers, on the other hand, kept their country in a state bordering on chaos (see TRANSVAAL). In 1877 the Transvaal once more came under British rule.

British and Dutch.

Up to the year 1870 the Dutch considerably outnumbered the British inhabitants not only in Cape Colony but throughout South Africa. At the time of the British annexation of Cape Colony the colonists were entirely of Dutch and Huguenot extraction, and although the settlers of 1820 had brought a British element among the colonists, and an element which has thriven and prospered, the Dutch continued, even after the Great Trek, to be considerably in a majority. The industries of the colony were almost entirely pastoral, and remained chiefly in the hands of the Dutch. Continual feuds with the Kaffres, and also the continual desire to trek into new countries, all tended to keep back farming as an industry, and the country in the years 1867 to 1870 was in a generally very depressed condition. The Zulus during these years went on foraging expeditions into the Transvaal, and threatened Natal. The Basutos were continually at feud with the Free State. The Kaffres had a series of wars, preceded usually by massacre, chiefly with the British colonists on the eastern frontier of Cape Colony. In 1870 a new era opened for South Africa. The era of commercial expansion began. In that year, following smaller finds of diamonds on the banks of the Vaal and Orange rivers, the diamond mines of Du Toits Pan and Bultfontein were opened up. In 1869 gold had been found in the Lydenburg and Zoutpansberg districts in the Transvaal, and diggers had resorted there from different parts of the world; moreover, farther up the country, in the territories of Mashonaland, Bain had reported discoveries of gold. Among the purely pastoral population ostrich-farming became a new industry, and added a considerable asset to the wealth of the colony. The revenue derived from the export of ostrich feathers in 1899 was recorded at half a million. It was, however, the mineral discoveries of diamond and gold that chiefly determined a new departure in the development of the country. Emigration, which had been going on slowly for some time past, now largely increased. Men rushed to the diamond fields, and in smaller numbers to the new gold fields of the Transvaal. From that time the immigration of Europeans of other than Dutch extraction went steadily on. The extension of railways, the influx of capital, the providing of markets for the produce of the country, were all due to the opening up of the gold and diamond mines. As the development of these industries proceeded, the line which divided the Boers from the colonists of British extraction became more clearly marked. It was soon evident that the Boer had little faith in and less capacity for mining, either as a digger on the diamond fields or as a prospector on the new gold-fields. He remained on his farm, content to reap such benefit as might be derived from the sale of farms at greatly enhanced prices, and also with what he could obtain in the way of cash for the small products he was able to offer in the various mining camps. On the other hand, a large mining population soon grew up, first of all at Kimberley, afterwards in and around Lydenburg and Barberton, and finally at Johannesburg—a population modern in its ideas, energetic, educated, cosmopolitan, appreciating all the resources that modern civilization had to offer them, and with a strong partiality for the life of the town or the camp rather than that of the farm and the veldt. The Boers remained very much what they had been in the 17th century. Their life of continual strife with natives continual trekking to fresh pastures, had not been conducive to education or the acquirement of civilization. In religion they were puritanical, fanatic, and their old traditions of Dutch East India government, together with their relation to the natives, undoubtedly developed a spirit of caste and even tyranny.

In the competition which now set in for such wealth as is won in cities, the Boer found himself hopelessly handicapped. From Cape Town to the north of the Transvaal a considerable difference has always existed amongst the inhabitants of Dutch origin. Beginning with the Dutch of Cape Town and the Western Province, many are enlightened gentlemen, who are well educated themselves and have sent their sons to European universities. Farther out in the Graaff Reinet and other districts of Cape Colony a more primitive life obtains among the Dutch, and in the Free State existence was of even a simpler character. Nevertheless, the history of the Free State, under the masterly presidency of Brand, shows that the Boers of that country evinced a considerable knowledge of the advantages of civilization, and in a measure endeavoured to increase them. Farther north, again, the Boer is a wilder and more turbulent spirit, as the history of the Transvaal down to 1877 testifies, until on the northern frontier of the Transvaal are to be found some of the wildest specimens of white men anywhere extant on the face of the globe. A race of hunters, and it is to be feared of slave-owners, they respected neither the laws of their own people nor sometimes those of humanity. The Boers were a prolific race, and in spite of all their losses from war, pestilence, famine, and other causes, they continually increased in numbers, if not in civilization. This increase did not, however, keep pace with the continual inflow of immigrants which began about 1870, and in 1872 we find the European inhabitants of the diamond fields returned at 35,000.

Sir Bartle Frere and confederation.

It was at this stage of affairs that responsible government was granted to Cape Colony. From that time down to the annexation of the Transvaal in 1877, to quote once more the homely phrase of Mr Botha, Great Britain "blew hot" in South Africa. Lord Carnarvon was Secretary of State for the Colonies, and in 1876 he appointed Sir Bartle Frere as High Commissioner of South Africa. Sir Bartle Frere's special mission was to further the confederation of the

states of South Africa, and in making the appointment Lord Carnarvon went so far as to express to Frere the hope that he would be the first governor-general of the South African Dominion. Meanwhile things had reached a critical stage in the Transvaal: the treasury was empty; the two factions were in open feud with one another; President Burgers was unable to raise taxes; the Boers were threatened with invasion from the Zulus, and were unable to suppress a native rising within their own territories. Under these circumstances, on 12th April 1877 Sir Theophilus Shepstone, who had been sent to Pretoria to investigate the state of affairs, annexed the Transvaal to Great Britain. Shepstone did not take this step until he had convinced himself that it was the only step which could save the Transvaal from ruin. His motive and the evidence which was before him are fully discussed under TRANSVAAL. In 1880 a change occurred in the Government of Great Britain, and with it there occurred another of those alterations of policy which have been so disastrous in South Africa. Great Britain once more "blew cold." Mr Gladstone returned to power, and with his return the hopes of the dissatisfied Boers in the Transvaal, who were already agitating for retrocession of the country, were still further encouraged. In 1880 the fate of Sir Harry Smith and Sir George Grey overtook Sir Bartle Frere. Frere, whose coming had been heralded with such encouraging messages, was recalled. In October 1880 he received a cablegram from Lord Kimberley that "there has been so much divergence between your views and those of her Majesty's present Government on South African affairs, that . . . they have with regret come to the conclusion that her Majesty should be advised to replace you by another Governor." It was such vacillation as this on the part of Home Governments which won for South Africa the title of "the grave of reputations." An article in the *Nineteenth Century* in 1880 by Sir Bartle Frere exactly expresses the attitude of the Transvaal Boers, and shows a true insight on the part of the writer:—

Annexation of Transvaal.

> "What the Boers individually wished for [he wrote] was individual independence of law and government generally, not of this or that foreign Government, but to obey no one by force of law; to be far from power of compulsion; to see, as they put it, no other man's smoke; to be free and unfettered in the wilds. This was the object of their aspirations. For national life and national independence they had a sentiment; but for national liberty they were not willing to make any sacrifice of individual licence or power to refuse obedience to law. The limits within which such freedom was possible had been reached before Mr Burgers undertook to attempt the task of governing."

The recall of Sir Bartle Frere was followed by a rebellion among the Boers in the Transvaal. In 1881, after a series of severe skirmishes terminating in the battle of Majuba, where the Boers were entirely victorious over the British forces, a treaty was signed between Sir Evelyn Wood and the Boer generals, and once more the Transvaal was recognized as an independent state. The terms on which this independence was granted were clearly defined, first of all in the Pretoria Convention of 1881, and subsequently in the London Convention of 1884. The boundaries of the Transvaal were defined in both conventions, the right of control in all foreign relations was retained by her Majesty's Government, and the suzerainty of the Queen was reserved. On these conditions the independence of the Transvaal in the conduct of its own affairs was duly recognized. In 1882 the Afrikander Bond, which had its origin at Bloemfontein and the Paarl, came into existence, and was joined by members in the Free State, Transvaal, and Cape Colony. The Cape Colony branch of the Bond dissociated itself later from those in the republics. With regard to the formation of the Bond, it is only fair to say that although the Bond partially originated in Bloemfontein, it was strongly denounced and openly discouraged by President Brand, then ruling the Free State. From this time forth the Dutch in South Africa on all political questions divided into two camps. These two camps were represented by President Kruger and his intriguing following in the Transvaal, and by President Brand, with an enlightened following of Free State Boers, in the Orange Free State. In Cape Colony, on the other hand, there was Mr Hofmeyer, at the head of the Bond, with a number of followers in intimate correspondence and relationship with Mr Kruger, while a small number of enlightened Dutchmen held aloof (see CAPE COLONY).

Transvaal rebellion and retrocession.

The Afrikander Bond.

From the signing of the Pretoria Convention the Transvaal Boers, who had never respected their own laws, showed that they had very little intention of respecting conventions. They raided over their borders to the west, north, and east. In the east they established the "New Republic" in Zululand, and on the west the republics of Stellaland and Goshen in the territories of Bechuanaland. Their aggressive action in Bechuanaland led, in 1884, to the Warren expedition, which expelled the Boers from Bechuanaland and compelled them to remain within their borders. It was about this time that Mr Hofmeyer thought it expedient to modify the extreme tone of his Bond policy, and that Mr Rhodes became a factor in Cape politics. The Warren expedition was clear evidence to the Bond and the rest of South Africa that whatever else Great Britain might contemplate, she did not propose either to withdraw or give up all claims to supremacy in South Africa.

The Conventions.

The year 1883 saw the introduction of another European Power into South Africa. The German flag was hoisted over Germany's first colony on the shores of Angra Pequeña Bay, in Damaraland. German missionaries had been settled on this coast for some time, and had previously on more than one occasion asked both the Imperial and Cape Colony Governments for protection. In 1878 Sir Bartle Frere had urged the British Government to respond to these appeals, saying that if they were neglected Germany would certainly step in. The result was the annexation to Great Britain at that time of Walfish Bay, with a small strip of territory adjoining. This port was handed over to Cape Colony in 1884. Meanwhile the colonial party in Germany had used their influence to obtain further expansion, and in August of 1884 Germany finally annexed 322,450 square miles of country, with a coast-line of 930 miles, excluding the small strip of British territory in the vicinity of Walfish Bay. The greater portion of German South-West Africa is a desert and barren country, and at the time of annexation was stated to contain between 2000 and 3000 white inhabitants and about 200,000 natives, chiefly Bantu. In September of the same year a German explorer, Herr Einwald, proposed to take possession on behalf of Germany of St Lucia Bay, on the coast of Zululand. After some correspondence between Great Britain and Germany, it was eventually arranged that Germany should make no annexation on the east coast of Africa south of Delagoa Bay. The whole of Zululand is now a portion of the colony of Natal.

Germany in South Africa.

After the retrocession of the Transvaal in 1881, and the re-establishment of the country under British suzerainty as an independent state, the attention both of the Boers and Europe was turned to Delagoa Bay. In order to

understand the complications which now arose with regard to this port, it will be well to review briefly the history of the territories in which Portugal had from time to time maintained settlements since the end of the 15th century. Vasco de Gama discovered Delagoa Bay in 1498, and it became the site of a small settlement similar to those established at the same time on the west coast of South Africa by the Portuguese. The history of these settlements since their foundation has remained, at least to the world at large, almost unknown. In 1899 investigations among various Portuguese archives at Lisbon and the British Museum in London were undertaken, on behalf of the Cape Colony Government, by Dr Theal, the well-known Cape historian, with a view to obtaining some details as to the records of colonization in these districts. From these researches, and also from the interesting record of events compiled by Mr Pratt in his *Leading Points of South African History*, the following facts have been gathered. The voyages of the early Portuguese navigators were very minutely described by Portuguese historians. They were full of adventure by sea and land. Of those who succeeded Diaz and De Gama, the most distinguished navigator and administrator was D'Albuquerque. He reduced Goa to submission and made it the capital of Portuguese India, of which the coast of Africa formed part. Forts were established at Sofala and Kilwa. Two armed fleets were maintained to keep the seas, the one from Cape Guardafui to the Gulf of Cambay, the other from the Gulf of Cambay to Cape Comorin. This state of things did not, however, last very far into the 16th century; and as Holland, England, and France took up the Eastern trade, that of Portugal declined, and with it also declined the settlements on the African coast. For three hundred years these Portuguese settlements remained depôts of trade, chiefly in gold and ivory, at times being practically abandoned, and again being used in slave traffic. In 1868 Pretorius, then President of the Transvaal, attempted to annex Delagoa Bay, on the pretext that it formed the natural outlet of the Transvaal to the sea. Thereupon both Portugal and Great Britain advanced claims to the port, and the whole matter was eventually referred in 1872 to the President of the French Republic for arbitration. In 1875 an award was given by the French President, Marshal MacMahon, entirely in favour of the Portuguese. While the inquiry was proceeding, an agreement had been come to between Great Britain and Portugal that whichever of them should obtain possession of the Bay, should give the right of pre-emption to the other. Previously to the arbitration the Boers had withdrawn their claim in favour of that of Portugal, on an understanding with the Portuguese that, should the award be given in their favour, they should allow the South African Republic special facilities for the importation of goods, and allow many of them to enter the state duty free. In fulfilment of this understanding a treaty was signed between Portugal and the South African Republic in 1875 granting these privileges, and also consenting to the construction of a railway from the port. President Burgers endeavoured to raise the capital necessary for the building of this railway, but only succeeded in obtaining a portion in Europe, and the scheme fell through. In 1883 an American, Colonel MacMurdo, succeeded in obtaining from the Portuguese Government a concession for the building of a railway from Delagoa Bay to the Transvaal frontier. In 1889 the Portuguese Government arbitrarily seized the railway, which was then open to Komati, the point contracted for and shown in the Portuguese plans, on the alleged ground that the "frontier" was really at a point five miles nearer to Pretoria. This alteration of the boundary and seizure of the railway, it was freely stated at the time, was done at the instigation of the Transvaal. As both American and British subjects were interested in this concession, a strong protest was made to Portugal at the time by the United States and Great Britain. Again the matter was referred to arbitration, on this occasion the tribunal being appointed by the Swiss Government. After a session of no less than ten years, Portugal was, on 29th March 1900, ordered by the court to pay compensation to the holders of the MacMurdo concession. The total amount disbursed was over £900,000. The amount awarded was less than was anticipated, but it was the award of an independent court, and at least went to show that the action of the Portuguese had been unjustifiable (see also ARBITRATION, INTERNATIONAL). In 1895 the Delagoa Bay railway was extended by the Netherlands Railway Company to Pretoria. In the drama of South African history the Portuguese states have not played an important part. Boundary disputes have occurred from time to time with both their Boer and their British neighbours, but with the exception of a few skirmishes in the early days of the British South Africa Company, these have been satisfactorily settled. What interest the Portuguese colonies have aroused in modern times has been centred round Delagoa Bay. While the Transvaal retained its independence, Delagoa Bay, as a port outside British control, was a source of strength to the Boers. Both President Kruger and his Hollander and German advisers interested in the railway concentrated their efforts on a close relationship with Portugal. In the war which began in 1899 munitions of war and recruits for the Boers were freely passed through Delagoa Bay.

Delagoa Bay.

In order to pursue the course of events in South Africa, it is now necessary to return to the British colonies and the Boer republics. If the year 1870 is memorable as marking the dawn of a great commercial era in South Africa, so must 1881 be taken to mark the beginning of a disastrous political period. It is well that the events from 1877 (the date of the British annexation of the Transvaal) onwards should be clearly remembered. In the first place, the Zulu power, which had so long menaced the Transvaal, was broken in 1878 by British forces, and by the expenditure of British money to the extent of £6,000,000, with practically no assistance from the Boers. Within the Transvaal the Bantu tribe, under Secocoeni, another native tribe in Boer territory, was defeated by a British force under Sir Garnet Wolseley. In 1881 the Transvaal was not only again independent, but the amount of its debt was funded and advanced by Great Britain. The Afrikander Bond was founded, with the deliberate intention on the part of its Boer promoters of forming a United States of South Africa under a Dutch flag. The raiding over both east and west boundaries which the Transvaal Boers continued to carry on in the face of conventions was a part of this policy.

The Boer Republic, 1881-87.

The Warren expedition, which cost over £1,000,000, had the effect of checking for a time the extreme ambition of the Dutch party throughout South Africa. Mr Hofmeyr, the leader of the Bond in Cape Colony, considerably moderated his attitude, and in 1887 proposed a Zollverein scheme for the whole British Empire. In the Free State President Brand continued to make his influence felt with the Boers of both republics, insisting upon the importance of a peaceful development of the country and friendly co-operation with the British Government. Mr Kruger remained implacable, bigoted, avaricious, determined on a policy of isolation and exclusion. The

old Transvaal dream which Brand had denounced in the early days (see TRANSVAAL) was now revived and adopted with redoubled fervour. President Kruger would have a seaport of his own, or, if not, Delagoa Bay should have a monopoly of the trade. The Transvaal would enter into an alliance with the Free State, and British trade was to be rigidly excluded. In 1887 a conference was held at Pretoria with delegates from the Free State. The proceedings reveal the gulf existing between the adherents of Kruger and the adherents of Brand (see CAPE COLONY, TRANSVAAL, and ORANGE RIVER COLONY). On the one hand was an undying hatred of Great Britain, combined with a deep scheme of ultimate attack upon British supremacy throughout South Africa; and on the other was a desire to work amicably with all the white races of South Africa for their mutual benefit and the prosperity of the country.

Free State and Transvaal conference.

The conference was followed by a personal visit from President Kruger to President Brand at Bloemfontein. The result was a complete failure to arrive at any treaty whatever. Brand refused to be ensnared in the wild intriguing policy of President Kruger, and while he lived the Free State held aloof. Meanwhile the great gold-fields of Johannesburg, which had been discovered in 1886, were developing by leaps and bounds, and by 1889 the population equalled that of Kimberley. Once more there occurred that rapid increase of the British and European (other than Dutch) population in South Africa, which from the beginning of the mineral discoveries has steadily gone on. From Cape Colony railways continued to be extended towards the new centres of wealth. In 1885 Kimberley was reached, and in 1890 this line was extended to Vryburg in Bechuanaland. In 1889 the Cape railway was extended to Bloemfontein, and in 1892 it reached Johannesburg.

Under the influence of a rapidly increasing revenue from the gold-fields and that system of trade monopolies which Mr Kruger had introduced, the Government of the Transvaal gradually brought into existence a large privileged class of concessionaries and office-holders, until at the outbreak of the war in 1899 one burgher out of every five in the Transvaal held some office or another. The effect of this development was the production of a body of officials in the Transvaal, partly Hollander and German, partly Boer, the majority of whom were very poorly educated, and the whole of whom were pledged supporters of Mr Kruger's Government in any policy, however extravagant, which he might choose to adopt. The Government grew narrower, more exclusive, and more entirely monopolist with every year of its existence. It would almost appear as if Mr Kruger had deliberately set himself to copy the model of the Dutch East India Company at the Cape, of which Watermeyer wrote in 1857 that it was "in all things political, purely despotic; in all things commercial, purely monopolist." Meanwhile

Afrikander Imperialists.

at the Cape there was growing up a party of South African Imperialists, or, as they have been called, Afrikander Imperialists, who came to a large extent under the influence of Mr Rhodes. Among these were Mr W. P. Schreiner and Mr J. W. Leonard, and apparently even to some extent Mr Hofmeyr. From the time of his entrance into politics Mr Rhodes endeavoured to induce the leading politicians and colonists in Cape Colony to realize that a development of the whole country could and should be accomplished by South Africans for South Africans. He fully admitted that the cry which had become so popular since 1881 of "Africa for the Afrikanders" expressed a reasonable aspiration, but he constantly pointed out that its fulfilment could best and most advantageously be sought, not, as the Kruger party and extremists of the Bond persisted in saying, by working for an independent South Africa, but by working for the general development, progress, and prosperity of South Africa on democratic, self-reliant, self-governing lines, under the constitution and beneficent shelter of British colonial rule and the British flag. An independent South Africa such as the Kruger party desired might have resulted in a so-called republic. But such a republic would have been a stranger to all true liberty and equality of rights: it would rapidly have become a prey to the same sort of faction, strife, and anarchy as had obtained in the Transvaal. Mr Hofmeyr's attitude became considerably modified after the Warren expedition. In that year (1884), having the power in his hands at the time of the fall of the Scanlen Ministry, he put Mr Upington into office, with Sir Gordon Sprigg as his colleague. In 1886 Sir Gordon Sprigg became Premier; and in 1890 he was succeeded by Mr Rhodes, who took office with the approval and support of Mr Hofmeyr. Mr Rhodes remained in office as Prime Minister until 1896. During this period of Mr Rhodes's life the part he played in the development and public life of South Africa was greater than that of any other man.

British South Africa Company.

In 1888 Mr Rhodes had succeeded in inducing Sir Hercules Robinson to send Mr Moffat, the missionary, to enter into a treaty with Lobengula, the Matabele chief. Under this treaty Lobengula bound himself not to make a treaty with any other foreign Power, nor to sell or in any other way dispose of any portion of his country without the sanction of the High Commissioner. By this step the country was secured from both the Portuguese and the Dutch, both of whom, more especially the latter, were already making overtures with the object of obtaining the country for themselves. This treaty was followed by the formation of the British South Africa Company, under royal charter (see RHODESIA and CHARTERED COMPANIES) in 1899, and the occupation of Mashonaland by the pioneer expedition in 1890. In 1891 a skirmish was fought with Portuguese forces. In 1893 a war was fought with the Matabele by Dr Jameson, then administrator of Mashonaland, and Bulawayo was occupied. The name Rhodesia was conferred upon the whole country by general consent in 1894. During the whole of these stirring events Mr Rhodes, in addition to being Premier of Cape Colony, was also managing director of the British South Africa Company, and responsible for the conduct of its affairs. He further occupied the position of chairman of the De Beers Consolidated Mines (the great diamond mining corporation in Kimberley), and was busily engaged in developing plans, in conjunction with Mr Alfred Beit, for an extension of the telegraph from Cape Town to Cairo, and the pushing forward of railway communication into the heart of Africa. The political effect of this northern movement was definitely to limit the northern boundary of the Transvaal. Living in Cape Town and at the head of the Government, Mr Rhodes used every effort in his power to demonstrate to the Cape colonists that the work he was doing in the north must eventually be to the advantage of Cape Colonists and their descendants. By this means he checked opposition to the movement which sentimental sympathy with the Transvaal Boers tended to develop under the pretext that the Transvaal, by reason of its proximity, had some sort of reversionary right to the country lying to the north. On the whole, Mr Hofmeyr and his friends were well pleased at having secured the co-operation of the "big Englander" Rhodes, or, as he was at one time called by Mr Merriman, the "young burgher."

In 1891 the Bond Congress was held at Kimberley, and harmony appeared to reign supreme. During his term of office Mr Rhodes addressed himself to bringing together all interests, as far as it was practicable to do so. He showed that his views of the situation were broad and statesmanlike. The directions in which practical progress was made were the steady development of inter-state and inter-colonial railway systems, and the establishment, as far as possible, of common customs, tariffs, and inter-colonial free trade under a customs union. The persistent opponent to both these measures was the Transvaal. In matters of colonial domestic legislation, referring to taxation, native questions, and excise, Mr Rhodes fell in to a considerable extent with Dutch prejudices. The leaders of the Cape Dutchmen apparently thought they might some day win Mr Rhodes to independent republicanism, while, on the other hand, Mr Rhodes endeavoured to demonstrate to the colonists, Dutch and British alike, that those very privileges which theoretically are associated with republicanism were practically more fully obtainable in an enlightened self-governing British colony. Afrikander Imperialism thus became a definite and living policy, and it was about this time that the term "progressive" came to be associated with the party which supported it.

Rhodes and the Bond.

Meanwhile the Kruger faction and retrogression were rampant in the Transvaal. In 1892 there began in that country what has since come to be known as the first reform movement. The National Union was founded at Johannesburg by ex-Cape Colonists of the Imperial progressive party. The first chairman was Mr Tudhope, who had held office in the Cape Ministry, and he was ably supported by the Hon. J. W. Leonard, at one time Cape Attorney-General, and his brother Mr Charles Leonard. For three years petitions and deputations, public meetings and newspaper articles, the efforts of the enlightened South African party at Johannesburg and Pretoria, were all addressed to the endeavour to induce President Kruger and his Government to give some measure of recognition to the steadily increasing Uitlander population. The President remained as impenetrable as adamant. Any measures he did take were retrogressive rather than progressive, intended still further to conserve the burgher privileges and exclude the Uitlander from any part or lot in the affairs of the State. Nine-tenths of the state revenue was contributed by the Uitlanders, yet, practically speaking, neither for them nor for their children were political privileges to be accorded. The Uitlanders had not even any municipal power. At this juncture a conspiracy was entered into between Mr Rhodes, Dr Jameson, and certain of the Uitlander leaders which led to the Jameson Raid. In conjunction with this conspiracy, and in order to lay before South Africa the true position of affairs in the Transvaal, as well as to give President Kruger a final chance to meet the Uitlanders, Mr Charles Leonard issued a manifesto as chairman of the National Union, the terms of which are memorable both for the completeness with which the Uitlander case was stated and for the fact that the claims advanced therein were those which the High Commissioner and the British Government very largely supported in 1899. This manifesto, the full text of which may be found in the appendix to Mr Fitzpatrick's *The Transvaal from Within*, concludes as follows :—

First Transvaal reform movement.

"We have now only two questions to consider: (*a*) What do we want? (*b*) How shall we get it? I have stated plainly what our grievances are, and I shall answer with equal directness the question "What do we want?" We want (1) the establishment of this Republic as a true Republic; (2) a Grondwet or Constitution, which shall be framed by competent persons selected by representatives of the whole people, and framed on lines laid down by them—a Constitution which shall be safeguarded against hasty alteration; (3) an equitable franchise law, and fair representation; (4) equality of the Dutch and English languages; (5) responsibility of the Legislature to the heads of the great departments; (6) removal of religious disabilities; (7) independence of the courts of justice, with adequate and secured remuneration of the judges; (8) liberal and comprehensive education; (9) efficient civil service, with adequate provision for pay and pension; (10) free trade in South African products. That is what we want. There now remains the question which is to be put before you at the meeting of 6th January, namely, How shall we get it? To this question I shall expect from you an answer in plain terms according to your deliberate judgment."

The conspirators believed that President Kruger and the burghers would realize the peril of further withholding redress of grievances, and be induced to do by force what he had always refused to do in deference to mere reason. The conspiracy entirely failed, and the Uitlanders were left in a worse plight than ever, although while Johannesburg was partially armed Mr Kruger had promised a consideration of grievances—a promise which was never fulfilled (see TRANSVAAL). The Reform leaders, sixty-four in number, were imprisoned at Pretoria, and the Uitlanders were now deprived of their services; for although the long terms of imprisonment were not carried out, under the agreement on which the reform prisoners were liberated in May 1896, they were bound to take no part or in any way interfere in politics for three years. Mr Rhodes's complicity in the Jameson Raid compelled him to resign his position as Premier of Cape Colony; and in 1896 he went to Rhodesia in time to take an active part in the suppression of the Matabele rebellion, which had occurred shortly after the surrender of Dr Jameson's force in the Transvaal.

Sir Gordon Sprigg took office for the third time as Premier of Cape Colony, in succession to Mr Rhodes, and in 1898 he was succeeded by a Bond ministry under Mr W. P. Schreiner. In 1896 and 1897 feeling ran very high throughout South Africa over the Jameson Raid controversy. The grievances under which the Uitlanders suffered were lost sight of; President Kruger proceeded on his retrogressive course unchecked in the Transvaal; while in the Free State Mr Steyn used the Raid as an electioneering cry during his contest for the Presidency, to work up the race feelings of the Free State burghers. Mr Fraser, who had been born and brought up in the Free State, and who was a supporter of the more enlightened policy followed, while living, by President Brand, was defeated by Steyn by a large majority. In Cape Colony the cleavage between the Progressives and the Bond party, although not more real, was more openly expressed than it had ever been before. The term "Progressive" was now formally adopted by the British mercantile communities in the various large towns and among the sturdy farmers of British descent in the Eastern Province. On returning to South Africa after the Raid inquiry at Westminster in 1897, Mr Rhodes had intended to withdraw from Cape politics and devote his energies entirely for a time to the development of Rhodesia, but the pressure put upon him by a section of the British colonists was so strong that he determined to throw in his lot with them and assist the Progressive party by every means in his power. In 1898 the Sprigg Ministry was defeated over a Redistribution Bill by which they hoped to secure more adequate representation for the Progressives, and Mr W. P. Schreiner became Prime Minister.

In 1897 Sir Alfred Milner had been appointed High Commissioner of South Africa and Governor of Cape Colony, in succession to Lord Rosmead. He at once addressed himself to a careful study of the situation, visiting

every part of the colony and obtaining a considerable command of the Cape Dutch language. In March 1898 he felt that the time had come when he should enter a public remonstrance with those Dutchmen in Cape Colony who avowedly encouraged President Kruger and the Transvaal Government in injustice to the Uitlanders and hostility to Great Britain. The remonstrance was moderately stated in a speech delivered at Graaff Reinet, and was of so important a character that it is advisable to reproduce a portion of it:—

Sir Alfred Milner.

"For my own part, I believe the whole object of the people for espousing the cause of the Transvaal is to prevent an open rupture between that country and the British Government. . . . They think that if they can only impress upon the British Government that in case of war with the Transvaal it would have a great number of its own subjects at least in sympathy against it, that is a way to prevent such a calamity. But in this they are totally wrong, for this policy rests on the assumption that Great Britain has some occult designs on the independence of the Transvaal. . . . But that assumption is the exact opposite of the truth . . . it is not any aggressiveness on the part of Her Majesty's Government which now keeps up the spirit of unrest in South Africa. It is that unprogressiveness—I will not say retrogressiveness—of the Government of the Transvaal, and its deep suspicion of the intention of Great Britain, which makes it devote its attention to imaginary external dangers, when every impartial observer can see perfectly well that the real dangers which threaten it are internal. Now, I wish to be perfectly fair. Therefore let me say that this suspicion, although absolutely groundless, is not, after all that has happened, altogether unnatural. I accept the situation that at the present moment any advice that I could tender, or that any of your British fellow-citizens could tender, in that quarter, though it was the best advice in the world, would be instantly rejected because it was British. But the same does not apply to the Dutch citizens of this colony, and especially to those who have gone so far in the expression of their sympathy for the Transvaal as to expose themselves to these charges of disloyalty to their own flag. Their goodwill, at least, cannot be suspected across the border; and if all they desire—and I believe it is what they desire—is to preserve the South African Republic and to promote good relations between it and the British colonies and Government, then let them use all their influence, not in confirming the Transvaal in unjustified suspicions, not in encouraging its Government in obstinate resistance to all reform, but in inducing it gradually to assimilate its institutions, and—what is even more important than institutions—the temper and spirit of its administration, to those of the free communities of South Africa, such as this colony or the Orange Free State. That is the direction in which a peaceful way out of these inveterate troubles, which have now plagued this country for more than thirty years, is to be found."

After this the colonists realized that in the High Commissioner they had a man of resolution, ability, and straightforwardness to deal with. The accession to power of a Bond Ministry at this juncture made the High Commissioner's position one of considerable difficulty. Affairs in the Transvaal were steadily going from bad to worse. An Industrial Commission, appointed by President Kruger in 1897 to inquire into a number of grievances affecting the gold industry, had reported in favour of certain reforms. The recommendations of the Commission, if adopted, would have done something towards relieving the tension, but President Kruger and his executive refused to be guided by them. Once more the Uitlanders determined to make a further attempt to obtain some redress by constitutional means, and the second organized movement for reform began by the formation in 1897 of a branch of the South African League. In 1898 Dr Leyds retired from the position of State Secretary in the Transvaal, and repaired to Europe as minister at large to the South African Republic. What the precise terms of that appointment may have been is unknown to history, but they apparently included the wearing of a picturesque uniform and the administration of secret service funds, which were chiefly expended on various organs of the Continental press. Dr Leyds was succeeded as State Secretary by Mr Reitz, ex-President of the Orange Free State. The change was certainly not for the better. Mr Reitz had ever since 1881 been one of the most pronounced anti-British Dutchmen in South Africa. He had co-operated with Borckenhagen in founding the Afrikander Bond. When elected President of the Free State in succession to President Brand, he utterly departed from the policy to which Brand had always adhered, and instead of continuing to hold aloof from the Transvaal, he entered into an offensive and defensive alliance with it. In him Mr Kruger found as willing, if not as skilful, an instrument as in Dr Leyds. At the end of 1898 the feelings of the Uitlanders were wrought up to fever pitch. The police service, which was violent where it should have been reasonable, and blind where it should have been vigilant, had long been a source of great irritation. On 18th December a Boer policeman, in pursuit of an Englishman named Edgar, whom he wished to arrest for an alleged assault on another man, entered his house and shot him dead with a revolver. The deepest indignation was aroused by this incident, and was still further increased by the trivial way in which the case was dealt with by the court. In 1899 matters reached a climax. After an ineffectual attempt to get a petition forwarded in December of 1898, the Uitlanders handed to the High Commissioner in March 1899 a petition to her Majesty with 21,684 signatures attached to it. The petition was accepted by Sir Alfred Milner and forwarded to London. This historic document will best serve to illustrate the course of events in the Transvaal after 1896, and also to show the status the Uitlander had arrived at in 1899. It is given in full in *The Times' History of the War*. The following extracts convey its general tenor and purport:—

Second Transvaal reform movement.

"29. The condition of Your Majesty's subjects in this State has become well-nigh intolerable.

"30. The acknowledged and admitted grievances of which Your Majesty's subjects complained prior to 1895 not only are not redressed, but exist to-day in an aggravated form. They are still deprived of all political rights, they are denied any voice in the government of the country, they are taxed far above the requirements of the country, the revenue of which is misapplied and devoted to objects which keep alive a continuous and well-founded feeling of irritation, without in any way advancing the general interest of the State. Maladministration and peculation of public moneys go hand in hand, without any vigorous measures being adopted to put a stop to the scandal. The education of Uitlander children is made subject to impossible conditions. The police afford no adequate protection to the lives and property of the inhabitants of Johannesburg; they are rather a source of danger to the peace and safety of the Uitlander population.

"32. Wherefore Your Majesty's humble petitioners humbly beseech Your Most Gracious Majesty to extend Your Majesty's protection to Your Majesty's loyal subjects resident in this State, and to cause an inquiry to be made into grievances and complaints enumerated and set forth in this humble petition, and to direct Your Majesty's representative in South Africa to take measures which will secure the speedy reform of the abuses complained of, and substantial guarantees from the Government of this State for a recognition of their rights as British subjects."

When this document was received at the Colonial Office in London, and its contents were made public, the British nation realized that Mr Kruger and his Government must either be mended or ended. In February 1899 Mr Kruger received a despatch from the British Secretary of State for the Colonies, Mr Chamberlain, protesting against his proposal to extend the dynamite monopoly for a further period of fifteen years, and pointing out that the monopoly was a breach of the Convention. There then followed a long series of despatches and correspondence on the various points at issue. On the dynamite question proposals were made on behalf of the Transvaal Government, through Mr Lippert, to the heads of the large mining houses in Johannesburg; but as President Kruger coupled them with impossible conditions, nothing came of them. On 4th May 1899 Sir Alfred Milner felt it his

duty to report at some length by cable to Mr Chamberlain. The concluding passages of this message sum up the whole South African situation in a masterly manner, and show the effect that was being produced by Mr Kruger's attitude not only in the Transvaal among the Uitlanders, but throughout South Africa. The telegram undoubtedly carried great weight in helping Mr Chamberlain to frame his policy. The concluding passages were as follows:—

The case for British intervention.

"The case for intervention is overwhelming. The only attempted answer is that things will right themselves if left alone. But, in fact, the policy of leaving things alone has been tried for years, and it has led to their going from bad to worse. It is not true that this is owing to the Raid. They were going from bad to worse before the Raid. We were on the verge of war before the Raid, and the Transvaal was on the verge of revolution. The effect of the Raid has been to give the policy of leaving things alone a new lease of life, and with the old consequences.

"The spectacle of thousands of British subjects kept permanently in the position of helots, constantly chafing under undoubted grievances, and calling vainly to Her Majesty's Government for redress, does steadily undermine the influence and reputation of Great Britain, and the respect for British government within the Queen's dominions. A certain section of the Press, not in the Transvaal only, preaches openly and constantly the doctrine of a Republic embracing all South Africa, and supports it by menacing references to the armaments of the Transvaal, its alliance with the Orange Free State, and the active sympathy which, in case of war, it would receive from a section of Her Majesty's subjects. I regret to say that this doctrine, supported as it is by a ceaseless stream of malignant lies about the intentions of the British Government, is producing a great effect upon a large number of our Dutch fellow-colonists. Language is frequently used which seems to imply that the Dutch have some superior right even in this colony to their fellow-citizens of British birth. Thousands of men peaceably disposed and, if left alone, perfectly satisfied with their position as British subjects, are being drawn into disaffection, and there is a corresponding exasperation on the side of the British.

"I can see nothing which will put a stop to this mischievous propaganda but some striking proof of the intention of Her Majesty's Government not to be ousted from its position in South Africa. And the best proof alike of its power and its justice would be to obtain for the Uitlanders in the Transvaal a fair share in the government of the country which owes everything to their exertions. It could be made perfectly clear that our action was not directed against the existence of the Republic. We should only be demanding the re-establishment of rights which now exist in the Orange Free State, and which existed in the Transvaal itself at the time of, and long after, the withdrawal of British sovereignty. It would be no selfish demand, as other Uitlanders besides those of British birth would benefit by it. It is asking for nothing from others which we do not give ourselves. And it would certainly go to the root of the political unrest in South Africa; and though temporarily it might aggravate, it would ultimately extinguish the race feud, which is the great bane of the country."

On receipt of Sir Alfred Milner's message Mr Chamberlain sent, on 10th May, a full and comprehensive despatch dealing both with the Uitlander petition and the message. He concluded by suggesting a conference at Pretoria between the President and the High Commissioner. Meanwhile a proposal had been made, at the instance of some of the Schreiner Ministry, in conjunction with President Steyn of the Free State, for a conference at Bloemfontein. This was accepted. On 31st May the conference began its sittings, and it was very soon evident that Mr Kruger's object was to obtain concessions, not to make them. Sir Alfred Milner practically confined his demands to a five years' franchise, which he hoped would enable the Uitlander to work out his own salvation. It is necessary to point out that even had Sir Alfred Milner's proposition been accepted, the Uitlanders would have been left with a very small representation in the Volksraad. Nevertheless, it was much too advanced a proposal for President Kruger. He had quite other views. His objects were to obtain Swaziland, Zambaansland, a seaport, and an arrangement whereby all future questions which might arise with Great Britain should be settled by arbitration.

Bloemfontein conference.

The conference broke up without any result, and the gulf seemed wider than ever. The two great parties into which South Africa had gradually been divided now made themselves heard all over the larger towns. The Imperialists held enthusiastic meetings, at which confidence in the High Commissioner was expressed. The Bond and Afrikander party openly proclaimed that Kruger had offered considerable concessions, though privately they expostulated with him. Messrs Hofmeyr and Herholt, the one the leader of the Bond and the other the Cape Minister of Agriculture, visited Pretoria to reason with Mr Kruger. They found him deaf to all argument, while the Transvaal Volksraad apparently regarded the whole franchise question as one which they could not be expected seriously to entertain.

In the despatches which followed from Pretoria, considerable confusion was manifest. Whether the obscurity was intentional, or whether it was the outcome of mental confusion on the part of Mr Reitz, whose retirement from the Presidency of the Free State had been caused by mental breakdown, it is impossible to say. But it is at any rate certain that one of the state papers purporting to contain the draft of a new franchise law was so ambiguous that it was supplemented by an explanatory memorandum from the State Attorney, and called forth the severe censure of Sir Henry de Villiers, the Dutch Chief Justice of Cape Colony, who in writing about it observed, "Surely a law should be clear enough to speak for itself, and no government or court of law will be bound by the State Attorney's explanations."

The fact is that all offers of amelioration on the part of the Transvaal, subsequent to the Bloemfontein conference, were as disingenuous as they had always been before. The end was bound to come. The Boers had long before made up their minds to a trial of strength with Great Britain for supremacy in South Africa. The warning of the wiser heads in the Afrikander party was useless. President Kruger, his executive, and a certain section of young Boers had persuaded themselves they could win the day in battle. On 9th October 1899 the Transvaal ultimatum was formally handed to the British Agent at Pretoria.

The Boer ultimatum.

This historic ultimatum was in the form of a somewhat long letter, and concluded by requesting Her Majesty's Government to give it the assurance

"(a) That all points of mutual difference shall be regulated by the friendly course of arbitration, or by whatever amicable way may be agreed upon by this Government with Her Majesty's Government.

"(b) That the troops on the borders of this Republic shall be instantly withdrawn.

"(c) That all reinforcements of troops which have arrived in South Africa since the 1st June 1899 shall be removed from South Africa within a reasonable time, to be agreed upon with this Government, and with a mutual assurance and guarantee on the part of this Government that no attack upon, or hostilities against, any portion of the possessions of the British Government shall be made by the Republic during further negotiations within a period of time to be subsequently agreed upon between the Governments, and this Government will, on compliance therewith, be prepared to withdraw the armed burghers of this Republic from the borders.

"(d) That Her Majesty's troops which are now on the high seas shall not be landed in any port of South Africa.

"This Government must press for an immediate and affirmative answer to these four questions, and earnestly requests Her Majesty's Government to return such an answer before or upon Wednesday, the 11th October 1899, not later than 5 o'clock p.m.; and it desires, further, to add that in the event of unexpectedly no satisfactory answer being received by it within that interval, it will with great regret be compelled to regard the action of Her Majesty's Government as a formal declaration of war, and will not hold itself responsible for the consequences thereof; and that in the event of any further movements of troops taking place within the above-mentioned time in the nearer directions of our borders, this Government will be compelled to regard that also as a formal declaration of war."

This ultimatum was cabled to London, and on the

following day, Mr Chamberlain telegraphed as follows to Sir Alfred Milner:—

"Her Majesty's Government have received with regret the peremptory demands of the Government of the South African Republic conveyed in your telegram of 9th October. You will inform the Government of the South African Republic, in reply, that the conditions demanded by the South African Republic are such as Her Majesty's Government deem it impossible to discuss."

On 11th October the Free State Boers seized a Natal railway train on their borders, and on 12th October, at Kraaipan, within Cape Colony, the first shot of the greatest war in which Great Britain had been engaged for nearly a hundred years was fired. For the course of the war, see under TRANSVAAL.

Recapitulation. The foregoing review of the history of South Africa from the earliest days of European colonization clearly brings out certain facts of the deepest interest. Colonization in the truest sense of the word, since the days of Greece and Rome, was not understood by European nations until the end of the 18th and first half of the 19th centuries. The Portuguese colonies are an instance of what results from merely establishing an official caste to hold some sort of nominal rule over a settlement, without endeavouring to develop a country for the advantage of all its inhabitants. The Cape under the Dutch East India Company was no better. The company ruled as absolute tyrants for one hundred and forty-three years. The so-called "free burghers" had no rights or privileges of any kind. They were little better than slaves of the company, and it was under this system that there grew up the "Trek Boer" class, who wandered like Arabs from one pasture on the frontiers to another. The habit of flying from all government and endeavouring to set up their own laws was thus acquired, and was never abandoned by the Trek Boers and their descendants. These men founded the Free State and Transvaal. If the laudable desire to shape their own destinies had combined with it a due appreciation of the principles of civil liberty and simple justice between man and man, it is probable that a permanent and strong independent Boer state would have grown up in South Africa, which would have become a formidable power. But the vices under which they had suffered when subject to the Dutch East India Company left their mark. Themselves at one time little better than slaves, they now meted out to the natives similar treatment. That they should have been slave-owners when all the rest of Europe was engaged in a similar traffic is no reproach to the Boers. But the humanitarian wave of sentiment which culminated in the abolition of slavery never reached the remote wilds of the colonial frontier. The name of Wilberforce, the cause he championed, the iniquity of traffic in human life—these were things unheard of on the Orange. The native was a hewer of wood and drawer of water provided by God for the service of white men. To the Boers the liberation of slaves in Cape Colony was only one more piece of European tyranny. Thus the Trek continued and the Boer republics were founded. The vacillation in British policy which followed has been referred to. It was deplorable. But whatever errors may have been committed by Colonial Secretaries, Governors, and High Commissioners, republicanism was established and recognized. Faction, strife, anarchy, and bankruptcy under a nominal republic brought about annexation of the Transvaal in 1877. Retrocession of the country by Great Britain in 1881 gave to republicanism another lease of life. Meanwhile mineral discoveries had brought wealth to the Free State, and they now brought it to the Transvaal. In both instances the work which brought about the industrial development of these resources was done by men not of Boer race. With wealth came still higher ambitions. The Republican Boers became divided into two camps. President Brand represented the enlightened division. They recognized the desirability of cordial co-operation with the British, who at least held the ports, constructed railways, chiefly conducted the commerce of the country, and protected the coasts. President Kruger, still cherishing the old ideals of monopoly in all things handed down through generations of trekkers from the Dutch East India Company, led the other division, an exclusive and even retrogressive party. The one hope, the one chance, for Boer republicanism was a reconciliation of these two divisions of Boerdom. The opportunities for such reconciliation were abundant. On at least three occasions after 1881 President Kruger deliberately spurned overtures which would have accomplished this object and have established Boer independence on a constitutional and permanent basis. He rejected President Brand's scheme for federating the two republics in 1887, because the constitution suggested was a liberal and civilized one, much on the lines of the United States. He refused the overtures of the large progressive and enlightened Uitlander section of the Transvaal inhabitants, a numerical majority, which might have been accepted at any time between 1892 and 1895, and which, while securing equal privileges to all white men, would have incorporated a progressive and wealthy element in the state. Such a combination, accepted in a liberal spirit, would have made a powerful republican state. Lastly, with the alternative of a suicidal war clearly before him, he rejected the Milner proposals at the Bloemfontein conference. If, then, republicanism failed in South Africa, the cause of its destruction cannot fairly be said to be the policy of Great Britain. The cause was the endeavour to perpetuate a system of monopoly in politics and commerce as the privilege of a class, a system which covered the Dutch East India Company with reproach and led to its dissolution, which drove the Trek Boers into the wilderness, the Uitlanders into rebellion, and finally drove Great Britain to fight for the establishment of that civil equality, impartial justice, and commercial freedom under British supremacy which Dutch so-called republicanism had refused to grant. The Dutchmen of South Africa adopted as their cry "Africa for the Afrikanders!" This is a cry which no Englishman need resent. But among Afrikanders should obviously, in justice, be included all British and other Europeans who have domiciled themselves in the country.

Law.—The basis of the common law of British South Africa is the Roman-Dutch law as it existed in Holland at the end of the 18th century. This was simply the old Roman jurisprudence embodied in the legislation of Justinian, modified by custom and legislative decrees during the course of the centuries which witnessed the growth of civilization in Europe; and it is to all intents and purposes the jurisprudence which was the foundation of the Code Napoleon. It was in part closely akin to the "modern Roman law" which is practised widely over the continent of Europe, and even in Scotland, at the present day. The authorities upon the common law in South Africa are: the Dutch commentators upon the civil law, the statute law of Holland, the decisions of the Dutch courts, and, failing these, the *corpus juris civilis* itself.

In the century which has elapsed since the establishment of British rule at the Cape the law has been considerably modified and altered, both by legislation and by judicial decisions, and it is not too much to say that at the present time there exists hardly any material difference in principle over the greater part of the field of jurisprudence between the law of England and the law of South Africa. The law of contracts, the law of torts, the

mercantile law, the law relating to shipping and insurance, not to mention other subjects, are practically identical with those of England; and even the criminal law is virtually the same, though the greater elasticity of the civil jurisprudence allows fewer opportunities for the escape of malefactors, notably in cases of fraud or falsity in any form, than exist under the law of England. The constitution of the courts is based on the example of the English judiciary, and the rules of evidence and procedure are practically the same in both criminal and civil cases as in England. All serious cases of crime are tried before a judge and jury, with the same formalities and safeguards as in England, while minor offences are dealt with by stipendiary magistrates possessing a limited statutory jurisdiction. In criminal cases it is necessary for the jury to find a unanimous verdict. In civil cases either party may demand a jury, a privilege which is seldom exercised; but in a civil case the verdict of the majority of jurors prevails.

The most marked difference between the English and South African systems of law is, as might be expected, to be found in the law relating to real property. In South Africa there is a rigid and universal application of the principle of registration. The title to land is registered, in all cases; and so, with a few exceptions, is every servitude or easement, mortgage or charge, upon land. With regard to the devolution of property upon death, it may be remarked that the law of intestate succession applies equally to real and personal estate, there being no law of primogeniture. The rules of distribution in intestacy differ, however, very considerably from those established in England. There is absolute freedom of testamentary disposition in Cape Colony and in some other parts of South Africa. In some of the colonies, however, the old restrictions of the civil law as to the legitimate portion (*legitim*) and kindred matters still obtain, but there is little doubt that these will soon be abolished. The effect of marriage upon the property of the spouses is, by the Roman-Dutch law and in the absence of any ante-nuptial contract to the contrary, to bring about a complete community of property, virtually a universal partnership between husband and wife, subject to the sole and absolute control of the husband while the marriage lasts. The courts have, however, the right to interfere for the protection of the wife in case of any flagrant abuse of the power thus vested in the husband. Ante-nuptial agreements may be of any nature the parties may choose. Such agreements must in all cases be publicly registered. Upon the dissolution of a marriage in community of property, or in the event of a judicial separation *a communione bonorum*, the property of the spouses is divided as upon the liquidation of a partnership. It is not necessary here to refer particularly to certain exceptions to this general rule in cases of divorce.

By the common law gifts between husband and wife during marriage are void as against creditors. This rule cannot be evaded even by ante-nuptial agreement. By the statute law of Natal post-nuptial agreements between spouses are permitted under certain conditions, to which it is not possible now to refer at length. Divorce is granted to either spouse for either adultery or malicious desertion, the distinctions established by the English law between husband and wife in respect of divorce being disregarded.

Language.—The languages spoken in South Africa by the inhabitants of European descent are English and Dutch, the latter chiefly in the form of a patois colloquially known as the Taal. The history of the Dutch language in South Africa is intimately bound up with the history of the South African Dutch people. The basis of the language as spoken to-day is that 17th-century Dutch of Holland which the first settlers brought to the country; and as a matter of fact, although the Dutch of Holland and the Dutch of South Africa differ very widely to-day, Cape Dutch differs less widely from the Dutch language of the 17th century than from the modern Dutch of Holland. The tongue of the vast majority of the Dutch-speaking inhabitants may thus be said to be a degenerate dialect of the 17th-century Dutch of Holland, with a very limited vocabulary. The limiting of the vocabulary is due to two reasons. In the first place, the early settlers were drawn principally from the peasant class, being chiefly discharged soldiers and sailors; and, further, when once settled, the necessity for making the language intelligible to the natives, by whom the settlers were surrounded, led to a still further simplification of speech structure and curtailment of the vocabulary. There thus grew up an ungrammatical dialect of Dutch, suited only to the most ordinary requirements of the everyday life of a rural population. It became a language with neither a syntax nor a literature. At the same time it remained in character almost entirely Dutch, no French—in spite of the incorporation into the population of the Huguenot emigrants—and only a few Malay words, finding a place in the Taal. But side by side with this language of everyday life a purer form of Dutch has continued to exist and find its uses under certain conditions. It must be borne in mind that the Boers of every grade have always been more or less sedulously instructed in religious subjects, at all events to the extent required to fit them for formal membership of their Church, and in all their wanderings they have usually been attended by their pastors. The Dutch Bible and Catechism are written in pure Dutch. The language of the Dutch Bible is as majestic as that of our English version. Moreover, the services of the Church have always been conducted in grammatical though simple Dutch; and the clergy, in their intercourse with the people, have as a general rule abstained from conversing in the ordinary dialect. The Boer thus has but slight difficulty in reading and understanding pure Dutch. Of late years strenuous efforts have been made to teach the language in the schools throughout the greater part of South Africa. In the Transvaal and Orange river republics education was imparted almost exclusively in Dutch. All public business in the Government offices and law courts was conducted in the language, and the Transvaal was being gradually inundated by officials, railway servants, and others introduced from Holland, who spoke modern Dutch.

AUTHORITIES—The reader is referred to the following works which have been consulted, among others, in compiling this article. With reference to the notes on law and language, the writer is much indebted to the Hon. J. W. Leonard, K.C., late Attorney-General of Cape Colony, who has placed his unique knowledge of these subjects at the writer's disposal. E. WATERMEYER. *The Cape of Good Hope under the Government of the Dutch East India Company*, 1857.—G. M'CALL THEAL. *History of South Africa.*—REES. *Life and Times of Sir George Grey.*—DILKE. *Problems of Greater Britain.*—LIVINGSTONE. *South Africa.*—JOHN MACKENZIE. *Austral Africa: Losing It or Ruling It.*—PRATT. *Leading Points in South African History.*—VINDEN. *Cecil Rhodes: His Political Life and Speeches.*—VAN OORDT. *Paul Kruger.*—STATHAM. *Paul Kruger.*—*The Times History of the War.*—FITZPATRICK. *The Transvaal from Within.*—HILLIER. *South African Studies.*—VAN ZYL. *Judicial Practice in South Africa.*—CLOETE. *History of the Great Boer Trek.*—PAUL BOTHA. *From Boer to Boer and Englishman.*—WORSFOLD. *The Story of South Africa.*—For Parliamentary Papers see Colonial Office List. The best library for reference on South African literature is that of the Royal Colonial Institute. (A. P. H.)

South Amboy, a borough and seaport of Middlesex county, New Jersey, U.S.A. It is situated in 40° 29′ N., 74° 17′ W., at the head of Raritan Bay, in

the eastern part of the state. Its site is hilly and its plan regular. It is on the Central of New Jersey, the Pennsylvania, and the Raritan River railways. It is an important point for coal shipments, and contains asphalt works, potteries, and other manufactures. Population (1880), 3648; (1900), 6349, of whom 1700 were foreign-born.

Southampton, a seaport and municipal county, (1888), and parliamentary borough of Hampshire, England, a county in itself, at the head of Southampton Water, 79 miles by rail south-west by west of London, on the main line of the London and South-Western Railway. The Itchen, bounding the town on the east, is crossed by the Northam (1889), a free, and a steam floating bridge. The town now consists of 13 wards under a mayor, sheriff, senior and junior bailiffs, 13 aldermen, and 39 councillors. There are 19 churches and many chapels of various denominations; 19 board and 14 National schools. Modern erections include the public library, baths, and the royal pier, reconstructed in 1892. In 1891, 539 persons were engaged in the making of machinery, and 381 in iron and steel manufactures. There are 1 daily, 1 bi-weekly, and 4 weekly newspapers. Since 1892 the docks have been the property of the London and South-Western Railway Company. They accommodate vessels of over 13,000 tons burden, and measure about 250 acres, comprising extensive quays both in the Test and Itchen rivers with 28 feet of water at low water of ordinary spring tides, and 15,000 lineal feet of accommodation; the Empress dock, 18½ acres, with a depth of 26 feet at low water spring tide; the outer dock, 16 acres, with 18 feet at low water spring tide; and the inner dock, 10 acres. There are also two coal barge docks capable of floating 10,000 tons of coal at one time. In all the docks contain about 3 miles of railway line. The five dry docks have from 29 feet to 12 feet depth of water over blocks at neaps. The Prince of Wales, or No. 5 dry dock, opened in 1895, is the largest single dock in the world; it is 750 feet long by 87½ feet wide at sill, and 112 feet at cope level. In 1888 the registered shipping was 322 vessels of 69,431 tons; in 1898, 337 of 123,406 tons. In 1888, 9690 vessels of 1,651,472 tons entered; 9478 of 1,593,780 tons cleared. In 1898, 12,347 vessels of 2,704,390 tons entered; 11,994 of 2,591,441 tons cleared. The value of the imports in 1898 amounted to £12,303,103, against £7,182,734 in 1888. The exports in 1898 were valued at £8,610,265, against £7,407,063 in 1888. The total tonnage of the entrances in 1899 was 4,257,085, of the clearances, 4,220,847. Including coin and bullion, imports were valued at £34,105,645, exports at £19,027,624. Population of municipal and county borough (1881), 60,051; (1891), 65,325. In 1895 it was extended to include, among other districts, Shirley and Freemantle, an urban district with a population in 1891 of 15,898. Extended area, 5295 acres. Population (1891), 82,126; (1901), 104,911. Area of parliamentary borough, 7774 acres. Population (1891), 93,589; (1901), 120,302.

South Australia.—(For geographical and geological features, see Australia.) Each state of Australasia has depended very largely for its prosperity upon the production and export of one or two staple products. What wool has been to New South Wales and gold is to West Australia, wheat has been to South Australia. In 1885 the colony saw the end of a series of seasons eminently favourable to the growth of grain and the production of wool, and to the pastoral industry generally. In the decade 1886 to 1895 there were only two good seasons, and the condition of the state would have been seriously affected were it not for the fortunate mineral discoveries made in Barrier District of New South Wales, the trade of which is commanded by Adelaide. The population in 1860 was 124,112, and the province was third in importance amongst the states forming the Australasian group. In 1870 the population stood at 183,797, and in 1880 at 267,573; in 1890 it was 319,414, and at the census of 1901, 362,604. These figures are inclusive of the population of the Northern Territory, the province of South Australia properly so-called containing 358,508 people and the Northern Territory 4096, the respective density of the two divisions being one person per square mile and one per 128 square miles. The number of males in 1901 was 184,422 and the females 178,182. The births during 1900 numbered 9177 and the deaths 3837, representing 25·59 and 10·70 per thousand of population respectively. The birth-rate has declined very greatly, and births were less numerous in 1900 than in 1880, notwithstanding an increase of about 30 per cent. in the population.

Dividing the years from 1861 to 1900 into five-yearly groups, the following were the average birth-rates:—

Period.	Births per 1000 of Population.	Period.	Births per 1000 of Population.
1861–65. . .	44·14	1881–85 . . .	38·52
1866–70. . .	40·60	1886–90 . . .	34·48
1871–75. . .	37·24	1891–95 . . .	31·24
1876–80. . .	38·28	1896–1900 . .	26·59

Illegitimate births are less frequent in South Australia than elsewhere in Australia; in the five years 1896–1900 the proportion of illegitimate to total births was 3·76 per cent.

The death-rate has always been remarkably light, not having exceeded 13 per 1000 in any year since 1886. The averages for each quinquennial period from 1861 were as follows:—

Period.	Deaths per 1000 of Population.	Period.	Deaths per 1000 of Population.
1861–65. . .	15·70	1881–85 . . .	14·71
1866–70. . .	15·01	1886–90 . . .	12·55
1871–75. . .	15·83	1891–95 . . .	12·08
1876–80. . .	14·90	1896–1900 . .	11·93

The excess of births over deaths in 1900 was 14·89 per 1000, which is in excess of the English experience. In the following quinquennial periods the excess was, 1881–85, 23·81; 1886–90, 21·93; 1891–95, 19·16; and 1896–1900, 14·66 per 1000 inhabitants. This remarkable reduction means a very serious check to the progress of the country, especially as there is very little immigration. The number of marriages celebrated during 1900 was 2313; this represents a marriage-rate of 6·45 and the number of persons married 12·9 per 1000. The number of divorces and judicial separations does not exceed seven a year, and since 1891 their number compared with the marriages in the same period has been as 1 to 300.

The people are mainly of British race; out of 320,000 persons whose birthplace was ascertained at the census of 1891, just over 300,000 were of British or Australian parentage, 11,653 were born on the continent of Europe—of whom 8553 were Germans and 1157 Scandinavians—and 4000 were Chinese. The total foreign-born element of the population numbered only 4·9 per cent. The population increased 16 per cent. between the census of 1891 and the close of 1899; allowing for this increase and adopting the proportion ascertained in 1891, there would be in 1899, 147,400 persons in the province following gainful pursuits, namely, 119,300 males and 28,100 females; the same numbers are got by independent estimates. Agriculture, the main industry, provided employment for 33,430 persons, of whom 32,480 were males and 1030 females. Pastoral pursuits and dairying employed 4640 males and 1540 females, total 6180; and mining employed 5800. The industrial class may be divided into (*a*) persons engaged in manufacturing industries, 16,200 males and 6400 females; (*b*) persons engaged in the construction of buildings, railways, roads, &c., numbering 7900; and (*c*) persons engaged in other industrial pursuits, 12,900; these are chiefly persons whose census description is merely "labourer." The commercial class, including

traders of all kinds as well as persons engaged in finance, numbered 18,900, namely, 16,700 males and 2200 females; while the numbers of persons engaged in transport by sea and land and in effecting communications was 11,800. The professional class comprised 5200 males and 3000 females, or a total of 8200; while the domestic class—comprising persons engaged in providing board and lodging, hotel and restaurant keepers, as well as servants—numbered 16,520, namely, 3550 males and 12,970 females. The foregoing classes show the distribution of employment amongst the 147,400 breadwinners; the remainder of the population, comprising, in 1899, 223,300 persons (75,260 males and 148,040 females), were dependent on the breadwinners, except a small number (1700) who are what is usually termed of independent means. South Australia does not possess any towns of importance besides the metropolis.

Local government. Adelaide was the first Australian city to acquire the right of self-government, and on the 31st October 1840 the first municipal elections in Australia were held in that city. The area of South Australia now under local government embraces 42,493 square miles, the local authorities being called corporations and district councils, according as they control urban or rural areas. Although a large part of the state, properly so-called (337,577 square miles), as well as the whole of the Northern Territory, are without local government, the incorporated area includes all those parts of which the development warrants the right of local government being conferred upon them. Local rates are assessed upon the assumed annual value of the properties liable to be rated, and the amount of such assessed annual value was, in 1900, £2,576,729, and the capital value about 40 millions. The expenditure was £346,081, of which £190,124 was spent on works. The revenue of the various local bodies was £348,768, of which £233,695 was obtained from rates and £115,073 from Government endowment. The total debt of the local bodies at that date was £78,400.

Instruction and religion. The South Australian system of popular education in its present form dates from 1878. It is compulsory, secular, and free. The compulsory ages are over seven and under thirteen years, but children who have attained a certain standard of education are exempt from compulsory attendance. Religious instruction is not allowed to be given in state schools except out of ordinary school hours. Secondary instruction is in the hands of private and denominational establishments, and the University of Adelaide is well endowed and efficient. The state maintained, in 1900, 690 schools, with a gross enrolment of 62,439 pupils, and the average attendance was about 43,100. The sum expended in 1900 on public instruction was £165,706, and of this amount £152,239 was on account of primary instruction. Although education is free, the instruction department has a small revenue; this in 1900 amounted to £11,512, of which £6113 was derived from rents, £3834 from sale of books and school material, and £1565 from fees; the greater portion of the fees comes from the advanced school for girls, which accounted for £1299, the remainder being paid by pupils attending classes in agriculture held in the public schools. The average cost of primary instruction to the state, including cost of school premises and maintenance, is about £3 7s. 4d. per scholar in average attendance. The revenue of the Adelaide University in 1900 was £19,023, of which £6556 was obtained from the Government, £7237 from fees, and £5230 from other sources. The number of students attending lectures during the same year was 465, of whom 238 had matriculated. Technical education is well advanced; the School of Design in Adelaide had 504 students on the roll, and there were branch schools at Port Adelaide and Gawler. The School of Mines and Industries, founded in 1899, had in 1900 an enrolment of 1603 students. Private schools numbered 290, with 860 teachers and 12,322 scholars; the average attendance was about 11,300. Of the teachers, 669 were engaged in general instruction, while 191 were specially engaged in particular subjects. In state and private schools there were 74,761 scholars at all schools and about 54,400 in daily attendance. There were in 1900, 169 public libraries, with 333,000 volumes.

The peculiarity of religion is the strength of the non-Episcopal Churches. The Church of England, which includes over 40 per cent. of the population of the other Australian states, claims only 27 per cent. in South Australia; and the Roman Catholic Church, whose adherents number 22 per cent. in the other colonies, numbers about 14 per cent. in South Australia. The Presbyterian Churches have also less supporters, for only 5·5 per cent. of the population belong to such Churches, compared with 13 per cent. in the other colonies. To the Wesleyan Churches 19 per cent. of the population belong, to the Congregational Churches 3·7 per cent., Baptists 5·5 per cent., Lutherans 7·5 per cent., and other Protestants about 8 per cent.

Finance. For the year ending June 1901 the state had a public revenue of £2,998,231, which is equal to £8 5s. 11d. per inhabitant. This amount includes revenue received by the Commonwealth Government on behalf of the State. The principal sources of public revenue were: import and excise duties, £687,146; land, income, and other taxes, £283,321; railways, £1,254,598; posts and telegraphs, £274,716; public lands, £162,346; and other revenue, £336,104. In 1871 the revenue of the province was £778,000, or £4 4s. 3d. per inhabitant; from that year it rose rapidly until in 1881 it stood at £2,172,000, or £7 16s. 10d. per head; in 1891 it was £2,732,000, or £8 11s. 1d. per head. The expenditure for the year ended 30th June 1901 was as follows: railway working expenses, £747,557; posts and telegraphs, £222,995; public instruction, £156,387; interest and charges of public debt, £1,039,106; and other services, £952,366. The debt charges amount to £2 17s. 11d. per head and absorb 34·5 per cent. of the total revenue of the state. Against this must be placed the net return from services upon which the loan moneys were expended; this amounts to about £634,327, so that the real burden of the province's debt is reduced to £404,779 per annum. On 30th June 1901 the public debt of the state stood at £26,423,805, which is equal to £73 2s. 6d. per head, and the purposes for which the debt was incurred were: railway construction and equipment, £13,332,206; water supply and sewerage, £4,839,140; telegraphs and telephones, £979,758; and other works and services not producing direct revenue, £6,077,613. The debt has tended upwards from the time the state first commenced borrowing, but the largest commitments were between 1878 and 1889, during which period the debt was increased by £15,000,000, and rose from £21 to £66 per head. The amount of the debt in ten-yearly periods commencing with 1861 was:—

Year.	Total Debt.	Debt per Head.
	£	£ s. d.
1861	866,500	6 16 8
1871	2,167,700	11 13 7
1881	11,196,800	39 2 1
1891	20,347,125	62 9 2
1901	26,423,805	73 2 6

South Australia has a large public estate: the area alienated or in process of alienation was 14½ million acres out of a total of 578 million acres, and under lease 265 million acres.

Defence. South Australia, on 31st December 1900, had a small defence force of 3021 men, comprising 2977 partially-paid troops and a paid staff of 44; but in addition to the land force there is a corps of 207 men capable of being employed on local war vessels or as a light artillery land force. The province maintains a twin-screw cruiser of 920 tons, whose armament comprises one 8-inch 12-ton B.L., five 6-inch 4-ton B.L., four 3-pr. Q.F., and five Gatling machine guns, and an auxiliary gun vessel carrying two 6-inch 5-ton B.L. guns. The expenditure of the province on defence in 1900 was £43,649; but this sum includes £10,355 contributed towards the cost of maintaining the auxiliary squadron attached to the Imperial fleet in Australian waters. About a quarter of a million has been expended upon permanent fortifications and charged to the general loans account.

Production. The minerals mined are copper, silver, and gold; and of these, only copper is found in large quantities in the province proper, the bulk of the gold being won in the Northern Territory. The great copper mines at Moonta and Wallaroo are still worked, but the production has greatly fallen off. In 1900 the value of copper raised in the province was £386,015, and the gross production to the end of that year amounted to £22,321,969. Gold to the value of £82,188 was won in 1900, chiefly obtained from the Northern Territory. The value of minerals other than gold and copper won during 1900 was £46,925. In 1871 the mineral production of the colony was valued at £725,000, in 1881 at £421,000, and in 1891 at £365,000, and in 1900 the value was £515,128.

The chief industry is distinctly wheat-growing, and out of 2,369,680 acres under crop in 1901, 1,913,247 acres were under wheat for grain and 341,330 wheat for hay. In some parts of South Australia very fine yields are obtained; but taking it as a whole, the yield of the province is very light. During the ten years 1891–1900 the return per acre varied from a minimum of 1·7 bushels in 1897 to a maximum of 6·1 bushels in 1893. South Australian wheat is of excellent quality and strength, and well known in European markets, to which the province has sent wheat since 1850. There has been little expansion of wheat cultivation since 1880; nor, indeed, has there been any material expansion in the total area under crop. Up to the year mentioned, every season showed an additional area devoted to cultivation; but repeated failure of crops, due to want of seasonable rain, have disheartened farmers, and much land that was formerly cultivated now lies fallow. The following is a statement of the area of wheat harvested for grain at specified intervals from 1861:—

Year.	Acreage under Wheat.	Production.	Average Yield per Acre.
	Acres.	Bushels.	Bushels.
1861 . . .	310,636	63,410,756	11·0
1871 . . .	692,508	3,967,079	5·7
1881 . . .	1,768,781	8,087,032	4·6
1891 . . .	1,552,423	6,436,488	5·6
1899 . . .	1,778,770	8,778,900	4·9
1900 . . .	1,821,137	8,453,135	4·6
1901 . . .	1,913,247	11,253,148	5·9

The total area under crop during the same period was: 1861, 400,717 acres; 1871, 837,730 acres; 1881, 2,156,407 acres; 1891, 1,927,689 acres; and 1901, 2,369,680 acres. In 1901 the principal crops grown, with their acreage, were: wheat 1,913,247 acres, oats 27,988 acres, other grain crops 15,352 acres, hay 341,330 acres, potatoes 6628 acres, vines 20,158 acres, other crops 44,977 acres. In viticulture the province has made considerable progress, and many Germans are employed in the industry. The production of wine for the year 1900 amounted to 1,388,847 gallons, while 2607 cwt. of currants and 8151 cwt. of raisins were also made. The wine made is of excellent quality, and about 400,000 gallons are exported annually to London.

The production of wool has been one of the chief industries since the foundation of the state, but of late years it has been much affected by droughts and low prices, so that the export of locally grown wool in 1901 was considerably less in quantity than in 1880, and little more than half as valuable. In 1861 the colony carried 3,038,000 sheep; in 1871, 4,412,000; in 1881, 6,811,000; in 1891, 7,745,000; and in 1900, 5,283,247. The quantity of wool exported in the year last named was equal to 33,277,660 ℔ weighed in the grease. There was also exported about 9,592,000 ℔ of wool grown in New South Wales. As a cattle-breeding country South Australia does not take a prominent place beside the three eastern states of Australia. The province proper depastured in 1900 only 214,761 cattle, and the Northern Territory about 257,667—in all, 472,428; in 1891 the number was 677,000, and in 1881, 315,000. It was between 1881 and 1891 that the Northern Territory was stocked. The horses in South Australia number about 179,400, and there has been no great increase, for the number in 1881 was 159,678.

Although there are some 30,000 persons engaged in one form or other of manufacturing, only 17,659 are accounted for in the annual statistics of the state; these hands are employed in 1036 establishments. The horse-power employed in the manufactories of the province was 10,794, and in 1900 the value of the plant was estimated at £1,810,000.

Commerce. The tonnage of shipping entering the ports in 1900 was 1,851,803, which is equal to five tons per inhabitant, a very considerable ratio compared with most countries; but this tonnage is quite beyond the requirements of the province, whose trade represents only about 750,000 tons per annum, and is due to the fact that Adelaide is a place of call for all the great lines of steamships trading between Europe and Australia; but when every allowance is made, it will be found that Adelaide is a great shipping centre and the third port of Australasia. The tonnage entering at Adelaide during 1900 was 1,335,442, and the value of imports, £4,739,483, and of exports, £4,363,971. At Port Pirie the value of imports was £405,473, and of exports, £1,566,357; at Wallaroo the imports were £65,052 and the exports £385,881; and at Port Augusta, £5661 and £146,490 respectively. The ports command the greater part of the trade of the Broken Hill and trans-Darling districts of New South Wales, and this trade is very valuable both to the merchants and the railways of the province. The trade at the periods specified was:—

Year.	Imports.	Exports.	Total Trade.	Exports of Domestic Produce.
	£	£	£	£
1861 .	1,976,018	2,032,311	4,008,329	1,838,639
1871 .	2,158,022	3,582,397	5,740,419	3,289,861
1881 .	5,320,549	4,508,754	9,829,303	3,755,781
1891 .	10,051,123	10,642,416	20,693,539	4,810,512
1899 .	6,884,358	8,388,396	15,272,754	3,945,045
1900 .	8,131,782	8,122,100	16,253,882	3,770,983

The great expansion following 1881 was due to the opening up of trade with the western districts of New South Wales. The exports of domestic produce, the value of which is given in the last column, when compared with the other figures in the table, show how greatly the province depends upon its re-export trade. The chief items of trade are bread-stuffs, wool, and minerals; the export of bread-stuffs is very variable, depending so largely upon the rainfall, which in South Australia is extremely uncertain. In 1884 the value of wheat and flour exported was £2,491,896, falling to £633,426 in 1886, and rising again to £2,197,735 in 1888. Since the year last named there have been great fluctuations: in 1898 the export fell to £261,898, and in 1899 it was £785,341, while in 1900 it was £837,642. The value of locally grown wool exported during the twenty-five years ending with 1900 varied between £950,000 and £2,000,000; the value in 1900 was £1,003,391. The value of minerals exported during 1899 amounted to £422,000, and in 1900 to £386,000.

Railways. The first railway was opened in 1856, and connected Adelaide with its port, and the following year saw a line constructed to Gawler, 25 miles from Adelaide. The inability of the Government to borrow money at reasonable rates greatly retarded the construction of railways in the province, and in 1875 there were still less than 200 miles of line: in the next ten years 800 miles were opened for traffic, and in 1901 there were 1736 miles in the province itself and 166 miles in the Northern Territory. There were, in addition, some 14 miles of privately owned lines. The cost of constructing and equipping the state lines stood at £14,326,775 by the middle of the year 1901, and the net earnings £496,142; this represents nearly 3·5 per cent. on the capital invested. The actual interest paid by the state upon its outstanding loans was in the same year nearly 3·8 per cent.: there was therefore a loss of 0·3 per cent. upon the working of the lines; but the state claims that the indirect benefits of railway construction far more than compensate for the direct loss. The gross earnings for the year ended 30th June 1901 were £1,250,461, and the working expenses £754,319; the former represents 5s. 8·3d. and the latter 3s. 5·2d. per train mile. In 1900 the number of passengers carried was 8,498,000 and the goods tonnage 1,628,000. South Australia has two gauges, namely, 508 miles of 5 feet 3 inches and 1393 miles of 3 feet 6 inches line. The line joining Adelaide with the Victorian border, as well as several of the trunk lines, are on the wider gauge.

Post and telegraphs. In 1900 there were 699 post offices, of which 285 were also telegraph stations. The business transacted was: letters and postcards transmitted 20,387,301, newspapers 9,956,351, packets 1,386,624, and telegrams 1,207,288. The total revenue from these services for the year 1900–1901 was £181,350, and the expenditure £148,277; in these sums are included the telephone revenue and expenditure, the former amounting to about £16,000. These sums are exclusive of revenue received by the Commonwealth Government. The use of telephones in Adelaide is rapidly extending; in 1900 there were 8 exchanges and 1558 telephones. There were 5742 miles of telegraph line in operation in 1900, and the state owns the principal overland line by which communication with Europe and the East is maintained.

Banking. The assets of all the banks of issue trading in South Australia on 30th June 1901 amounted to £6,567,776, and the liabilities to £6,747,644; these latter comprised deposits at call £2,608,269, deposits at interest £3,662,127, making a total of £6,270,396; notes and bills in circulation £424,487; and other liabilities £52,761. Amongst the assets were coin and bullion, £1,657,972. The South Australian people are very thrifty, and thirty-one in every hundred have accounts with the savings banks. On 30th June 1901 the deposits numbered 111,537, and the amount to the credit of depositors £3,782,575, a sum equal to £33 18s. 3d. per depositor. Taking deposits in banks of issue and in savings banks together, the total was £10,052,971, which is equal to £27 14s. 6d. per inhabitant. The figures for 1900–1901 show an increase on the total amount of deposits with banks operating in the state; in 1891 the total was £9,992,338, which is £60,000 less than the figures for 1900–1901. The figures of the people's banks are a better guide to the progress of savings than are the banks of issue, which have been accustomed to solicit deposits in England and elsewhere. In 1871 the savings banks held £517,000 on deposit; in 1881, £1,288,450; in 1891, £2,217,419; and on 30th June 1901, £3,782,575.

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RECENT HISTORY.

Political developments. The political and social developments in South Australia have been in harmony with the far-sighted Liberalism which attended the infancy of the state. On the attainment of autonomy Governor MacDonnell, in closing the last session of the then partially nominated legislature, made use of the following words:—"I confidently expect that the extended political power entrusted to the people of this country, and the universal suffrage conceded by the new constitution, will prove in reality a safe and conservative measure; and whilst conferring the utmost possible power of self-government, will render stronger and more enduring than ever the cherished ties of affection and loyalty which link this province to the throne of our respected and beloved Sovereign." Judged from every standpoint, this prediction appears to have been amply verified: South Australia deservedly enjoys the reputation of being one of the most progressive and at the same time one of the most stable of existing communities. From its origin as the venture of private enterprise, the state has passed through orderly stages of evolution up to the zenith of democratic government. Such alterations as have been made in the constitution have been in the direction of a still further enlargement of the franchise; for it is recognized that, in a young country of unexplored capacity and unfathomed resources, the ever-varying public problems are most likely to reach a satisfactory solution when, by means of a wide enfranchisement, the activity and intelligence of the whole community are brought to bear upon each question. Payment of members proved to be the corollary of manhood suffrage. It was held that an unrestricted right of selection was unavailing if the area of selection was limited to the few who had been specially favoured by fortune. In 1887 a temporary Act was passed for the payment of £200 a year to each member of both Houses, and in 1890 the law was made permanent. Thus was rendered possible the direct representation of all classes. Soon afterwards the parliamentary labour party came into existence; this forms a considerable proportion of the membership of both Houses, and includes in its ranks men of the highest intelligence, industry, and eloquence. In 1894 the principle of "one man one vote" was extended to that of "one adult one vote" by the inclusion of women as voters on terms of absolute equality with men. There is no bar to the election of women to Parliament whenever the electors think fit to be só represented. The delegates to the Federal Convention and to the Commonwealth Parliament were in South Australia elected by the combined vote of men and women. Elections were formerly held in successive batches, but since 1893 they have taken place simultaneously in all the districts. Electoral expenses are rigidly limited, both as to objects and amount, and a declaration of money thus expended has to be filed by every candidate. Experience has demonstrated that, owing to the intrusion of the personal element, general elections have often failed to afford conclusive evidence of the state of the popular will. Attention has therefore been directed towards the referendum as a means of obtaining an unquestionable verdict on important public issues. Although no general statute had been formulated on the subject up to 1902, custom has definitely established the practice. In 1896, at the general elections, the following questions were submitted to the electors:—"Do you favour (1) the continuance of the present system of education in the state schools? (2) the introduction of scriptural instruction in the state schools during school hours? (3) the payment of a capitation grant to denominational schools for secular results?" An overwhelming majority pronounced in favour of (1) and against (2) and (3). Again, in 1899, a direct vote was similarly taken on the question of household franchise for the Legislative Council. Undoubtedly the practical application of the referendum in South Australia facilitated the adoption of this principle in the ratification and in the method of amendment of the Commonwealth Constitution. The right of the Second Chamber to suggest amendments to Bills which it has not power to amend was borrowed by the Commonwealth from the Constitution of South Australia, as also was the idea of a simultaneous dissolution of both Houses as a means of overcoming possible deadlocks between the Chambers. As one among many improvements in parliamentary procedure may be mentioned the practice of permitting Bills lapsed owing to prorogation to be replaced on the notice paper in the ensuing session by motion without debate.

Finance. The facile but unsound method of meeting a large proportion of the current expenditure out of the proceeds of land sales has long ceased to exist in South Australia. In 1884 a land and income taxation Act was passed, and in 1894 these taxes were made progressive. The land tax is ½d. in the £ on unimproved land values without exemption, with an addition of another ½d. in the £ on land values owned by any individual in excess of £5000. An increase of 20 per cent. on the tax is levied on land held by absentees. There is an exemption of £200 on all incomes. The rate on the taxable income derived from personal exertion is 4½d. in the £ up to £800, and 6d. in the £ for every pound of income in excess of that amount. On incomes derived from property the rates are double, namely, 9d. and 1s. respectively. The death duties are also graduated, and are payable not on the total estate bequeathed, but on the amount received by each beneficiary; the rates range up to 10 per cent. on amounts of £200,000 and upwards. Stamp duties were imposed in 1886. In 1901 South Australian securities were made trustee stocks for British investors.

Crown lands. In partially settled countries such as South Australia the Crown lands policy rivals finance in engrossing the attention of the legislature, but as time goes on the relative importance of these subjects varies in inverse ratio. The earlier budgets, compared with those of later years, when the country had become more fully developed, might be said to resemble the finances of the nursery, whereas the initial alienations of land, comprising the most central and most valuable blocks, necessarily surpassed later transactions in significance. Many phases of public opinion as to the method of disposing of the Crown lands have been witnessed. A general review indicates clearly that the change has been uniformly in the direction of removing impediments and increasing facilities for the settlement of the people either as freeholders or state tenants, on the land. Under the auction system the land was allotted to the highest bidder, with the result that the payment of the purchase-money frequently exhausted the resources of the settler, and subsequent relief had to be afforded by relaxation of the conditions of the agreement to purchase. Eventually land boards were created to allot selections to applicants at low rates and deferred purchase. Perpetual leases are now taking the place of absolute alienation. The tenure is equally good for all purposes of the *bonâ fide* settler, and capital which would otherwise be sunk in acquiring the freehold is set free for making improvements, purchasing machinery, and the manifold requirements of efficient husbandry. Small blocks of 20 acres, or not exceeding £100 of unimproved value, can be obtained by working men in the vicinity of towns, thus on the one hand affording the necessary supply of agricultural labour during the busy seasons, and on the other hand providing a homestead which the holder can with advantage cultivate at slack times when unemployed. Provision was made, under the Closer Settlement Act of 1897, for the repurchase of large estates for agricultural purposes; these lands are leased to farmers at an average rent of about 4½ per cent. on the value. The industry of wheat-growing has received an impetus through the system of drilling in a small quantity of phosphatic manure with the seed. By this means exhausted lands have been restored almost to primitive

fertility. Vine-growing has now become one of the staple industries, and, owing to stringent precautions, the state remains free from the scourge of phylloxera. The great bulk of the unalienated land of South Australia is held in huge areas by Crown tenants, known as squatters, under pastoral leases, which now have a currency of 42 years, with security of tenure. In 1893, when the unemployed were very numerous, the Government established co-operative village settlements on tracts of land adjoining the river Murray. Seven of these are now in existence as irrigation colonies. The water is raised from the river by rotary pumps, and distributed by means of channels, after the plan adopted at Renmark. By the application of water to the adjacent sun-steeped soil, miles of worthless mallee scrub have been converted into vistas of vineyards, orange groves, and orchards. The paramount importance of water supply and conservation has received ever-increasing recognition. The Beetaloo reservoir has a capacity of 800,000,000 gallons, and from its 695 miles of trunk mains a district of over one million acres is reticulated. The supply of Adelaide and its vicinity has been reinforced by a reservoir at Happy Valley, having a contour of about 7½ miles at high-water mark, and containing 2,950,000,000 gallons. The reservoir was formed by the construction of an earthen embankment 2645 feet long and 72 feet high; this is filled from the Onkaparinga river through half a mile of steel main 6 feet in diameter and 3½ miles of tunnel. Works on a large scale have also been constructed at Bundaleer and Barossa. The custom for many years past has been to construct these and other great public works departmentally instead of by contract. Many artesian wells have been sunk on the routes for travelling stock in the interior. The bores of some of these exceed 3000 feet in depth, and the supply varies from 200,000 to 1,000,000 gallons a day. Around some of these wells in the far north plantations of date palms have yielded excellent results.

Agriculture and water.

South Australia was founded when the tide of the *laissez faire* régime was running high, and a patriotic bias in the customs tariff was regarded as an unwarrantable restriction; it is therefore not surprising that free trade should at the outset have received many adherents. There were not wanting, however, some who saw clearly that a country almost entirely occupied in primary production would prove but a barren field for the cultivation of the many-sided activity necessary to a complete national life. It was also maintained that if inducements were given to capital to embark in home industries, a cheapening of the product, due to approximation of supply and demand, would ensue. In accordance with these views, a protective tariff was adopted in 1885. Two years later the duties were increased and extended. The establishment of manufactures and new industries opened a career for youths of inventive and mechanical aptitude, and in several instances the predicted reduction in price of the protected article has been strikingly manifested.

One of the most notable developments in public policy consisted in the extension of the sphere of the state so as to embrace activities formerly considered to be solely within the province of private enterprise. Railways from the outset have been Government undertakings, so also have been water-works of any degree of magnitude; telegraphs and telephones, taken over by the Commonwealth, have always been regarded as state monopolies. A public trustee undertakes, when desired, the administration of estates. In 1895 a state bank was established to provide farmers with the necessary working capital at lowest current rates of interest. A state produce depôt was also organized at the same time to assist farmers in placing their produce to the best advantage on the world's markets. Produce is received by the Department of Agriculture, prepared for shipment, certified as to quality, and graded. Small parcels from a number of producers are grouped together in one consignment and shipped at the lowest rates. The Government of South Australia also undertakes, if so desired, to act as agent in London for the consignor, and to arrange for the sale of his produce; so that a farmer who has no representative at the port of destination, but is desirous of ascertaining whether a profitable trade can be established in any class of produce, has only to send the goods to the depôt, and await the arrival of a cheque when the account sales come to hand. An advance amounting to three-fifths of the value of the produce at 5 per cent. is made if desired. Wine shipped through the produce depôt is analysed and examined in bulk by Government experts, and if found to be both sound and pure, is sent to the bonded depôt in London with a certificate to that effect: this is recorded on the label of the bottles in which it is retailed, under the name of the "Orion" brand. Cyanide works have been erected in various centres for treating ore raised by miners working in the neighbourhood. State smelters for copper ore have been built at Port Augusta, but are not now in operation. There is a Factory Act permitting the establishment of wages boards, and also legislation providing for a weekly half-holiday and the early closing of shops. A compulsory conciliation Act deals with the prevention and settlement of industrial disputes. The Right Hon. C. C. Kingston was the pioneer in Australasia of legislation of this description. These measures were at first denounced by some as Socialistic, and were regarded by many as an undue interference with private enterprise. Some of the state aids were, however, speedily recognized as affording additional incentives to industry, and by enabling producers and workers to obtain a better return for their labour, may fairly be held to have assisted rather than to have retarded private enterprise. In 1893 a bonus on butter exported to the world's markets was successful in bringing into existence a fully equipped export trade. Public opinion in South Australia has little tolerance with laxity. Children are prevented from selling articles in the streets after 8 P.M., and are not allowed to fetch beer from public-houses. The age of consent has been raised to 17 years. The notification by medical men of cases of pulmonary tuberculosis to the local authorities is compulsory.

Government enterprise.

No pains have been spared to keep pace with modern improvements in popular education as an indispensable feature in democracy. South Australia holds in reverent and loving memory the name of John Anderson Hartley, the originator of the state school system, who died in 1896, and to whose character as a man and genius as an organizer the schools of South Australia will remain as a perennial monument. School fees for children under the compulsory age of 13 were abolished in 1891, and in 1898 the older children were also admitted free. Students in training have now the advantage of a two-years' course at the university. Technical education has received much attention. A foundation was long ago laid in the primary schools by the inclusion of drawing as a compulsory subject, and by affording facilities for manual training. In 1889 the South Australian School of Mines and Industries was established, and under the presidency of Sir Langdon Bonython has proved a most valuable institution. Other technical schools are in operation in industrial and mining centres. A reserve of two acres is attached to all new country schools, and systematic lessons in practical agriculture are given by many teachers. In order to encourage tree-planting, a yearly school holiday devoted to this purpose, and known as Arbor Day, was established in 1886. With a similar object, the state has distributed, free of charge, 5,000,000 forest trees to 21,000 persons. Over 1,250,000 vines have also been given away. The boys' field club, with the motto "The naturalist loves life," has since 1887, under the direction of Mr W. C. Grasby, been one of the pioneers of nature-study. A state secondary school for girls has been for many years self-supporting, and in 1897 secondary agricultural schools for boys were organized in Adelaide and other centres. Half the school hours of each day are spent in the class-room, the remainder being devoted to workshop, field, and laboratory practice. An agricultural college at Roseworthy, 25 miles north of Adelaide, imparts a high-class theoretical and practical training in the various branches of agriculture, including viticulture and wine-making. The fee charged is £30 a year, including board and lodging. Information as to practical and scientific husbandry is disseminated among the farmers by means of an Agricultural Bureau, with numerous branches throughout the country. A journal is published conjointly by the departments of agriculture and industry, containing reports of the proceedings of the bureaus, and articles by Government experts, together with industrial topics and matters of interest to artisans, and also particulars furnished by the Labour Bureau as to prospects of employment in various districts.

Education.

South Australia played a conspicuous part in the attainment of Australian Federation. The popularly-elected Convention which framed the Commonwealth Constitution Act, held in 1897 its first session in Adelaide. The Right Hon. C. C. Kingston, then Premier of South Australia, afterwards Minister for Trade and Customs in the Commonwealth, was elected president of the Convention, which subsequently met both in Sydney and Melbourne. South Australia was the first of the colonies to submit the Federal Bill to the referendum, and to pass the address to the Sovereign praying that Imperial assent might be accorded to the measure. Mr Kingston was one of the delegates who watched the passage of the Act through the British Parliament. When the Commonwealth Parliament was constituted, and the Hon. Sir Richard Baker, K.C.M.G., president of the South Australian Legislative Council, and the Hon. Sir Frederick Holder, K.C.M.G., leader of the South Australian House of Assembly, were respectively elected President and Speaker of the Federal Senate and House of Representatives. South Australia was also the first Australian state to make the necessary adjustments in the local legislature consequent on some of its most important functions being taken over by the Federal authority. The number of members of the Legislative Council has been reduced from twenty-four to eighteen, and of the Assembly from fifty-four to forty-two, and there are now four ministers in place of the previous six.

Federation.

The existence of South Australia as a colony was coterminous with the reign of Queen Victoria. The colony was established only a few months before the accession of that monarch, and South Australia ceased to be a colony by entering the Commonwealth as a state within a few days of the close of the Victorian Age. (J. A. CO.)

South Bend, a city of Indiana, U.S.A., capital of St Joseph county. It is situated in 41° 39′ N. and 86° 12′ W., on St Joseph river, in the northern part of the state, at an altitude of 725 feet. It has five railways, the Grand Trunk, the Illinois and Iowa (including the St Joseph, South Bend, and Southern), the Lake Shore and Michigan Southern, the Michigan Central, and the Vandalia. It is an active manufacturing place; in 1900 there were 302 establishments, with a total capital of $18,156,638. They employed 8257 hands, and the product was valued at $14,236,331. The two principal articles of manufacture were agricultural implements, with a value of $2,432,083, and carriages and waggons, value $3,494,052. The assessed valuation of real and personal property was, in 1899, $15,047,350, the net debt only $918,238, and the rate of taxation $24.50 per $1000. Population (1890), 21,819; (1900), 35,999, of whom 8601 were foreign-born and 572 negroes. Of 10,402 males 21 years of age and over, 536 were illiterate (could not write).

South Bethlehem, a borough of Northampton county, Pennsylvania, U.S.A. It is situated in 40° 37′ N. and 75° 23′ W., on the south bank of the river Lehigh, in the eastern part of the state. It is on three railways, the Central of New Jersey, the Lehigh Valley, and the Philadelphia and Reading. The site of the borough is hilly; it has an excellent water-supply and sewerage. It is the seat of the famous iron-works of the Bethlehem Iron Company, with its furnaces, rolling mills, ordnance shops, and armour-plate works. Besides these it has brass and zinc works and other manufactures. It is the seat of Lehigh University, a non-sectarian institution, opened in 1866, which had in 1899 a faculty of 42 and was attended by 325 students. Population (1890), 10,302; (1900), 13,241.

Southbridge, a town of Worcester county, Massachusetts, U.S.A. It is in the southern part of the state, bordering on Connecticut. The town has an area of 21 square miles, and contains a village bearing the same name, located on Quinebaug river and on a line of the New York, New Haven, and Hartford Railroad, at an altitude of 500 feet. It has a variety of manufactures. Population (1890), 7655; (1900), 10,025, of whom 3468 were foreign-born.

South Carolina, one of the original thirteen states of the American Union, situated on the southern Atlantic coast between North Carolina and Georgia. It was founded under royal charters of Charles II. of 1663–1665. The state was peopled first by a colony from England by way of Barbados, followed by others of Dutch from New York, Huguenots from France, Scots, Irish, and Scots-Irish, Germans, and Welsh. The colony was planted as an outpost to assert the right of Great Britain to disputed territory, and so was warred upon by Spain and France, and suffered from Indian incursions instigated by those Powers. This circumstance, and her great distance from the other colonies, led to the development of the peculiar characteristics for which the state has been noted. The great staples of rice and indigo, cultivated upon a rich virgin soil by negro slave labour, produced great wealth, in the enjoyment of which a closer intercourse with the mother country was maintained than that of other colonies: her young men were sent to the universities abroad for their education, and a highly-educated, cultured, and refined society was thus formed. In consequence of the close ties to England, there was great opposition in South Carolina to the American Revolution. Her people were divided upon the subject, and yet it was upon her soil that the last three years of that struggle were waged, and in it she suffered more than any other state. Within her borders no fewer than 137 battles or affairs, great and small, were fought. Much of the history of the United States turns upon that of this little state. She led in both the Nullification and Secession movements. Three times has the city of Charleston been besieged, *i.e.*, by the Spaniards and French in 1706, by the British in 1780, and by the Union forces in 1861–65. Her harbour is celebrated for the victory of Fort Moultrie over the British fleet and army in 1776; for the battle of Fort Sumter on the 12th–13th April 1861, which precipitated the war between the states; and for the defence of that fortress by the Confederate army during the years 1863–65. With a white population of but 291,300, and only 55,046 arms-bearing men, in the first year of the war she put in the field 44,000 volunteers, and during its existence 62,838 effective men, with an enrolment, including reserves, of 71,083, of whom 22 per cent. were killed in the field or died of disease or in prison. The state suffered so terribly after the war, under the iniquitous rule of the Reconstruction Government, as to be known as "the prostrate state." Her recovery since has been wonderful.

Population.—The population in 1880 was 995,577; in 1890, 1,151,149, an increase of 155,572, or 15·6 per cent.; and in 1900, 1,340,316, an increase of 189,167, or 16·4 per cent. The total land surface of the state is approximately 30,170 square miles, and the average number of persons to the square mile has increased from 38·2 in 1890 to 44·4 in 1900. In 1900 there were 16 incorporated towns and cities which had each a population of more than 2000 and less than 5000, 4 more than 5000 and less than 10,000, and 4 more than 10,000, namely, Charleston (55,807), Columbia (21,108), Greenville (11,860), and Spartanburg (11,395). The population of Charleston increased during the decade from 1890 to 1900 only 1·6 per cent. Of the population in 1900, 664,895 were males and 675,421 females; 1,334,788 were native-born and 5528 foreign-born; 557,807 were whites, 782,321 negroes, 67 Chinese, and 121 Indians. Of the white male population of 21 years or over, numbering 130,375, 15,865, or 12·2 per cent., were illiterate; of the corresponding negro population, numbering 152,860, 83,618, or 54·7 per cent., were illiterate.

Finance.—When the first governor under the Reconstruction Act was inaugurated in 1868, the actual debt of the state was a little less than $5,800,000. In five years a legislature but few members of which were taxpayers, and those only to a nominal amount, had increased this to a sum estimated at $33,900,000. Fortunately for the taxpayers, these legislators were obliged themselves to repudiate a large part of this indebtedness. In 1876 the Democratic party rose, under the lead of Wade Hampton, and overthrew the carpet-bag rule, as it was called. One of the first measures of the restored government was the appointment in 1877 of a commission to investigate the debt of the state. Under this commission the total valid indebtedness was fixed at $6,406,606, which was funded in 1894 in bonds bearing interest at the rate of 4½ per cent.

Election Legislation and the Negro Vote.—In order to restrict the ignorant negro vote, under which it was impossible to maintain a decent government, the General Assembly in 1882 instituted an electoral system which enforces an educational qualification by requiring the voter (who is secluded) to select his ticket himself and deposit it in the appropriate box. The system has become known as the "Eight-Box" system, and has been imitated in other states. In 1895 a convention framed a new state constitution, differing from the old in many important particulars. The qualifications for suffrage were extended. From the adoption of the constitution in 1895 to 1st January 1898 it was made necessary for the voter to understand and explain any section in the constitution when read by the registration officer; but since that day persons applying for registration are required (*a*) to read and write any section of the constitution submitted to them, or (*b*) to show that they own property in the state assessed at $300 or more, and have paid all taxes collectable during the previous year. At the same time a system of registration, which is peculiar to South Carolina, was incorporated in the constitution. Registration is not, as elsewhere, repeated before each election, but is renewed only once in every ten years. Upon a given day in every month, however, persons coming of age, or otherwise becoming entitled to vote, may have themselves enrolled. When a voter enrolls, he is given a certificate, which he is required to present when voting, for comparison with the entry in an official book. This system was adopted to meet

the difficulty of identifying the negro by the features of the face, whose surname, adopted at random upon emancipation, is often repeatedly changed, and whose nomadic habits since emancipation permit no identification by residence. The system, of course, applies to all electors, white or black.

Dispensary Liquor System.—During the existence of slavery the negroes were little used to the intoxicating effect of liquor, but after their emancipation every cross-road soon had its saloon or travelling liquor waggon, and in consequence their riotous conduct threatened the peace and safety of rural communities. This led to the prohibition of the sale of liquor outside incorporated towns, where the sale was under police regulation. Meanwhile a general prohibition agitation was carried on, which resulted in the adoption of local prohibition laws in many towns and cities, and finally in the present dispensary system. This system is based upon that of Gothenburg, though not identical with it. By it the state becomes the sole dispenser, and undertakes to furnish to purchasers chemically pure liquors in packages of not less than one-half pint, securely sealed, the package not to be opened nor the liquor to be drunk on the premises of the dispenser. The profits are appropriated to state, county, and municipal purposes, that which goes to the state being devoted to education. To carry on the system a vast machinery of officers, state and county boards, and dispensers is provided, which has opened the way to corruption and extravagance. Heretofore a large constabulary force has been employed, and the enforcement of the system has caused bitterness, strife, and bloodshed. As a vendor of liquor the state becomes interested in the profits, and has practically forced dispensaries upon localities in which absolute prohibition previously obtained. The system is now as much opposed by prohibitionists as by those who are against any interference with the business of liquor-selling beyond the necessary police regulation. It must be said, however, that the rigid enforcement of its prohibitory features has so completely broken up the city saloons and the cross-roads liquor dealers as to reconcile many citizens and planters who are opposed to the system on general grounds. The Constitutional Convention of 1895 incorporated a prohibition of the saloon system into the constitution.

The Supreme Court.—The Constitutional Convention of 1895 provided also that the Supreme Court shall consist of four members instead of three, *i.e.*, a chief justice and three associate justices, the concurrence of a majority of whom is necessary to reverse on appeal, thus giving weight to the circuit decision appealed from, and securing a clear preponderance of legal opinion in the decision of any question. It also extended the length of the terms of the justices of the Supreme Court to eight years, and so classified its members that the term of one of them expires every two years. It gives to the Supreme Court power to call in all the circuit judges of the state to sit *in banc* with them in certain cases.

Divorce.—By virtue of an unwritten law of the state, divorces have never been granted, except during the Reconstruction period. The Convention of 1895 ordained that "divorce from the bonds of matrimony shall not be allowed in the state."

Manufactures.—In 1860 South Carolina raised her largest crop of cotton up to that time—to wit, 350,000 bales of upland cotton. It was believed then that cotton could not be raised without slave labour. In 1898–99 the crop was 1,040,000 bales, of which 400,000 bales were spun in South Carolina. In other words, the state spun more cotton of her own growth than she had raised in the year 1860, and had still for export a crop 26 per cent. larger than the whole of that of 1860. One of the happiest results of this development is that the poor white—forced away from the farms by competition of negro cheap labour—finds a haven in the cotton-mills villages. A family the limit of whose income was from $100 to $150 dollars a year gets at the mills from $70 to $80 per month, paid in some cases every two weeks, with entire liberty to trade at their own pleasure. The best managed of these mills have free schools, open ten months in the year, with churches and reading-rooms. The following table illustrates the extraordinary recent increase of cotton mills:—

Year.	Mills.	Capital.	Spindles.	Looms.	Employés.
1820 .	1	...	588	...	...
1840 .	15	$617,500	16,400	200	600
1850 .	18	857,200	20,000	300	1,000
1860 .	17	827,825	16,461	931	900
1870 .	12	1,337,000	34,940	745	1,100
1880 .	14	2,776,100	82,334	1,676	2,100
1890 .	34	11,141,833	334,476	8,546	8,200
1899 .	105	45,000,000	1,906,000	53,351	45,000
1902 .	109	...	1,931,900	54,535	...

The following table shows the condition of the manufacturing and mechanical industries in 1890 and 1900:—

	1890.	1900.	Per cent. of Increase. 1890–1900.
Number of establishments . . .	2,382	3,762	57·9
Capital . . .	$29,276,261	$67,356,465	130·1
Wage-earners . .	22,748	48,135	111·6
Value of product .	$31,926,681	$58,748,731	84·0

The value of the manufactures of cotton goods was $29,723,919 in 1900 as compared with $9,800,798 in 1890. Lumber timber products rose from $2,146,750 in 1890 to $5,207,184 in 1900.

Tobacco.—So recently as the middle of the 'eighties, not one pound of tobacco was planted in South Carolina. According to the best estimates, there were sold in 1899 in the various markets of the state 25,500,000 ℔, and shipped from the state 8,000,000 ℔, making a total of tobacco raised in the state 33,500,000 ℔. The average yield per acre is 770 ℔, the total acreage about 44,000. The crop averages 8 to 10 cents per ℔. The crop of 1899 was valued at $2,680,000. South Carolina is now the second state to North Carolina as a producer of "bright tobacco," the whole of her crop being of that description.

The "Pinehurst" Tea Experiment.—The "Pinehurst" tea experiments, begun about 1890 by Professor Charles U. Shepard, M.D., and latterly assisted pecuniarily by the U.S. Department of Agriculture, bid fair to result in the creation of a new industry. The experiments have been conducted with many varieties of seed and under different conditions of soil, and over 50 acres have been planted. To reduce the cost of labour for plucking tea-leaf, which was inordinately high as compared with the Orient, a free school was built where negro children are taught the ordinary branches, earning the money to buy food and clothing by picking tea. The yield of (dry) tea has been as follows: 1894, 83·8 ℔; 1895, 185·7 ℔; 1896, 215 ℔; 1897, 247·5 ℔; 1898, 307·3 ℔; 1899 to 15th September, 496·1 ℔. It has been shown that the yield per acre approximates that in the countries from which the plants were imported.

Phosphate.—From 1867 to 1890 the state produced enough phosphate rock to fix prices for all other varieties, and to control both foreign and domestic markets. This monopoly was ended by the discovery of phosphate rock in Florida and Tennessee. South Carolina now produces about 500,000 tons annually, Tennessee about the same, and Florida as much as both of these. In the manufacture of fertilizers, established on the basis of her phosphate rock, the state still holds her prestige. Factories in the state can manufacture 475,000 tons of fertilizer, representing a business on manufactured goods of about $5,000,000, to which should be added $300,000 for raw materials furnished in connexion with manufactured fertilizers. The state probably manufactures and sells more fertilizers than any other in the Union, and it is believed that the city of Charleston is the largest manufacturing centre of this class of goods in the world.

Education.—One of the reasons urged for calling the Constitutional Convention of 1895 was that the school tax of two mills prescribed in the constitution of 1868 should be eliminated, as the constitution was not the place for a tax levy; the sentiment of the convention for the advancement of education was, however, so strong that the prescribed tax was not only retained, but was increased from two mills to three mills. In addition to the collegiate institutions of the state previously established, to wit, the South Carolina College at Columbia and the State Military Academy in Charleston, in 1889 the state established the Clemson Agricultural College of South Carolina at Clemson, Anderson county, S.C., in which there are three full courses of study: agricultural, mechanical, and textile. In 1895 it established the Winthrop Normal and Industrial College (female) at Rock Hill, which during the first three years of its existence received 800 students. In 1900 there were 50 graded schools in the state, the term "graded" being applied to all schools in towns which have a special tax levied for their support.

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South Dakota, one of the north-western states of the American Union, about 360 miles long, with an average width of about 225 miles; it contains 77,850 square miles.

Geography and Geology.—The surface of the state, with the exception of the Black Hills in the south-west corner, is generally rolling prairie. The land east of the Missouri river is fertile and well adapted to agriculture, that west of the river is drier, more broken, and well suited to stock-raising. No timber is found in the state outside the Black Hills, except along the banks of the rivers and streams. The Black Hills, where the timber has not been cut off, are covered with pine. The timber along the rivers and streams is ash, elm, cotton-wood, and box elder. Oak and black walnut are also found. The greater portion of the state is of Cretaceous formation, with some Tertiary deposits in the southern part. The Black Hills are a distinct formation. Discoveries are constantly being made of gold and silver in this part of the state. In 1899, 312,962 ounces of fine gold and 145,600 ounces of silver were mined; and mines of mica, gypsum, and bituminous coal of good quality have been also opened and developed. Natural gas has been discovered in different parts of the state, especially in Hughes, Sully, and McCook counties, and is being utilized to some extent for heating and illuminating. Quartzite sandstone and other kinds of building rock are found in abundance in various parts of the state. In 1899, 50,000 barrels of very excellent cement, equal in strength and endurance to the best Portland cement, were manufactured at Yankton from the chalk rock and clays found in abundance along the bluffs of the Missouri river.

Agriculture.—Of the agricultural products, wheat is the staple crop, and has a world-wide reputation as producing the best of flour; 41,889,380 bushels were grown in 1899, valued at $20,957,917. The yield of corn in the southern part of the state and on the Missouri bottom lands frequently averages 75 bushels to the acre; 32,402,540 bushels were grown in 1899, valued at $7,263,127. Of oats, 19,412,490 bushels were grown, valued at $4,114,456. Flax, barley, peas, beans, hay, and other farm products are grown everywhere in the state. The grasses on the ranges are very nutritious. Timothy, alfalfa, and other grasses are cultivated successfully east of the Missouri river. Some failures of crops have resulted from drought in the northern and north-western portions of the state. An artesian basin has been developed in the central portion of the state at a depth of from 500 to 1100 feet, which is being utilized for irrigation, and in some localities for manufacturing. Though there is a period of low temperature during midwinter, the climate is dry and bracing.

Education and Charities.—There were in 1898, 3582 common schools, with 4322 teachers and a total attendance of 77,516. The children of school age (between 6 and 20 years) numbered 96,134, and the expenditure on common schools for that year amounted to $1,729,462. According to the census of 1900, the number of persons between 5 and 20 years of age inclusive in that year was 147,165. The percentage of illiterates is very small. Out of 112,681 males of voting age in 1900, 5442 (4·8 per cent.) were unable to write; of these, 2234 were of foreign birth. The State University at Vermilion had 384 students for the year 1900, and has 28 instructors. It is under the control and management of the state. There are also normal schools at Madison, Spearfish, Springfield, and Aberdeen; an agricultural college at Brookings; a school of mines at Rapid City; and a school for deaf mutes at Sioux Falls. These have a total of 1420 students and 63 instructors. There are several excellent denominational schools and colleges. The state penitentiary is at Sioux Falls, the insane asylum at Yankton; there is a reform school at Plankinton, and a soldiers' home at Hot Springs.

Railways.—In 1898 there were 2797 miles of railways in operation within the state, of which the principal lines in point of mileage were the Chicago, Milwaukee, and St Paul, the Chicago and North-Western, the Great Northern, the Burlington and Missouri, the Fremont, Elkhorn, and Missouri Valley, and the Chicago, St Paul, Minneapolis, and Omaha.

Finance.—The total assessed value of property in the state in 1898 was $120,175,431, which yielded state taxes to the amount of $478,881. The state debt in 1898 (1st July) was $861,600. The state banking law is modelled after the United States Banking Act. There are 25 national banks, with deposits of $5,330,951 and a capital of $1,460,000; 109 state banks, with deposits of $5,322,384 and a capital of $1,245,227; and 70 private banks, with deposits of $3,329,486 and a capital of $945,076.

Population.—The census of 1890 gave the population of South Dakota alone as 328,808, being an increase during the preceding ten years of 234·6 per cent. In 1900 the population was 401,570, an increase for the decade of 72,762, or 22·1 per cent., approximately that of the country as a whole. The average number of persons to the square mile was, in 1900, 5·2, as compared with 4·3 in 1890. There were, in 1900, 134 incorporated cities, towns, and villages in South Dakota, of which 25 had more than 1000 inhabitants, 12 more than 2000, and only 2 more than 5000. These two were Sioux Falls, with 10,266, and Lead City, with 6210 inhabitants. The capital, Pierre, had 2306 inhabitants. The death-rate of the entire state in 1900, on the basis of the number of deaths reported to the census enumerators in that year, was about 7·7. Of the total population in 1900, 216,164 (53·8 per cent.) were males and 185,406 females; 313,062 (78 per cent.) were native-born and 88,508 foreign-born; 380,714 (94·8 per cent.) were white and 20,856 were coloured, of whom 465 were negroes, 165 Chinese, 1 Japanese, 20,225 Indians. Although there are numerous settlements of Scandinavians, Germans, Dutch, Bohemians, and other nationalities, the American element is being rapidly increased by the immigration of farmers from Iowa, Wisconsin, Illinois, and other states, who, having sold their farms at high prices, go west to buy equally good lands at a cheaper rate. Great numbers of Indians have abandoned their tribal relations and are taking their lands in severalty.

History and Politics.—The state formed a part of the Louisiana purchase, and a portion of it was at one time included in Minnesota territory, and later formed a part of the territory of Nebraska. The territory of Dakota was organized in 1861, and included the present states of North and South Dakota and a large portion of Wyoming and Montana. It contained less than 5000 white inhabitants. In 1870 that part of the territory that is now the state of South Dakota contained 11,776, and in 1880, 98,268, an increase for the decade of 734·5 per cent. The first constitutional convention met at Sioux Falls in October 1883, and drafted a state constitution, which was adopted by the people and presented to Congress for approval; but no action was taken. On 22nd February 1889 Congress passed an Enabling Act, under which South Dakota was admitted as a state, 3rd November 1889. The former large Indian reservations west of the Missouri river have been subdivided and large portions thrown open to settlement.

The state is Republican in politics, but was carried for Mr Bryan and the Populist ticket in 1896 by a majority of a few hundreds, and in 1898 a Populist governor was elected by a small majority, though the Republican Congressmen and the balance of the state ticket were elected by a large one. In 1900 the state went Republican by a plurality of 14,986. Three important amendments to the constitution were submitted to the voters at the election of 1898. One of them, involving the initiative and referendum systems of legislation, was adopted by a majority of 7331; another, involving women's suffrage, was defeated by a majority of 3285; and the third, involving

the dispensary liquor system founded on that of South Carolina (see LIQUOR LEGISLATION), was adopted by a majority of 1643; the Legislature of 1898–99, however, instead of enacting any legislation to put the amendment in force, passed a resolution submitting to the voters its repeal, which was carried in the election of 1900. The civil and penal codes, as well as civil and criminal codes of procedure, are similar to those adopted in California, and are founded on those favourably reported by the Code Commissioners of New York. (B. T.)

South Easton, a former borough of Northampton county, Pennsylvania, U.S.A. It is on the south bank of the river Lehigh, at its mouth, opposite Easton, on the Lehigh Valley Railroad. It is situated mainly on the summit of the river cliffs, here 100 feet or more in height. Population (1880), 4534; (1890), 5616. In 1890 it was annexed to Easton.

Southend-on-Sea, a municipal borough (incor porated 1892, extended 1897) and watering-place in the south-eastern parliamentary division of Essex, England, on the estuary of the Thames, 35 miles east of London by rail. A commission of the peace was granted to the borough in 1894. Modern buildings are a church, a theatre, and a large hall. There are a marine park of 26 acres, several pavilions, a revolving tower, and other attractions. Southend has considerably extended towards the west, and a new and handsome suburb, Westcliffe, now adjoins it on that side. Westcliffe has a railway station on the London and Tilbury line, several hotels, and many pretty villas, commanding delightful views of the mouth of the Thames and the opposite county of Kent. Population (1881), 7979; (1901), 28,857.

South Framingham, a village in the town of Framingham, Middlesex county, Massachusetts, U.S.A. It is in the eastern part of the state, at an altitude of 163 feet, at the intersection of the main line of the Boston and Albany with a line of the New York, New Haven, and Hartford Railroad.

South Georgia, an uninhabited British island in the South Atlantic, about 900 miles south by east of the Falklands, 54°–55° S. and 36°–38° W.; area, 1600 square miles. It is mountainous, with snowy peaks 6000 to 8000 feet high, their slopes furrowed with deep gorges filled with glaciers, which in some places descend to sea-level. Its geological constitution—gneiss and argillaceous schists, with no trace of fossils—shows that the island is, like the Falklands, a surviving fragment of some vanished continent, most probably indicating a former seaward extension of the Andean system. At Royal Bay, on the south-east side, was stationed the German expedition sent out to observe the transit of Venus in 1882. The slopes being covered with succulent herbage (tussock grass), the island would be well suited for cattle or sheep farming but for its damp, foggy climate, with a mean annual temperature of 34° or 35° F., seldom rising to 66°, but falling in winter to 9° or 10°. Yet, regard being had to the conditions, the flora is surprisingly rich, and the German naturalists were able to collect thirteen flowering plants, mostly common also to the Falklands, but one allied to a form found in distant New Zealand. South Georgia is politically attached to the Falklands.

Southington, a town of Hartford county, Connecticut, U.S.A. It is near the centre of the state, mainly in the valley of Quinnipiac river, and extending to the hills on either side. Within its area of 38 square miles is a borough of the same name, located on the river, at an altitude of 149 feet and on a line of the New York, New Haven, and Hartford Railroad. Its manufactures consist largely of cutlery and other metal goods. Population of the town (1890), 5501; (1900), 5890; of the borough (1900), 3411, of whom 790 were foreign-born.

South McAlester, a city of the Choctaw Nation, Indian Territory, U.S.A. It is near the centre of the territory, at the intersection of the Missouri, Kansas, and Texas and the Choctaw, Oklahoma, and Gulf railways, at an altitude of 716 feet. Near it, on the east and west, are the valuable coal-mines of Indian Territory, and its prosperity is in great part due to the handling and shipping of coal. Its inhabitants consist almost entirely of whites, as the Indians remain aloof from the railroad. Population (1900), 3479, of whom 119 were foreign-born, and 621 coloured, including 592 negroes.

South Norwalk, a city and seaport of Fairfield county, Connecticut, U.S.A. It is at the mouth of the river Norwalk, and on the New York, New Haven, and Hartford Railroad, in the south-western part of the state. The site rises from the water, and beautiful villas have been built upon it. Its harbour is good, and there is regular steamer communication with New York and other Sound ports. Population (1880), 3726; (1890), 6152; (1900), 6591, of whom 1528 were foreign-born.

South Omaha, a city of Douglas county, Nebraska, U.S.A. It is on the west bank of the Missouri, immediately adjoining Omaha on the south, at an altitude of 1124 feet. It is entered by seven railways. Next to Chicago and Kansas City, it is the greatest slaughtering and meat-packing centre in the United States, containing several large packing-houses and immense stock-yards. In 1900 it had 109 manufacturing establishments, with a capital of $16,471,329, employing 6606 hands, and with a product valued at $70,080,941. Of this product no less than $67,716,724 was wholesale slaughtering and meat packing. It was chartered in 1885. Population (1890), 8062; (1900), 26,001, of whom 5607 were foreign-born and 571 negroes. There were 8106 persons of school age (5 to 20 years). Of 9880 males 21 years of age and over, 205 were illiterate (could not write).

South Orange, a township and village of Essex county, New Jersey, U.S.A. It is on the river Rahway, and on the Delaware, Lackawanna, and Western Railroad, in the north-eastern part of the state, at an altitude of 142 feet. It is 15 miles west of New York City, of which it is in great measure a residential suburb. It has a beautiful situation on Orange mountain, and contains many fine residences. Population of the village (1900), 4608; of the township, exclusive of the village (1900), 1630. Of the population of the village in 1900, 1140 were foreign-born.

Southport, a municipal borough and seaside resort in the Southport parliamentary division of Lancashire, England, 18½ miles north of Liverpool by rail. Modern erections are the Victoria Science and Art School, an infirmary, and additions to the convalescent hospital. A marine park was laid out in 1887; a marine carriage drive and a recreation ground were provided in 1895. Area (1891), 3665 acres. Population (1891), 41,406. In 1900 the area was extended to 9093 acres. Population (1901), 48,087.

South Portland, a city of Cumberland county, Maine, U.S.A. It is on Portland harbour, and on the Boston and Maine Railroad, in the south-western part of the state. It has been formed from a part of Cape Elizabeth Town. Population (1900), 6287, of whom 763 were foreign-born.

Southwell, a parish, city, and township in the Newark parliamentary division of Nottinghamshire, England, 14 miles north-east of Nottingham by rail. The cathedral church of St Mary, founded in 630 by the first archbishop of York, is a magnificent cruciform building, mainly Norman, but partly Early English in style, with some Perpendicular insertions. In 1882 it was thoroughly restored at an expenditure of about £20,000. The ancient palace of the archbishops of York, now partly ruinous, adjoins the churchyard of the minster, and in 1882 its "great chamber" was restored. The episcopal see of Southwell was founded in 1884. The city has lace and silk factories. The racecourse was closed in 1898, owing to its dangerous condition. Population (1881), 2866; (1891), 2831; (1901), 3160.

South-West Africa, German.—This German possession covers roughly the region formerly known as Damaraland and Namaqualand. The coast in its entire length of about 800 miles has no good harbour, and those ports which exist—Angra Pequeña, Sandwich Harbour, Walfish Bay—are gradually being filled with sand by the strong, cold, northerly coast current. Only Swakopmund, where proper precautions are taken, is likely to escape this fate. The coast-line is bordered by a belt of sand-dunes and desert, which in the south is about 35 miles wide and narrows towards the north. On the east this coast belt is flanked by a mountain range, which attains its highest elevation in Mount Omatako (8500 feet). These mountains form the escarpment of the great Kalahari plateau, which, gently rising from the interior towards the coast, slopes again towards the south and north from the point of its highest elevation. The Kalahari plateau changes the undulating character which it has in the west to a perfect plain in the far east, where the habitable country, with water, merges into the sterile Kalahari desert. There are only two important rivers found in South-West Africa, which do not entirely belong to the hydrographic system of the country. The Cunene comes from the Portuguese colony of Angola, and for a short distance forms the northern boundary of the colony; the Orange river, which forms the entire southern boundary, is the recipient of all the rivers of the protectorate which have a southerly direction. The Cunene and Orange have water all the year round, but are not navigable. The Okovango, which comes from the north and runs into Lake Ngami, is also perennial, but, like the other two rivers, belongs only partly to the hydrographic system of the country, receiving the rivers which take a northerly course. All the other streams of the protectorate, especially those running westwards, have water only after heavy rain, and only in exceptionally rainy years do they carry it on to the ocean. It mostly disappears in the sand which fills the river-beds, and there the water may be obtained by digging. The chief rivers are the Great Fish river and the Oub and Nosob, which, together with another eastern branch, form the Malopo. Both join the Orange. The Okavango receives the Omuramba and Umatako; the Kuisip and Swakob flow into the Atlantic. Hot springs are frequent, and it is remarkable that those of Windhoek flow more copiously during the dry than the rainy season.

Physical features.

On the coast the mean temperature is low, and there is little rainfall. The necessary moisture is supplied by dense fogs, which rise almost daily. South-west winds prevail. The interior enjoys a luxurious climate, with bracing, clear atmosphere. There are considerable differences of temperature between day and night, and two well-marked seasons, one cold and dry from May to September, the other hot and rainy from October to April. In winter ice frequently forms during the night on open water on the plateau, but it never remains all day. The yearly rainfall is not great; there is more in the north than in the south, and in the east than in the west, so that the north-east part of the protectorate is probably that with the most abundant atmospheric precipitation. Only here malarial fevers sometimes occur.

Meteorology.

The vegetation corresponds exactly with the climate. In the dry littoral region we find plants able to exist with the minimum of moisture they derive from the daily fog—*Amarantacea, Sarcocaula, Aloe dichotoma, Aristida subacaulis,* and the wonderful *Welwitschia.* Farther inland we can distinguish between those plants which spring up and disappear with the rain and those whose roots reach permanent water. The former are chiefly grasses, the latter exist almost solely in or near river-beds. Amongst the truly fine trees often seen here, the Ana tree (*Acacia albida*) is the most noteworthy, its seeds being favourite fodder for all domestic animals. *Acacia giraffæ, Ac. horrida, Adansonia sterculia,* near the Cunene the *Hyphæne ventricosa,* deserve special notice. Large game, which was formerly abundant, especially pachyderms, is scarce now. Of antelopes the following species are still plentiful in parts: springbok, steenbok, kudu, rietbok, pallah; of monkeys, the *Cynocephalus porcarius* is frequent. Various kinds of hyænas and jackals with fine fur (*Canis mesomelas*), also *Felis caracal,* abound. The spring-hare (*Pedestes caffer*) and rock-rabbit (*Hyrax capensis*) may often be observed by the traveller. Of birds there are 728 species. Crocodiles, turtles, and snakes are frequent.

Flora and fauna.

Among the coloured inhabitants of South-West Africa three classes may be distinguished. Of the Hottentot and Bushmen, the former probably came from the south, while the latter, together with the second class, the Mountain Damara, may be looked upon as indigenous races. The third class belongs to the Bantu stock, and came from the north-east, expelling and enslaving the Mountain Damaras, and settling in various parts of the country under different names. The most prominent are the Herero, thorough nomads and cattle-breeders; while the Ovambo or Ambo, in the northern part of the protectorate, are agriculturists. The Herero waged long wars with the Hottentots, who are divided into twelve tribes under as many chiefs. One of them, Hendrik Witboy, was the inveterate enemy of the Herero; then turned against the German administration, whose friend and ally he afterwards became. The Bastards are a small tribe originating from a mingling of Cape Boers with Hottentots. They are all Christians, able to read and write, and probably destined to play a part in the future of the colony.

Ethnology.

South-West Africa was annexed on 7th August 1889, when the German flag was raised in Lüderitz Bay. Its northern boundary is the Cunene river and a strip of Portuguese territory, as arranged by agreement of December 1886. From the mouth of the Cunene the boundary goes along to the rapids which this river forms on cutting through the Serra Cama; thence along the parallel of that locality until it reaches the Kubango, following this river to a spot called Andara, which remains on the German side, and thence straight to the Catima rapids of the Zambezi. The west boundary is the ocean from the mouth of the Cunene to that of the Orange river; the territory of Walfish Bay forms a small British enclave of little importance. The south and east boundaries, according to agreement of 1st July 1890, runs as follows:—From the mouth of the Orange river along its northern bank to where this is struck by 20° E. Thence along the meridian to its point of intersection with 22° S. Along that parallel to where it cuts 21° E.; it follows that till it reaches 18° S., along which it continues as far as the Chobe, following the valley of that river to its confluence with the Zambezi. The area thus enclosed measures about 322,450 square miles. The population is estimated at 200,000, 125,000 of whom are Bantu. The European population in 1900 numbered 3388, of whom 2104 were German, besides military.

Boundaries, area, population.

German South-West Africa is divided into three districts, Keetmanshoop, Windhoek, and Otyimbingue. In each of these is a *Bezirksamtmann,* with his staff of officials and a small police force. Each district has a number of small stations, where a non-commissioned officer with a few men keeps the natives in order. In each district is a law court, to whose jurisdiction not alone the whites but also the Bastards are subject. As in all German colonies, there is a court of appeal at the residence of the governor. In Keetmanshoop there is a mining department to register claims and to grant mining licences. The armed force consists of about 1000 regular troops and a militia formed of Bastards. The *Landeshauptmann* is the chief administrator and commander of the forces.

Government.

With the exception of the Bastards, the natives are all pagans. The Rhenish Missionary Society is doing good service on eight stations and the Finnish Mission on five stations in the northern part of the country.

The revenue of South-West Africa is small, and the empire has to pay a considerable subsidy. The revenue for 1901 was 10,452,000 marks, inclusive of an imperial contribution of 9,103,000 marks; expenditure, 10,452,000 (£527,600). The sale of land is progressing favourably, and the growing number of European settlers causes a corresponding increase of imports.

Revenue.

Various taxes exist in those parts of the protectorate where Government authority has been thoroughly established. On articles of export, such as feathers and hides, 5 per cent. *ad valorem* duty has to be paid; on cattle and horses, an export tax per head. The sale of spirituous liquors is subject to a licence, and travelling traders pay for each waggon, cart, or horse they employ.

Shipping. There is regular steamship communication between Hamburg and Swakopmund. The Woerman line despatches a steamer once in two months, which calls at Swakopmund, Walfish Bay, and Lüderitz Bay. A small steamer plies regularly between the coast harbours. A sailing vessel leaves Cape Town regularly once in six weeks, and calls at Lüderitz, Walfish Bay, and Swakopmund. A small schooner sails between Cape Town and Lüderitz Bay only, and a steamer calls about once a month at Walfish Bay and Lüderitz Bay.

Roads, post, and telegraph. A narrow-gauge railway is in course of construction between Swakopmund and the interior, of which about 180 miles were open for traffic at the end of 1901. The existing roads have been considerably improved. On several spots wells have been dug, to enable transport riders to rest their cattle where formerly want of water made forced marches necessary. The construction of water reservoirs or dams is progressing steadily. Across the Awas mountains a wide road has been cut. The protectorate is within the Postal Union, and there is a post office in every larger settlement. From Warmbad runners carry mails once a fortnight to the nearest post office in Cape Colony. From Windhoek a mail cart goes to Swakopmund, and thence either *viâ* Cape Town with the English mail or direct to Hamburg with the Woermann steamer. There is no telegraphic communication with South-West Africa. Telegrams are received at Cape Town and forwarded by ordinary mail.

Production, industry. The products are chiefly animal. The scarcity of water in the southern parts is not favourable for agricultural pursuits, while the good grazing lands offer splendid pasturage for cattle, which the Herero raise in numbers amounting to many hundred thousands. A flourishing cattle trade with Cape Colony existed before the rinderpest. Hides form a valuable export article; also feathers and horns. Sheep thrive well, and are beyond doubt the stock of the future. Goats also answer well. Horses have been imported from the Cape. Unfortunately, the climate does not suit them everywhere, and they are subject to a virulent distemper. Cattle and sheep also suffer from the diseases which are common in the Cape Colony. Camels have been imported, and are doing well. Vegetable products are scarce; agriculture is only carried on in the north, and the products—maize, sorghum, &c.—reach the south only in small quantities; near the coast the natives collect the kernels of the nara, a wild-growing pumpkin; they are exported to Cape Town. Minerals, especially copper, are plentiful in the country, but cannot yet be exploited owing to want of labour, cheap means of transport, and water. Of native industry there is next to nothing. A little pottery is carried on, and the women are clever in making fur cloths. In the north the Ovambo do a little smith-work and grass-plaiting. The imports in 1900 were valued at 6,968,400 marks and exports 907,600 marks. The chief exports are guano and ostrich feathers.

History. When South-West Africa was annexed, only a few mission stations existed, and a few white traders and hunters wandered through its wilds. Since then a considerable number of settlements have sprung into life, of which the most important is Windhoek, the seat of the *Landeshauptmann*, established on the old site of Jonker Afrikander's residence; and little Windhoek, a purely agricultural settlement, where the growth of the grape from the Cape promises every success. In the beginning the natives were hostile, and Hendrik Witboy strenuously opposed German rule. After a protracted war he was subdued, and became a firm ally of the authorities. Safety of life and property was thus secured throughout the country. Many companies, some of them British, have been formed. Private settlers are increasing, and they are recruited mostly from the men who have served their term in the colonial force and have had every chance of judging for themselves the resources of the country. In 1895 there were 13 trading firms, in 1898, 98.

AUTHORITIES.—N. SCHINZ. *Deutsch Süd-West Africa.* Leipzig, 1891.—SCHWABE. *Die Verkehrs-Verhältnisse des Deutsch Süd-West Africanischen Schutzgebietes.* Berlin, 1897.—REHBOCK. *Deutsch Süd-West Africa.* Berlin, 1898. (J. VON P.)

Southwold, a municipal borough and watering-place of Suffolk, England, in the Northern, or Lowestoft, parliamentary division, 12 miles south-south-west of Lowestoft, with a station on a single line connecting with the Great Eastern at Halesworth. The church of St Edmund's (Perpendicular) is an ancient flint structure. Herrings, sprats, smelts, and shrimps caught here are sent to the London market. A lighthouse was erected in 1890 on the North Cliff. In 1900 a pier 270 yards long was constructed, and serves as a calling-place for pleasure steamers, and the corporation has expended large sums in the improvement of the sea front. A fine common to the south of the town is used for golf, lawn-tennis, cricket, and other sports. Population (1891), 2311; (1901), 2800.

Sovereignty.—The word sovereignty is said to be derived from the mediæval word *supremitas, i.e., suprema potestas.* (See Skeat's *Etymological Dictionary* as to various forms of the word, and Meyer, *Lehrbuch des Deutschen Staatsrechts*, 15, as to its derivation.)

Sovereignty may be viewed in three ways: there is the historical explanation of its origin and growth, its rude beginning in the savage horde, its completion in the modern state; there is the analytical or juridical explanation; there is also what (for want of a better phrase) may be called the organic explanation of sovereignty.

History. The following are some of the chief stages in the history of sovereignty:—While society is in a rude state or only tribally organized, there is no distinct sovereignty, no power which all persons habitually obey. Thus there is no sovereignty among wandering groups of Australian savages: each family is isolated; each horde is a loose and unstable collection. When the horde has become a tribe, there may exist no definite sovereign. Distinct in time of war, the power of the chief may be fluctuating and faint in time of peace; even in time of war it may be subject to the authority of a council. Tribes of the same ethnic stock may form a sort of federation, permanent or temporary. "With the council of the confederacy," it has been said, "and, more generally, in the confederacy, sovereignty arises and the true political tradition is evolved" (Giddings, *Principles of Sociology*, p. 285). When the city and the State are conterminous, the seat of sovereignty becomes defined. Such was the condition of things in Greece, as considered by Aristotle in his *Politics.* He discusses the question what is the supreme power in the State (3. 10), which he defines as an aggregate of citizens (3. i.), and he recognizes that it may be lodged in one, a few, or many. In his view, the distinctive mark of the State is not so much sovereignty (7. 4) as self-sufficiency; a State is not a mere aggregate of persons; it is a union of them sufficient for the purposes of life (7. 8); sufficiency being "to have all things and to want nothing" (7. 5. 1). The Roman jurists say little, and only incidentally, as to sovereignty. But in the Middle Ages, under the influence of the Roman law, and with the belief in the existence of an empire entitled to universal sway, an absolutist theory of sovereignty was developed in the writings of the jurists who revived the study of that law: the emperor was sovereign; "quod principi placuit legis habet vigorem" (*Institutes*, i. 2. 6).

Those jurists often justified the *plenitudo potestatis* conceded to the emperor by the fact that he stood at the head of Christendom. Among the theories prevalent in the Middle Ages was one that mankind formed a unity, with the pope and the emperor at the head of it: the universal Church and the universal emperor ruled the world. Even to Leibnitz, writing in the 17th century, it seemed that "totam Christianitatem unam velut Rempublicam componere, in qua Cæsari auctoritas aliqua competit" (*Opera*, 4. 330). When the power of the emperor was weakened, and the idea of a universal ruler was gone, a new test of sovereignty was applied—that of external independence; the true sovereign States were *universitates superiorem non recognoscentes.* There were

times and countries in the Middle Ages in which the collective power of the community was small: many of the great corporations were virtually autonomous; the central authority was weak; the matters as to which it could count upon universal obedience were few. In such circumstances the conception of sovereignty was imperfect. It has been suggested that the modern conception of it was evolved from the contest between three powers: the Church, the Roman Empire, of which the individual States in Europe were theoretically provinces, and the great landowners and corporations. Whatever may be the truth as to this, the modern theory is first clearly stated in Jean Bodin's book *On the Commonwealth* (French edition, 1576; Latin version, 1586), which was the first systematic study of sovereignty. Bodin defines the State thus: "Respublica est familiarum rerumque inter ipsas communium, summa potestate ac ratione moderata multitudo." His theory, which corresponded on the whole to the state of things in France in the time of Louis XI., was a theory of despotism. It may be also described as a type of the mechanical or juridical theory of sovereignty. According to Bodin, there is in the State unlimited one power: "Majestas est summa in cives ac subditos legibusque soluta potestas" (i. p. 8). There exists a central force from which are derived all the powers which make or give effect to laws; a power which he describes sometimes as "majestas summa potestas summum imperium." This was the conception expressed by Bossuet, "Tout l'état est en la personne du prince," or in Louis XIV.'s saying, "L'état c'est moi."

One favourite theory was that sovereignty originated in a social contract. It was assumed that the individual members of society, by express or implied pact, agree to obey some person or persons; sometimes it is described as an unqualified handing over; sometimes it is a transfer subject to qualifications, and with notice that in certain contingencies this will be withdrawn. Gierke, in his book *Johannes Althusius und die Entwickelung der Naturrechtlichen Staatstheorie*, shows (p. 76) that the conception of a treaty or agreement as the basis of the State was in the Middle Ages a dogma which passed almost unchallenged, and that this theory was maintained up to a late period. It is to be found in the writings of Thomas Aquinas (*de Regimine Principum*, 266), Marsillus of Padua, Buchanan, Mariana, and Suarez. It is the kernel of the theories of Hobbes, Rousseau, Filmer, and Locke. Among the clearest and most logical exponents of this theory was Hobbes, who in his *Leviathan* expounded his notion of an agreement by which absolute power was irrevocably transferred to the ruler. Puffendorf, with some variations, states the same theory. In his view there is a *pactum unionis*, followed by a *pactum subjectionis*. The best-known exponent of this theory of the source of sovereignty is Rousseau, who assumes the existence of a *pacte social*, the terms of which are: "Chacun de nous met en commun sa personne et toute sa puissance sous la suprême direction de la volonté générale; et nous reçevons encore chaque membre comme partie indivisible de tout" (*Du Contrat Social*, 1. c. 6).

Those who distinguish society from the State, and who see in the latter only one of a group of institutions included in the former, do not regard sovereignty in any of the above lights. The tendency of students of sociology is to give little prominence to sovereignty, and to treat it as an incident of a highly organized society. Comte, Spencer, Bagehot, Durkheim, and Giddings, for example, refer to it, if at all, only briefly and incidentally; they conceive society as an organism, or at all events as a growing whole, no one part or force being the cause of all others, and all interacting; society is not the product of any agreement or of force alone, but of a vast variety of interests, desires, and needs. Not the State or Government comes at a certain stage of organization: small groups are drawn together; powerful corporations fall into line; a national feeling develops; eventually the State as we know it is formed. Sovereignty is a resultant of many forces. It may not exist as to some regions of conduct; as to others it may be weak and mutable; only in certain conditions is the sovereign power supreme as to all matters of conduct.

Among the different senses in which "sovereign" has been used are the following:—

(*a*) "Sovereign" may mean titular sovereign—the King in the United Kingdom, the Kaiser in Germany.

(*b*) The legal sovereign: the person or persons who, according to the law of the land, legislate or administer the Government.

(*c*) The political or constitutional sovereign: the body of persons in whom the actual power at any moment or ultimately resides. Sometimes this is designated "the collective sovereignty."

(*d*) Sovereignty is also used in a wider sense as the equivalent of the power, actual or potential, of the whole nation or society (Gierke, 3. 568).

The distinction between real and nominal sovereignty was familiar to mediæval writers, who recognized a double sovereignty, and distinguished between (1) the real or practical sovereignty resident in the people, and (2) the personal sovereignty of the ruler. (Adolf Dock, *Der Souveranitätsbegriff*, &c., p. 13.) By many writers sovereignty is regarded as resident not in any one organ, but in the *Gesammtperson* of the community (Maitland, *Political Theories of the Middle Ages*, xliii.).

Sometimes sovereignty is defined as the organized or general will of the community (Combothecra, *Conception Juridique de l'État*, p. 96). "Sovereignty is the organized will of an organized independent community. . . . The Kings and Parliaments who serve, as its vehicles." "Sovereignty resides in the community" (Woodrow Wilson, p. 1448). The same theory is often expressed by saying that the majority in a community, or a particular group, in fact, rules (Guizot, *Representative Government*, i. p. 167). This was the doctrine of the French Revolution. "Sachez que vous êtes rois et plus des rois," said a revolutionary orator cited by Taine. It was the language of the founders of the American Constitution and contemporary political writers; the language, for example, of Paine: "In republics such as there are established in America the sovereign power, or the power over which there is no control and which controls all others, remains where nature placed it—in the people" (*Dissertations on Government*, i. 6).

The same theory assumes a more subtle form, especially in the writings of Hegelians. Sovereignty is with them a term descriptive of the real will of the community, which is not necessarily that of the majority. "If the sovereign power is to be understood in this fuller, less abstract sense, if we mean by it the real determinant of the habitual obedience of the people, we must look for its sources much more widely and deeply than the analytical jurists do; it can no longer be said to reside in a determinate person or persons, but in that impalpable congeries of the hopes and fears of a people bound together by common interest and sympathy, which we call the common will" (Green's *Works*, 2. 404). "Though it may be misleading to speak of the general will as anywhere, either actually or properly, sovereign . . . yet it is true that the institutions of political society are an expression of, and are maintained by, the general will" (2. 409).

Sovereignty is used in a further sense when Plato and

Aristotle speak of the sovereignty of the laws (*Laws*, 4. 715; *Politics*, 4. 4; 3. 15). Thus Plato remarks: "I see that the State in which the law is above the rulers, and the rulers are the inferiors of the law, has salvation." (See also Gierke, *Genossenschaftsrecht*, 3. 8.) Even in mediæval writers such as Bracton is found the notion that the king is subject to the laws: "Bracton knows of no sovereign in the Austinian sense, and distinctly denies to the royal authority the attribute of being incapable of legal limitation" (Figges, *The Divine Right of Kings*, p. 13). We find the same expressed by many German jurists, *i.e.*, the idea of a State which exists only in the law and for the law, and whose life is but by a legal order regulating public and private relationship (Gierke, iii. x.).

Definitions of sovereignty.

Among the definitions of sovereignty may be quoted these: "That which decides in questions of war and peace, and of making or dissolving alliances, and about laws and capital punishment, and exiles and fines, and audit of accounts and examinations of administrators after their term of office" (Aristotle, *Politics*, 4. 4. 3). "Suprematum illi tribuo qui non tantum domi subditos manu militari regit, sed et qui exercitum extra fines ducere et armis, fœderibus, legationibus, ac cæteris juris gentium functionibus aliquid momenti ad rerum Europæ generalium summam conferre potest" (Leibnitz, *Opera*, 4. 333). "La souveraineté est celle qui sert a exprimer l'independance d'un état aussi bien à l'intérieur qu'à l'extérieur" (De Martens, *Traité du Droit International*, translated by A. Leo, 1881, i. 378). "L'independance complete qui peut se manifester à deux points de vue; l'un extérieur, l'autre intérieur" (M. Despagnet, *Droit International Public*, 1894, p. 80). "Sovereignty as applied to States imports the supreme, absolute, uncontrollable power by which any State is governed" (Cooley, *Constitutional Limitations*, p. 1). "Social control, manifesting itself in the authoritative organization of society as the State, and acting through the organs of Government, is sovereignty" (Giddings, *Elements of Sociology*, p. 217). See the collection of definitions in *Der Souveranitätsbegriff im Bodin*, &c., by Dr Adolf Dock (1897), p. 6, and in *La Conception Juridique de l'État*, by Combothecra, p. 90). Many of these definitions describe an ideal state of things rather than realities. Some of the definitions would apply to the authority of powerful religious bodies in certain periods of history, or of illegal associations, such as the Mafia, which have terrorized the community.

Territorial sovereignty is used in a variety of senses. Often the phrase is the equivalent of sovereignty. It may mean a state of things such as existed in the Middle Ages, in which ownership and sovereignty were not clearly separated: when he who was owner had sovereign rights incident thereto, or, as it was sometimes phrased, when sovereignty inhered in the territory, when the king was the supreme landowner (Maine, *Ancient Law*, 106); when all political power exhibited proprietary traits, and was incident to the ownership of land (Maitland, *Township and Borough*, 31). Territorial sovereignty is thus defined by Leibnitz: "Superioritatem territorialem in summo subditos coercendi jure consistere" (*Opera*, 4. 358. See Laband, 1. c. 8).

Nature of sovereignty.

Certain propositions are often stated with respect to sovereignty. One of them, stated by Rousseau (*Du Contrat Social*, 2. c. 2), is that it is indivisible: a proposition true in the sense that in regard to the same matters at the same time there cannot be two sovereigns, but not true in the sense in which it has often been employed, namely, that in the last analysis of society there are some persons or person who controls all conduct and are habitually obeyed as to all matters. Rather we may say with Maine, "Sovereignty is divisible, but independence is not." A frequent deduction from the theory of the indivisibility of sovereignty is that there cannot be double allegiance; in other words, no one can be the subject of two States. This deduction is not in fact true. With the existing differences in the laws of modern States as to nationality, persons may be, and are, subjects of two or more States. In the native states in India there may be said to be double allegiance. Mr Tupper, in his work on *Indian Protectorates*, refers to "the double allegiance of the subjects of native states" in India; and he explains that the native rulers are themselves subject to the Indian Government. "For all purposes of our relation with Powers the subjects of Indian native states must be regarded as subjects of Her Majesty" (Tupper, *Indian Protectorates*, p. 353). Such double allegiance is apt to exist in times of transition from one sovereignty to another; for example, in the 18th century, in the British possessions in India, the Mogul was said to exercise a personal sovereignty. As Sir William Scott remarked in the *Indian Chief*, 3 C. Rob. 22, it hardly existed otherwise than as a phantom: the actual authority was exercised by the East India Company.

Another deduction from the same proposition is that any corporation or private body which appears to exercise sovereign powers together with the State does so only by delegation. This theory is thus stated by Burke (*Works*, 7. 289) with reference to the East India Company: "The East India Company itself acts under two very dissimilar sorts of power, derived from two sources very remote from each other. The first source of its power is under charters which the Crown of Great Britain was authorized by Act of Parliament to grant, the other is from several charters derived from the Emperor of the Moguls. . . . As to those of the first description, it is from the British charters that they derive a capacity by which they are considered as a public body, or at all capable of any public function. . . . This being the root and origin of their power, renders them responsible to the party from whom all their immediate or consequential powers are derived."

Another proposition often stated with respect to sovereignty, is that it is unlimited: a proposition which is not true of the legal or political sovereign. In all States are limits, more or less definite, to such powers, according to the character of the subjects and the relations of the State to foreign powers. Even despotism is tempered by assassination and the liability of revolution (Dicey, *Law of the Constitution*, p. 73). A third proposition often expressed with respect to sovereignty, is that it cannot be alienated: a proposition thus stated by Rousseau: "Je dis que la souveraineté, n'étant que l'exercise de la volonté générale, ne peut jamais s'aliéner" (*Du Contrat Social*, 2. 1).

According to one view, sovereignty is not the distinctive note of a State. Many communities usually regarded as true States do not possess it. There are sovereign and non-sovereign States; international law recognizing both. In the view of many writers sovereignty is not a necessary attribute of a State, but a mark of independence (Laband, *Das Staatsrecht des Deutschen Reiches*, 1. 87; Jellinek, *Die Lehre von der Staatenverbindungen*, p. 37; Meyer, *Lehrbuch des Deutschen Staatsrechtes*, p. 5; Rehm, *Allgemeine Staatslehre*. See the contrary view presented by Professor Burgess, *Political Science or Constitutional Law*, i. 52; *Political Science, Quarterly*, 3. 123; M. Georges Streit, *Revue de Droit International*, 1900, p. 14).

The phrase *half sovereign States* was invented by J. J. Moser to describe States possessing some of the attributes

of sovereignty. Under this class are grouped very diverse communities. There are States which possess some attributes of sovereignty, but not others; States possessing internal autonomy, but not externally independent; States which are more or less under the influence of others. There are also States which have certain of the attributes of sovereignty, but are subject to servitudes or burthens imposed by treaty, usage, or force. Feudalism had a phraseology to express the varieties of fiefs which existed under it; modern international law has no generally accepted terminology for the still greater variety of States which now exist. These varieties tend to multiply, and it is difficult to reduce them all to a few types. The theory that States are equal, and possess all the attributes of sovereignty, was never true. It is still more at variance with the facts in these days when a few great States predominate, and when the contact of Western States with African and Asiatic States or communities gives rise to relations of dependence falling short of conquest. The division into federations, confederations, and alliances is not complete. Jellinek has suggested this classification (*Die Lehre von der Staatenverbindungen*, p. 58): (*a*) Unorganized associations, including—(1) treaties; (2) occupation of the territory of one State and administration by another, as in Bosnia and Cyprus; (3) alliances; (4) protectorates, guarantees, perpetual neutrality; (5) *Der Staatenstaat*, the feudal State, of which Jellinek gives the Turkish empire and the old German empire as examples. (*b*) Organized associations, including — (1) international commissions (*internationale Verwaltungsvereine*, such as international postal and telegraph unions, &c.); (2) the *Staatenbund* or federal State; (3) real unions of States as distinguished from personal; (4) the *Bundesstaat*. Most of the existing varieties may be conveniently ranged in the following classes:—

Half-sovereign States.

(1) States which have complete independence, complete autonomy, external and internal, and which are recognized in international law as sovereign States.

(2) States which have complete external independence, but are more or less subject permanently to other States as to their internal affairs. Of this class there are few examples. Perhaps, however, such States as permit, permanently or normally, of interference by others on behalf of certain classes of subjects may be so described. Among such are Bulgaria, Montenegro, Servia, and Rumania, as to which the Treaty of Berlin (Article 5) of 1879 stipulates for rights of members of all creeds and religious worship. The general principle is that a treaty does not detract from sovereignty. As Jellinek expresses it, "Der Staatenvertrag bindet, aber er unterwirft nicht" (*Gesetz und Verordnung*, p. 205); or as Grotius (1, c. 3, 22. 2) expresses it, "Nec regi aut populo jus demit summi imperii."

(3) States which enjoy complete autonomy as to internal affairs, but which are more or less subject to other States as to foreign relations. Some writers would place in this category all States forming part a of true confederacy. It includes States which are united temporarily—cases of inorganic unity, to use Jellinek's expression. It includes also permanent alliances or organic unions. These are some examples:—

(*a*) *Protectorates and Suzerainties.* The status of certain States, such as Bulgaria, Rumania, the late South African Republic, are peculiar. They are undoubtedly for many purposes sovereign.

(*b*) The unions between a superior and inferior State, *e.g.*, the relations of the various States to the old German Empire; the relations of the Ottoman Porte to its Christian provinces. In the Middle Ages the question was often mooted whether States subject to feudal superiors, or the States forming the German Empire, were sovereign. According to one common definition they were not: a true sovereign State was *universitas quæ non superiorem recognoscit.* "Celui est absolument souverain qui ne rien tient après Dieu que de l'espée. S'il tient d'autrui il n'est plus souverain." The prevalent opinion, however, was that sovereignty was compatible with rights such as were possessed by the *Reich* over the princes of Germany; that there might be fiefs held in full sovereignty; and that vassal States, when subject only to "nude vassalage," were sovereign. That was the view of Grotius (1. 1. c. 3, 23. 2), who holds that the *nexus feudalis* is consistent with summum imperium.

(4) States which have, by treaty or otherwise, parted with some portion of their sovereignty and formed new political units: what Mr Herbert Spencer calls "compound political heads," or, to use Austin's expression, "composite States." The most important examples of this class consist of federal or composite States which by treaty or otherwise have surrendered certain of their powers, or which have created a new State (Staatenbund). For many years one of the burning questions in the politics of the United States was the question whether the individual States of the Union remained sovereign. According to the theory of Calhoun, the States had entered into an agreement from which they might withdraw if its terms were broken, and they were sovereign. According to the theory expounded in the *Federalist*, the individual States did not, after the formation of the constitution, remain completely sovereign: they were left in possession of certain attributes of sovereignty, while others were lodged in the Federal Government; while there existed many States, there was but one sovereign. Even if the origin was a compact or contract, after the "United States" were formed by a "Constitutional Act" there no longer existed a mere contractual relation: there existed a State to which all were subject, and which all must obey (von Stengel, *Staatenbund und Bundesstaat*; *Jahrbuch für Gesetzgebung*, 1898, p. 754; Cooley, *Principles of Constitutional Law*, pp. 21, 102). According to Austin: "In the case of a composite State or a supreme federal Government, the several united governments of the several united societies, together with a government common to these several societies, are jointly sovereign in each of those several societies and also in the larger society arising from the federal union, the several governments of the several united societies are jointly sovereign in each and all" (5th ed., i. 258). In point of fact, there are fields of action in which A is sovereign, others in which B is sovereign, and certain others in which A and B are jointly or alternately sovereign. To take the American Constitution, for example, the States are sovereign as to some matters, the Federal Government as to others.

(5) Another division includes anomalous cases, such as Cyprus or Bosnia, in which one Government administers a country as to which another State retains certain powers, theoretically large.

(6) The territories governed or administered by chartered companies form a class by themselves. Nominally such companies are the delegates of some States; in reality they act as if they were true sovereigns.

(7) Two other classes may be mentioned: (*a*) cases of real union between States, *e.g.*, that between Austria and Hungary; (*b*) personal unions, distinguished from the above-named forms—for example, the union of England and Hanover.

(8) A small group consists of instances of *condominium* or arrangements similar thereto; for example, the arrangements as to the Samoa Islands from 1889 to 1899.

According to modern usage the appellation "sovereign State" belongs only to States of considerable size and population exercising without control the usual powers of a State, *e.g.*, able to declare peace or war. Leibnitz, discussing this subject in his *Tractatus de Jure Suprematus*,

(*Opera*, 4. 362), says: "Itaque valde etiam dubito, an possit Reipublicæ illi Italiæ, quam vocant Sancti Marini oppidum, concedi suprematus, tametsi jure liberam esse nemo negot," a remark which would apply also to the Republic of Andorra: "Illi tantum vocantur souverains ou potentats, qui territorium majus habent, exercitumque educere possunt; atque hoc demum illud est, quod ego voco suprematum, et Gallos quoque arbitror, cum de rebus ad jus gentium spectantibus, pace, bello, fœderibus sermo est, et ipsi aliquos vocant souverains, eos non de urbibus liberis loqui, nec exiguorum territoriorum, Dominisquœ facile dives Mercator sibi emere potest, sed de majoribus illis potestatibus, quæ bellum inferre, bellum sustinere, propria quodammodo vi stare, fœdera pangere, rebus aliarum gentium cum auctoritate intervenire possunt" (4. 359).

Size of State.

With this view may be compared that of a writer in the *Law Magazine*, vol. xxv., 1899, p. 30, who argues that the Republic of San Marino is a State in the full sense.

It is sometimes suggested that self-governing colonies are to be regarded as true States. Undoubtedly some of them can no longer be regarded as colonies in the old sense. The self-governing colonies forming part of the "multi-cellular British State," as Mr Maitland describes it (*Political Theories of the Middle Ages*, p. x), have an essentially "State-like character." If Liberia is a State, the same may surely be said of Canada. It is true the British colonies have not the power of declaring war or peace, or regulating the foreign policy of the Empire; and the Crown may disallow a measure passed by the Dominion Parliament (Bourinot, *Constitution of Canada*, 1888, p. 75; Lefroy, *Legislative Power in Canada*, 244). Colonial legislatures are said to have delegated powers. It is more accurate to say that as to certain matters the Legislature of the Canadian Dominion is sovereign, and as to certain others that it is not (Lefroy, 244; Quick and Garrad, *Australian Commonwealth*, 328; Dicey, 106); and as to some matters they are in fact, if not in form, *universitates superiorem non recognoscentes* (Quick and Garrad, 319); or that they are States in process of making. Occasionally the expression "subject of a colony" is now used (*Low* v. *Routledge*, L.R. 1 Ch. 42; Lefroy, *Legislative Power in Canada*, 329). At all events, the self-governing colonies may be classed as "half sovereign States" or "quasi-sovereign."

Colonies.

Many attempts have been made to enumerate the attributes of sovereignty, *i.e.*, the regalia, prerogatives, &c., as they were called. For example, Bodin gives a list of the properties of majestas or sovereignty: (*a*) "Legem universis, &c., singulis civibus dare posse; (*b*) bellum indicere aut pacem inire; (*c*) to appoint and change magistrates; (*d*) power of final appeal; (*e*) power of pardon; (*f*) raising revenue; (*g*) coining money" (*De Republica*, i. c. 10). Leibnitz, with the Middle Ages in view, divides the attributes or faculties into two classes: regalia majora and regalia minora. Hobbes (*Leviathan*), analysing these attributes, enumerates twelve attributes. "These," he says, "are the marks which make the essence of sovereignty, and which are the marks whereby a man may discover in what man, or assembly of men, the sovereign power is placed or resideth." He also describes them as "inseparable rights." Bluntschli (*Allgemeine Staatslehre*, i. 575) enumerates these attributes: (*a*) right of recognition of majestas; (*b*) independence; (*c*) power to determine constitution; (*d*) right of legislation; (*e*) action through deposed organs; (*f*) irresponsibility. All of these enumerations are open to the objection that they merely describe the action of the State at a particular time, or indicate a theory of what an ideal State should be.

Attributes of sovereignty.

AUTHORITIES.—The literature of the subject is immense; every book on political science, from *Republic* of Plato and the *Politics* of Aristotle, has dealt with or touched sovereignty. A few of the chief modern works are—BLUNTSCHLI. *Allgemeine Staatslehre.* 1852.—GIERKE. *Das Deutsche Genossenschaftsrecht.* 1863–81.—AUSTIN. *Lectures on Jurisprudence*, 3rd ed. 1869.—MAINE. *Minute on the Kāthiáwár States.* 1864 (printed in *Life and Speeches*, p. 320); *Early History of Institutions.* 1875.—LABAND. *Staatsrecht des Deutschen Reiches.* 1876.—VON MOHL. *Encyclopädie der Staatswissenschaften*, 2nd ed. 1872.—GIERKE. *Johannes Althusius.* 1880.—JELLINEK. *Die Lehre von den Staatsverbindungen.* 1882.—MEYER. *Lehrbuch des Deutschen Staatsrecht.* 1878.—ROSIN. *Souveranitätstaat.* 1883.—GAREIS. *Allgemeines Staatsrecht.* 1882.—COOLEY. *Constitutional Limitations*, 6th ed. 1890.—JELLINEK. *Ueber Staatsfragmente.* 1896.—WESTERKAMP. *Staatenbund und Bundesstaat.* 1892.—GREEN'S *Works.* 1892.—FOWLER. *City State of the Greeks and Romans.* 1893.—SALOMON. *L'Occupation des Territoires sans Maîtres.* 1896.—DICEY. *Law of the Constitution*, 5th ed. 1897.—COMBOTHECRA. *La Conception Juridique de l'État.* 1899.—REHM. *Allgemeine Staatslehre.* 1899.—GIDDINGS. *Principles of Sociology*, 3rd ed. 1899.—BURGESS. *Political Science and Constitutional Law.* 1899.—MERRIAM. *History of the Theory of Sovereignty since Rousseau.* 1900.—BRYCE. *Studies on History and Jurisprudence*, 2. 49. 1901.—BORNHAK. *Einseitige Abhängigkeitsverhältnisse unter den Modernen Staaten.* 1896.—WILLOUGHBY. *The Nature of the State.* 1896. (J. M†.)

Sowerby, a large village, Yorkshire, England, in the Sowerby parliamentary division of the West Riding, on both sides of the river Calder, 3½ miles west-south-west of Halifax and 1½ mile distant from Sowerby Bridge station. Since 1894 Sowerby and its neighbouring parish of Sowerby Bridge have been governed by urban district councils. At Sowerby Bridge a free public library was opened in 1893. The population of the urban districts was—Sowerby, in 1891, 4051; in 1901, 3653: Sowerby Bridge, in 1891 (altered area), 10,426; in 1901, 11,477.

Spa, a watering-place in the province and 21 miles south-east of the town of Liége, Belgium. The altitude of the town varies from 820 feet to 1080 feet above sea-level. The surrounding scenery is very picturesque, consisting chiefly of low, wooded hills. The town has flourished since the 16th century, but attained its highest popularity in the 18th century, when it was visited by, among others, Peter the Great, Gustavus III. of Sweden, Joseph II. of Austria and the Emperor Paul of Russia (before he ascended the throne). Altogether there are sixteen springs, the waters being chalybeate (50° Fahr.). A new parish church was built in 1884–85. The Gallery Leopold II. contains a small museum, as well as music halls, reading-rooms, &c. Like Monte Carlo and Ostend, Spa permits public gambling in its casino. The season lasts from May to October, during which period the place is visited by some 17,000 persons annually. Population (1890), 7109; (1900), 8192.

Spahis (in Persian *Sipari*, meaning "warriors," and synonymous with *Sepoy*) originally denoted the holders of fiefs in Central Asia who were under an obligation to yield personal military service to their superior chief. In process of time the term came to be applied to the soldiery whom these inferior nobles furnished in their own stead. A like feudal institution existed in Turkey, and the "Spahis" were the light irregular cavalry which from the time of Sultan Amurath I. (1326) down to the beginning of the 19th century formed the flower of the Turkish army; at one period they are estimated to have numbered 130,000. "Spahis" is the term now applied to certain native cavalry regiments in Algiers and Tunis, which are officered by Frenchmen.

SPAIN.

I. Statistics.

THE present 49 provinces of Spain are subdivided into 495 districts, styled *partidos judiciales*, and 9274 parishes or *ayuntamientos*. A plan has been mooted for once more grouping the provinces into regional divisions, and the parishes into groups also, to carry out the prevalent tendency towards decentralization. In 1857 the population, according to the census, was 15,464,340; in 1877, 16,631,869; in 1887, 17,673,838; in 1897 (excluding soldiers and their families abroad), 18,226,040, of which 8,884,389 were males and 9,341,651 females. The census of 1897 shows that there were 28,460 foreigners permanent residents and 9080 foreigners temporarily resident in Spain. Only 24·79 per cent. of the whole population lived in towns. The density of the population is greatest in Galicia, parts of Catalonia and the Basque provinces; lowest in Cuenca, Teruel, and some parts of Andalucia and Aragon. The average on the whole kingdom was 90 per square mile in 1887; 93 in 1897. In 68 towns (in 1897) the death-rate was higher than in Madrid, and the average was in the provinces from 1·95 per cent. in Canaries to 3·88 per cent. in Palencia; and the birth-rate ranged from 2·78 per cent. in Pontevedro to 4·36 in Palencia.

Territorial divisions and population.

The following table shows the provinces, area, and total Spanish population in 1887 and 1897:—

Provinces.	Area in Square Miles.	Population, 1887.	Population, 1897.
New Castille	*28,018*	*1,778,155*	*1,849,929*
Madrid	2,997	683,484	730,807
Guadalajara	4,869	205,040	202,282
Toledo	5,586	356,398	369,830
Cuenca	6,726	246,091	245,122
Ciudad Real	7,840	287,142	302,088
Old Castille	*25,409*	*1,744,301*	*1,784,620*
Burgos	5,651	342,988	343,359
Logrono	1,945	183,430	188,620
Santander	2,112	249,116	267,292
Avila	2,982	195,321	201,836
Segovia	2,714	155,927	159,057
Soria	3,836	157,008	153,522
Palencia	3,126	189,349	193,963
Valladolid	3,043	271,162	276,971
Asturias	*4,091*	*615,844*	*622,955*
Oviedo	4,091	615,844	622,955
Leon	*15,242*	*984,711*	*996,063*
Salamanca	4,940	320,588	322,198
Zamora	4,135	274,890	278,947
Leon	6,167	389,233	394,915
Estremadura	*16,702*	*808,685*	*834,045*
Badajoz	8,688	476,273	487,468
Caceres	8,014	332,412	346,577
Galicia	*11,343*	*1,967,239*	*2,020,030*
Coruna	3,078	635,327	651,623
Lugo	3,787	438,076	465,996
Orense	2,739	415,237	417,327
Pontevedro	1,739	478,599	485,084
Andalucia	*33,926*	*3,393,681*	*3,433,693*
Almeria	3,302	345,929	350,822
Granada	4,937	482,787	479,159
Malaga	2,824	523,915	490,331
Cordova	5,300	413,883	434,802
Jaen	5,184	428,152	456,358
Cadiz	2,828	423,261	429,576
Seville	5,429	535,687	541,744
Huelva	4,122	240,067	250,901
Valencia	*8,897*	*1,461,453*	*1,533,024*
Castellon	2,466	292,852	307,107
Valencia	4,353	730,916	774,206
Alicante	2,098	437,685	451,711
Carry forward	143,628	12,754,089	13,074,359

Provinces.	Area in Square Miles.	Population, 1887.	Population, 1897.
Brought forward	143,628	12,754,089	13,074,359
Murcia	*10,449*	*720,843*	*755,494*
Albacete	5,972	231,073	236,345
Murcia	4,477	489,770	519,149
Catalonia	*12,483*	*1,836,139*	*1,951,730*
Lerida	4,775	296,609	284,693
Gerona	2,272	311,153	302,345
Barcelona	2,985	879,771	1,028,113
Tarragona	2,451	348,606	336,579
Aragon	*17,979*	*922,554*	*907,251*
Huesca	5,878	260,585	247,317
Saragossa	6,607	415,152	412,172
Teruel	5,494	246,817	247,762
Navarra	*4,046*	*307,994*	*300,381*
Navarra	4,046	307,994	300,381
Basque Provinces	*2,782*	*510,194*	*576,358*
Vizcaya	849	234,880	289,405
Guipuzcoa	728	181,149	192,311
Alava	1,205	94,165	94,642
Balearic Isles	*1,860*	*313,480*	*309,807*
Canary Isles	*2,944*	*301,963*	*339,203*
African possessions	...	6,582	11,270
Total	196,171	17,673,838	19,225,853

In regard to professions, the 1897 census showed that 4,854,742 inhabitants were occupied in agricultural pursuits, 243,876 in manufacturing and mining, 194,755 in commerce, 11,804 lawyers, 40,528 in holy orders, 28,549 nuns, 20,555 in medical professions, 97,257 public officials, 49,665 employed in railways and companies, 39,136 teachers, 16,849 artists, 423,999 servants of both sexes, 91,226 paupers and mendicants, 823,310 operatives and handicraftsmen.

In 1897 Madrid had 510,616 inhabitants, Barcelona 504,396, Valencia 203,958, Seville 145,728, Malaga 125,434, Murcia 108,476, Saragossa 97,433, Bilbao 74,076, Granada 74,599, Cadiz 67,987, Palma 62,626, Carthagena 86,424, Valladolid 67,917. There were 44 towns with a population of over twenty and below sixty thousand, and 133 towns ranging from ten to twenty thousand. In the last twenty years of the 19th century there was a marked increase in the population of great towns.

The birth-rate in Spain was 37·50 per 1000 in 1861–70 and 36·20 in 1886–92. The marriage-rate was 7·60 per 1000 in 1861–70, dropping to 6·40 in 1883–85, and rising again to 7·30 per 1000 in 1886–92. The death-rate per 1000 was 30·10 in 1861–70, 33·90 in 1883–85, and 31·40 in 1886–92. The percentage of illegitimacy is 5·8. The death-rate in Madrid, 32·80 per 1000, is the highest of all European capitals.

Emigration and Immigration.—From 1882 to 1890, 611,295 persons emigrated from Spain, and the immigrants were 462,893, leaving a balance against Spain of 148,402. In the years 1891–95 the emigrants were 337,106 males and 53,571 females, and the immigrants 245,048 males and 55,893 females, leaving a balance against Spain of 89,736 in all. More than half the emigrants and immigrants belong to the agricultural classes, the latter chiefly returning from Portugal and Algeria. About 66 per cent. of the emigrants went to America, about 29 per cent. to Africa, meaning Algeria, and the rest to Europe and Oceania. In these figures are included the reliefs of the colonial army, the officials and civilians going and coming from the colonies up to 1895. The average annual emigration for the years 1898–1900 was 58,808 persons.

Roman Catholicism is the established religion and State Church under the Constitution of 1876. In the budget of 1899–1900, £1,639,262 was assigned as Church estimates under the Concordat

with Rome. Spanish codes still contain many severe penalties, including fines, correctional prison, and penal servitude, for delicts against the State religion, as writers and journalists frequently discover when they give offence to the ecclesiastical authorities. Blasphemy is punished by imprisonment. The bishops sit in the Superior Council of Education, and exercise much influence on the programmes of public instruction. The latest education reform in 1899 obliges all boys to follow lectures on theology and religion during six out of seven years of their curriculum to obtain the B.A. degree. Canon law and Church doctrine form an obligatory part of the studies of men qualifying for the bar and magistracy. By the Constitution of 1876 non-Catholics are only permitted the exercise of their form of worship on condition that they do so in private, without any public demonstration or announcement of their services. The same rule applies to their schools, which are, however, numerously attended, in Madrid, Seville, Barcelona, and other towns, by children of Protestant families, and of many Catholics also. The Protestant cemeteries, in the few places where they exist, are respected because chiefly foreign property. Many Spanish cemeteries have a corner set apart for Protestants, Jews, and Freethinkers. At the census of 1877 the total official number of Protestants was 6654, and of Freethinkers 9645, out of 16,634,345 Spaniards. In 1887 the figures were 8000 and 11,000 out of over 17 millions; but the facts are not fully disclosed, as both Protestants and Freethinkers are known to be much more numerous, especially in the middle and lower classes. Though Wilkomm said, in the early 'eighties, that he had grounds for supposing that indifferentism was then general in the upper and even in the lower classes, and fanaticism and bigotry limited to some distant provinces where the clergy had much influence on the lower orders, such was not at all the case at the close of the 19th century. With liberty of conscience during the Revolution, from 1868 to 1877, certainly the Church lost ground, and indifference, scepticism, and anti-clerical ideas did prevail for a while in great towns, in the centres of Republicanism in Catalonia and Andalucia; but a reaction set in with the Restoration. The Governments of the Restoration showed the Church much favour, allowed the Jesuits and religious orders of both sexes to spread to an extent without precedent in the century, and to take hold of the education of more than half of the youth of both sexes in all classes of society. The revival of Church and monastic influence began during the reign of Alphonso XII., 1877–85, and considerably increased afterwards under the regency of Queen Christina, during the long minority of Alphonso XIII., the godson of Pope Leo XIII. It made itself felt very visibly at court, in society, in politics, and even in legislation.

Religion.

A law of 17th July 1857 made primary education compulsory on all children of school age, originally fixed at six to nine, and made free for the poor. It proved impossible to enforce this statute, and the majority of Spaniards are still illiterate, though in decreasing proportion at each census. The primary schools for both sexes are kept up at the expense of the parish; the ayuntamientos, or municipal councils, in many provinces pay the teachers very irregularly, and often owe them arrears of several years. The secondary schools are styled institutes and are mostly self-supporting, as the fees paid by the pupils for attendance at lectures and for their B.A. degrees in general cover the expenses of such establishments, which get, besides, subsidies from some of the provincial councils. Spain has ten universities: Madrid, the most numerously attended, has 14,000 students; Salamanca, the most ancient, the alma mater of Spanish science and letters in the Middle Ages and Renaissance; Granada, Seville, Barcelona, Valencia, Santiago, Saragossa, Valladolid, and Oviedo. Most of the universities are self-supporting from the fees of matriculations and of degrees. In fact, the State is in great part thus reimbursed, the £360,000 placed nominally on record in the annual budget for education. The primary schools were attended in 1897, by 1,168,013 boys and 1,095,184 girls, making a total of 2,263,197 children receiving education in the State municipal schools alone, exclusive of free schools and religious houses of education. The normal State schools for the training of professors contained 2041 male and 3518 female pupils. The free normal schools had 2025 male and 2219 female pupils. The secondary or higher schools of the State had 29,362 pupils, and the free schools of the same grade 6866. The universities had 91,995 students, of whom 11,947 alone belonged to the class called free students, trained in addition to the regular matriculated undergraduates. The professoriate consisted of 549 university professors, who mostly secured their chairs by competitive examinations, 567 professors of institutes, 617 professors in the normal schools to train teachers of primary schools, and 37,754 teachers of the primary State schools. The total number of Spaniards who could read and write in 1877 was 4,071,823 out of a population amounting to 16,631,869. In 1887, 5,004,470 Spaniards could read and write, 602,005 read only, and 11,945,875 could neither read not write, out of 17,565,632. The census of 1897 did not give the details of these three classes, as the returns were incomplete, but it is believed there is a further progress of about 9 per cent. There are, besides the State universities, institutes, and primary schools, numerous Jesuit and other ecclesiastical schools for boys, a Jesuit Catholic University at Deusto, near Bilbao, whose pupils have to pass their final secondary examinations and take all degrees in the State establishments as free scholars. The education of girls has been much developed not only in the State schools but even more so in the convents, which educate more than half the girls of the upper and middle and part of the lower classes. There are free day-schools for girls and an institute in Madrid. Many girls attend the provincial institutes, and some have successfully gone in for the B.A. degrees and even higher honours in the universities.

Education.

Spain is a hereditary monarchy, the Constitution of which was voted by the Cortes and became the fundamental law of 30th June 1876. The sovereign becomes of age on completing his or her sixteenth year. The legislative authority is vested in the sovereign in conjunction with the Cortes. The Cortes consist of an Upper House, styled Senate, and a Lower House, styled Congress of Deputies. Half the members of the Senate, 180, are life peers—who sit as nominees of the Crown by royal decrees, or in their own right as marshals, archbishops, and cardinals, presidents of the Council of State or Supreme Court, after holding such appointments several years—and grandees. The other half of the Senate, 180, are elected three each by the 49 provinces of the kingdom, and the remainder by academies, universities, dioceses, and State corporations. The senatorial electors in the provinces are delegates of the communes and all the members of the provincial council, presided over by the governor. The Lower House of the Cortes were elected by a very limited franchise from 1877 to 1890, when the Cortes passed a Reform Bill that became law on 29th June 1890. This law re-established universal suffrage, that had existed during the Revolution, from 1869 to 1877, when the first Cortes of the Restoration replaced that electoral system by a limited franchise. Under the law of 29th June 1890 every Spaniard who is not debarred from his civil and civic rights by any legal incapacity, and has resided consecutively two years in his parish, becomes an elector on completing his twenty-fifth year. Soldiers and sailors in active service cannot vote. All Spaniards aged 25 and who are not clerks in holy orders can be elected. The same electoral law was extended to the municipal elections.

Constitution and Government.

The executive administration is entrusted to a responsible Ministry, in which the president generally holds no portfolio, though at times some Prime Ministers have also taken charge of one of the eight departments. The ministerial departments are: Foreign Affairs, Grace and Justice, Finance, Interior, War, Education and Fine Arts, Marine, and Public Works, which includes all the material interests. Under the Secretary of State for the Interior the civil administration in each province is headed by a governor, who represents the central power in the provincial council, which is also elected by universal suffrage. There are 49 provincial councils, and 9274 ayuntamientos or municipal councils.

The present civil code was put into force on 1st May 1889 for the whole kingdom. The penal code dates from 1870, and was modified in 1877. The commercial code was put into force on 22nd August 1885, the code of civil procedure, 1st April 1881, and the code of criminal procedure, 22nd June 1882. There is a court of first instance in each of the 495 *partidos judiciales*, or legal districts, into which the kingdom is divided. From this inferior jurisdiction the appeals go to the 15 *audiencias territoriales*, or courts of appeal. There is in Madrid a Supreme Court, which is modelled upon the French Cour de Cassation, to rule on points of law when appeals are made from the decisions of inferior

Law and justice.

courts, or when conflicts arise between civil and military jurisdiction. When the law of 20th April 1888 established trial by jury for most crimes and delicts, 49 *audiencias criminales*, one in each province, were created; these are a sort of assizes held four times a year. The administration of justice is public. The parties to a suit must be represented by counsel. The State is always represented in every court by *abogados fiscales*, public prosecutors, and counsel that are nominees of the Crown.

Spanish finance passed through many vicissitudes during the 19th century. In the reigns of Ferdinand VII. and Isabella II. the creditors of the State had to suffer several suspensions of payments of their dues, and reductions both of capital and interest. During the Revolution, from 1868 to 1874, matters culminated in bankruptcy. Payments of interest were only in part resumed after the Restoration in 1876, and in 1882 the Government of King Alphonso proposed arrangements to consolidate the floating and Treasury debts of the Peninsula in the shape of £70,000,000 of 4 per cent. stock, redeemable in 40 years, and to reduce and consolidate the old exterior and interior debts, then exceeding £480,000,000, in the form of £78,840,000 of exterior 4 per cent. debt—exempt from taxation under an agreement to that effect with the council of foreign bondholders in London on 28th June 1882—and £77,840,000 of perpetual interior 4 per cent. The colonial debts were not included in those plans of Señor Camacho. The debts of Spain were further increased in 1891 by a consolidation of £10,000,000 of floating debt turned into 4 per cent. redeemable stock similar to that of 1882; and this did not prevent a fresh growth of floating debts out of annual deficits averaging two to three millions sterling during the last quarter of the 19th century. The floating debt in 1900 had swollen to £24,243,300. The Governments of Spain having guaranteed the colonial debts of Cuba and of the Philippines, when those colonies were lost in 1898, at the close of the colonial and American wars, Spain was further saddled with £46,210,000 of colonial consolidated debts, and with debts contracted to face the expense of those wars amounting, besides, to £63,257,000. Consequently, once more the Spanish Government had to attempt to make both ends meet by asking its creditors to assent to the suppression of all the amortization of imperial and colonial debts, and to a tax of 20 per cent. on the coupons of all the debts, whilst at the same time the Cortes were asked to authorize a consolidation and liquidation of the floating and war debts and an annual increase of £3,200,000 in already heavy taxation. Under these modifications the Spanish debt at the close of the 19th century, exclusive of £44,000,000 of Treasury debt, consisted of £41,750,000 of exterior debt, still temporarily exempted from taxation on the condition of being held by foreigners, of £270,000,000 of 4 per cent. interior consols, and of £60,000,000 of new 5 per cent. consols, replacing the war and floating debts. In the budget for 1900—the financial years of Spain now coinciding with the calendar years—the credits voted for the debts of all kinds under these consolidations and conversions amounted to £16,742,285.

Finance.

The following table shows the equivalent at par value, 25 pesetas to the pound sterling, of the budget estimates since 1880–81:—

	Revenue.	Expenditure.
	£	£
1880–81 . . .	31,666,031	33,466,047
1885–86 . . .	34,900,575	35,885,869
1890–91 . . .	33,622,057	33,367,750
1895–96 . . .	30,340,688	30,689,150
1898–99 . . .	34,632,675	34,739,176
1900	36,218,073	35,439,928
1902	38,977,510	38,847,050

The chief heads of revenue were in 1902: direct taxation £16,538,815, indirect taxation £13,583,600, State monopolies and services managed by the State itself £6,512,800, sales of and income accruing from State property £1,175,014, Treasury ways and means £1,167,280. The chief items of expenditure for 1900 were: civil list of the royal family £376,275, public debt £16,552,470, pensions £2,871,220, justice and worship £2,168,105, education £1,734,405, army £6,180,270, navy £1,437,670, Home Office £2,103,125, and public works £2,975,035.

The Bank of Spain has a charter which has been renewed and enlarged several times since its foundation after the Restoration, and its privileged note issue has had to be gradually and very largely increased by legislative authorizations, especially in 1891 and 1898, as its relations with the Treasuries of Spain and of her colonies increased, since nothing in the services rendered by the bank to the public would ever have justified the growth of the note issue first to thirty millions sterling in 1891, then by quick strides to fifty and over sixty-one millions sterling in 1899 and 1900. At the close of the 19th century the remodelled bank charter, which is only to expire in 1921, authorized a maximum issue of £100,000,000, on condition that the bank keeps cash in hand, gold and silver in equal quantities, equal to a third of the notes in circulation up to £60,000,000, and equal to half the amount issued above that sum. After the budget of 1900 came into force, in April the balance-sheet of the bank showed a note circulation of £62,324,178, and cash gold in hand £13,689,257, cash silver in hand £15,605,336. Spain still keeps up the French monetary system, francs being styled pesetas of one hundred centimos each. Gold has disappeared from business of every kind since 1881, when the premium began to rise, and it reached a maximum of 120 per cent. during the war with America. Afterwards it dropped to about 30 in 1900. Bank notes and silver coin have been practically the currency for many years. The French metric system of weights and measures has been established since 1871, and has slowly replaced the older Castilian methods.

The Spanish army, and the navy also, are recruited by conscription. Liability to service begins with the first day of the calendar year in which the 20th year is completed. Except in extraordinary circumstances, the War Ministers have seldom called for more than forty to sixty thousand men annually, and of this contingent all who can afford to do so buy themselves off from service at home by payment of £60, and if drafted for colonial service they can buy themselves off by payment of £80. The period of service for all arms is twelve years—three with the colours, three in the first-class reserve, six in the second-class reserve. The War Ministers can, and frequently do, send on unlimited furlough, or place in the first-class reserve, men who have not completed their first three years, and thus a considerable saving is made. Brothers can take each other's place in the service, and eldest sons of aged parents, or sons of widows, easily get exempted. A project for obligatory service for all Spaniards, without the faculty of buying themselves off, has been drawn up. Spain is divided into eight military regions or army corps. Each army corps is commanded by a lieutenant-general, who has under his orders two or more generals of division and a corresponding number of brigadier-generals. The strength of the regular army for many years varied between 85,000 and 100,000 in time of peace, and during the Carlist war, 1868 to 1876, Spain had 280,000 under arms, and nearly 350,000 during her more recent colonial wars. For 1899–1900 the figures were only 80,000. The active army is divided into 56 regiments of the line with 2 battalions each, 20 battalions of rifles or cazadores, 4 African, 2 Baleares, 1 Melilla battalions of light infantry, 2 battalions of rifles in the Canaries. The cavalry includes a squadron of royal horse guards, 28 regiments of the line, remount and depôt establishments, 4 regional squadrons in Mallorca, the Canaries, Ceuta, Melilla. The artillery comprises 13 field and 3 mountain regiments, 1 siege and 10 garrison battalions, and auxiliary companies. The royal engineers are 4 regiments of sappers and miners, 1 of pontooners, 1 battalion of telegraph engineers, 1 of railways with cyclists, 1 balloon corps, and 4 colonial corps. Spain has besides her regular army other permanent military forces in the shape of 1075 officers, 1604 mounted and 16,536 foot gendarmes, mostly old soldiers, and 14,156 carabineers, all of them old soldiers. The regular army, at the close of the war with the United States and with the colonies in 1898, had 26,000 officers and about 400 generals, but a law was afterwards made to reduce their numbers by filling only one out of two death vacancies, with a view to reach a peace establishment of 2 marshals, 25 lieutenant-generals, 50 divisional and 140 brigadier-generals, and 15,000 officers. Spain has manufactories of arms and gun foundries at Toledo, Sevilla, Oviedo, Trubia, and Segovia. Her military academies are Toledo for infantry, Segovia for artillery, Valladolid for cavalry, Avila for commissariat, Escorial for carabineers, Getafe for civil guards, besides a staff college styled Escuela Superior de Guerra at Madrid.

Army.

The Spanish navy had been increased from 1888 to 1897. The Cortes had assigned several millions sterling out of the ordinary

naval estimates for the improvement of the arsenals and dockyards, and for shipbuilding. They had also voted extraordinary credits amounting to nine millions sterling to create a powerful squadron of battleships, cruisers, destroyers, and torpedo-boats in Europe, and credits for the naval defences of the colonies. The results of these efforts were the squadrons that were defeated by the United States in the Philippines and in Cuba during the disastrous war of 1898. Afterwards the Spanish navy was seriously reduced. The official list for 1900 showed 2 first-class ironclads and 3 third-class, of which 2 only were available for coastguard service, 4 first-class cruisers, 10 second-class, 17 gunboats, 4 destroyers, 15 torpedo boats, 3 training ships, 5 despatch vessels, and a few coastguard pontoons. The navy is recruited by conscription in the coast or maritime districts. The Peninsula is divided into three naval captain-generals' departments—at Ferrol, at Cadiz, and at Cartagena—at the head of each being a vice-admiral. In 1899 the Cortes voted credits for 3500 seamen and 2500 marines.

Navy.

Agriculture.

Cereals are the staple of cultivation; wheat ranks first, barley, rye, maize, and oats next. The first two are cultivated in all parts, plains and mountains equally, rye and oats in poorer mountain soils, and maize mostly in North Spain. Rice is cultivated in the finely irrigated soil of Valencia. In 1898 the 49 provinces of Spain drew 93,628,960 bushels of wheat alone from 7,141,452 acres, 43,590,821 bushels of barley from 3,786,142 acres. Rye gave 14,606,602 bushels from 1,783,812 acres, maize 10,208,475 bushels from 1,022,225 acres, oats 6,676,496 bushels from 942,307 acres. In all, more than nineteen million acres are devoted to cereals. The produce per acre thus indicated places Spain among the countries in which the return is least, much as her agriculturists have tried to improve their cultivation of late years in many provinces. The imports of agricultural machinery of every kind, especially from Great Britain and the United States, are steadily increasing. The cereals, and especially the wheat and flour production of the kingdom, had regularly furnished a considerable export as long as high duties in the colonial tariffs obliged the Spanish possessions beyond the seas to draw such articles of indispensable consumption from the mother country; in fact, the value of the exports of cereals and similar pod stuffs averaged from three to five per cent. of all the exports from 1879 to 1895. Curiously enough, though these exports of the products of Spanish agriculture kept steady during so many years, Spain was at the same time very frequently importing considerable quantities of foreign corn from the United States, Russia, and Turkey for her own consumption. In most years, and especially in bad ones, the value of the imports under this head greatly exceeded that of the exports. In the production of pulse and kitchen vegetables Spain is one of the foremost of European nations. The chick-pea, or *garbanzo*, is part of the daily food of all classes, and beans, peas, and lentils are extensively grown. Garlic, onions, tomatoes, pepper or "pimientos," are staple products. Lucern and clover are prominent in the fodder crops. No less than 410,330 acres were devoted to the chick-pea, giving 2,900,000 bushels in 1898. Taken as a whole, these minor crops yielded 14,162,900 bushels out of two million acres.

Among the fruits of Spain the olive tree stands first. It occupies an area almost as extensive as the vine. Its range embraces the whole of the southern provinces, some parts of the central plateau, most of the Ebro valley, and a few districts of Galicia. From the 2,731,820 acres of olive plantations in the 33 provinces where olives are cultivated, 23,796,787 bushels of olives were drawn, of which seven-tenths were used to make oil. The exports of oil amounted to 54,073 metric tons, valued at £2,292,030, in 1899, and the exports of olives in the same year were 4849 metric tons, worth £143,645. Among the fruit-trees next in importance to the olive is the orange, which cannot be grown on the central plateau, where the winters are too cold. In Andalucia and along the Mediterranean coast the orange groves thrive, and in 1897 Spain exported £1,876,455 worth of oranges, and £1,563,000 in 1898. In the same years she exported about £150,000 worth of lemons, that grow in her southern provinces side by side with figs, almonds, pomegranates, carobs, date palms, agaves or American aloes, bananas, and prickly pears. In the northern maritime provinces the apple is extensively cultivated, and excellent cider is made in Asturias and in the Basque provinces. At the census of 1897, 4,033,391 men and 828,541 women were stated to be employed in agricultural pursuits.

Wines.

Among the natural products of the soil of Spain, in regard to quantity, wines come next to cereals, and at one time had taken a very rapid development. In the 'eighties, when the French vineyards suffered so much from various plagues, and when Spain gave a great impetus to her foreign trade by numerous treaties of commerce, none of her products showed such an increase in exports as her wines. The vine-growing districts had been formerly mostly in the provinces of Cadiz, Malaga, Barcelona, Aragon, and Navarre. Then the vineyards spread all along the Ebro valley and in the Mediterranean seaboard provinces, as well as in New and Old Castille and Estremadura, to such an extent that wine is now produced in all the 49 provinces of the kingdom. The average result of the vintage was estimated between 440 and 500 million gallons in 1880 to 1884, and it rose to more than double that amount towards 1890, and amounted in 1898 to 880 million gallons. The total area under the vine was 3,546,375 acres in 1898. In the heyday of the cultivation of the vine Spain sent the bulk of her wine exports to France. The imposition of high duties in France on foreign wines in 1891 dealt an irreparable blow to the export trade in Spanish wines, as will be seen by the following figures:—Exports of Spanish common wines to France in 1888, £9,106,386; in 1890, £9,603,000; and when the denunciation of the treaties of commerce of 1891 took effect in 1892, the exports of these wines to France fell to £3,869,937 in 1892, £1,604,651 in 1894, and £915,000 in 1900. The export of wines of the south of Spain—Jerez, Malaga, and other full-bodied wines styled *generoso*—did not suffer so much as the common wines from the effects of the protectionist policy that prevailed in Spain and in most Continental countries since 1890, and England and France continued to take much the same quantities of such wines.

The official Spanish tables distinguish the wines exported as common wines, sherry and similar wines, and *generoso vino*. The statistics of values in the following table speak for themselves as to the state of the wine trade:—

	Aver. 1874-78.	Aver. 1879-83	1891.	1894.	1898.	1899.	1899.
	£	£	£	£	£	£	
Common wines	2,547,000	7,748,000	11,037,024	2,541,712	5,510,426	3,806,378	England 149,138 France 2,725,998
Sherry and similar wines	2,466,000	2,137,000	1,145,000	740,537	567,231	225,748	England 114,057 France 56,059
Other full-bodied wines styled generoso	470,000	879,000	215,696	73,020	48,100	83,491	England 3,465 France 36,259

There is also a large export of grapes and raisins, especially from the southern provinces—Malaga and Valencia foremost. The average quantity of the two together exported in each of the five years 1879–83 was valued at £1,560,000. The value of raisins exported in 1898 was £688,771, of grapes £330,014, of which the most part went to England, France, and the United States. The Spanish vines have suffered, like those of France, from mildew and phylloxera. The latter has done most damage in the provinces of Malaga, Alicante, Catalonia, and in some parts of the Ebro valley in Navarre and Aragon.

Sugar.

The production of sugar from cane and beetroot had considerably developed before Spain lost her colonies, but this event naturally gave fresh impetus to the sugar industry. The production in 1887–88 amounted to 2541 metric tons of sugar from the cane and 2407 metric tons of beetroot sugar. In 1899–1900 the figures were 29,654 metric tons of sugar from the cane and 49,024 tons of beetroot sugar. In 1901 the official statistics showed 22 sugar-cane factories and 47 beetroot factories. The Government considered that these manufacturers were making such handsome profits that the Cortes were asked to increase the tax upon native sugars, with a view to draw about one million sterling from this source of imperial revenue. The sugar-cane industry is still confined to the provinces of Almeria, Granada, Malaga, where there are, besides, a few beetroot sugar factories. The latter industry has spread to Central and North Spain, in the provinces of Madrid, Saragossa, Valladolid, Santander, Leon, Oviedo, and Pontevedra. The imports of foreign sugars to Spain dwindled down from 18,899 tons in 1883 and 22,145 tons in 1884 to 805 tons in 1897 and 866 tons in 1898. The imports of Cuban and Porto Rico sugars, that had averaged between 72,100 tons and 40,706 tons before the loss of the colonies, dropped to 7816 tons in 1898.

Live stock.

Despite all the efforts of the breeders and of the Government, a decline has gone on not only in horse-rearing, but also in other classes of live stock since 1865, as the following table shows:—

	1865.	1895.
Horses	680,373	397,172
Mules	1,021,512	767,928
Asses	1,298,334	753,914
Cattle	2,967,303	2,217,659
Sheep	22,468,669	13,359,473
Goats	4,531,228	2,534,219
Swine	4,357,736	1,927,864
Camels	3104	...

Among the causes assigned for this decay is the fact, proved by

detailed data in the above report, that horse, sheep, goat, and swine rearing are becoming progressively less remunerative. Heavy taxation, aggravated by a generally unequal distribution of the burden, owing to insufficient survey of the assessable property, has also contributed to the decline of this and other branches of Spanish agriculture. Besides the cattle reared throughout the kingdom for field labour and consumption, and in the north-western provinces for export, chiefly to Great Britain, bulls are reared for the great national sport in many provinces. Goats are mostly bred in the mountainous districts all along the Spanish side of the Pyrenees from Biscay to Catalonia, and in Badajoz, Caceres, Ciudad Real, Granada, and Leon; swine in Badajoz, Lugo, Oviedo, Caceres, and Coruna. The richest provinces in live stock of every kind in 1891 were: Badajoz with 1,302,754, Caceres with 1,038,435, Teruel with 965,327. Spanish sheep, which in former times enjoyed such reputation and formed an important part of the national wealth, lost more ground than any other branch of agriculture between 1875 and 1901, the decrease in total figures having been nearly 41 per cent. between 1865 and 1891 alone. The average quantity of wool exported in the five years 1879–83 was about 9 million ℔, 29 millions in 1896, 26 millions in 1897, and 30 millions in 1898. The rearing of the silkworm is still important in the Mediterranean provinces.

Minerals.

The mineral resources of Spain are considerable and varied. They are not yet turned to full account, owing chiefly to lack of sufficient means of transport. Spain stands at the head of European countries in the production of copper ore, lead ore, and quicksilver. The total value of the products at the mine was £4,057,772 in 1897 and £7,565,500 in 1900. The total value of the products of Spanish metallurgy was £6,639,123 in 1897 and £8,657,870 in 1900. The number of *fabricas* or works in 1898 was 126, being a decrease of 3 on the figures of 1897. The number of persons employed in the mines was 65,995 in 1897 and 89,066 in 1900, and in the works, 17,752 in 1897 and 22,613 in 1900.

The following table gives particulars regarding the production of some of the principal minerals in the year 1898:—

	1898. Number of Productive Mines.	Metric Tons produced.		Value, 1898.	Persons employed.
		1883.	1898.		
				£	
Iron ore	440	4,526,000	7,197,047	1,246,496	19,482
Lead ore	438	280,000	150,472	989,611	10,193
Argentiferous ore	382	25,000	244,068	1,604,752	9,985
Silver ore	5	23,000	767	21,218	225
Copper ore	309	2,455,000	2,302,417	552,749	8,348
Mercury	26	23,000	31,361	250,404	2,056
Zinc	91	54,000	99,836	198,277	1,977
Common salt	83	20,000	479,358	205,136	2,167
Coal	657	1,044,000	2,414,127	829,466	17,164
Manganese	20	,,	102,228	68,609	997
Sulphur	13	,,	105,757	39,627	506

The coal-mines of Spain are yearly developing their production, these being 2,019,400 tons in 1897, 2,466,800 tons in 1898, 2,672,194 in 1899. This amount did not suffice for national consumption, and, despite high duties, Spain imported 1,772,651 tons of foreign coal and coke in 1897, 1,935,000 tons in 1898, 1,875,216 in 1899. Iron ore is drawn mostly from Biscay, Santander, Murcia, Almeria, and Seville, all producing over 300,000 tons each, and Biscay alone 5,073,338 tons in 1898 and 6,146,542 in 1899. The total figure was 7,197,047 tons in 1898 and 9,234,302 in 1899, of which Great Britain took 4,748,557 and 6,224,229 tons. There has not been much progress in the extraction of copper ores—which had risen from 246,000 tons in 1863 to 2,445,000 in 1883, dropping to 2,299,444 in 1898 and rising again to 2,626,875 in 1899—in the provinces of Seville and Huelva, where the Rio Tinto mines lie, as those of several other provinces are not yet worked. Argentiferous iron ore is found in the province of Almeria, 24,190 tons in 1898; argentiferous lead is extracted from the provinces of Badajoz, Ciudad Real, Cordoba, Murcia, Almeria, and some others, in all 244,068 tons in 1898; and the lead mines are chiefly in the provinces of Almeria, Jaen, and Tarragona, which produced 150,472 tons in 1898 and 175,000 in 1899. The exports of copper were in 1898, 179,518 tons; in 1899, 162,131 tons. Spanish salt is partly marine, partly drawn from rock-salt and brine springs, in all 479,358 tons in 1898, 620,000 in 1899, in the provinces of Alicante, Baeeares, Cadiz, Saragossa, Murcia, and Guadalajara.

The working of the mines is carried on under State supervision. The whole kingdom is divided for this purpose into three sections. At the head of each section there is an inspector-general of mines of the first class, at the head of each division an inspector of the second class, and in each district a Government mining engineer. Under the law of 6th July 1859 many important mines were reserved as State property, but financial necessities have compelled the Government to part with one nine after another. Some of the most important have thus passed into the hands of foreigners, like Rio Tinto, Tharsis, Linares, and Almaden.

Spanish metallurgy has much increased since 1883, when lead and mercury were the only products of any importance. The working of iron is an industry of old standing in Spain, but the total production of iron, refined and unrefined, in 1873 was only 60,000 tons; in 1883, 200,000; and already in 1898 it included 54,500 tons of Bessemer steel, 58,105 of Siemens, and 154,000 of wrought iron. The Spanish works turned out in 1898, besides, 261,790 tons of lingot or pig iron, and in 1899, 295,840 tons, of which 49,919 were exported to foreign countries. Spain produced in 1899, 68,300 tons of Bessemer steel, 54,654 tons of Siemens, 173,566 tons of wrought iron. Next in importance ranked hydraulic cement 164,862 tons, lead 78,370 tons, zinc 6031 tons, copper 46,972 tons, sulphur 3100 tons, coke and agglomerates 369,418 tons in 1898. The following table gives particulars of the exports of the chief mineral products in 1898, in metric tons, compared with those of 1883:—

Minerals.	Total Exports.	
	1883.	1898.
Iron ore	4,226,000	6,884,583
Copper ore	565,000	838,956
Zinc ores, calcium	30,000	15,356
,, blend	15,000	25,688
Manganese	4,500	95,756
Iron	30,000	217,545
Argentiferous lead	51,000	6,040
Non-argentiferous lead	77,000	4,924
Lead, wrought	546,425	79,980
,, argentiferous		91,796
Wrought iron	186,510	48,168
Copper	385,551	52,265

The figures of 1899 showed more progress in the principal exports of minerals: the totals were 8,606,558 tons of iron ores, 10,353 tons of lead, 95,088 tons of zinc, 948,912 tons of copper, 139,352 tons of manganese, 331,081 tons of salt, 8073 tons of coal, 319,285 tons of iron pyrites—in all, 10,458,799 tons in 1899, against 8,247,816 in 1898. The exports of metals showed a decline of 252,422 tons in 1899 against 281,773 in 1898. The total value of exports of minerals and metals in 1899 was £10,431,522, being 36 per cent. of the whole exports of Spain in that year.

Manufactures.

At the census of 1877 about 3 per cent. of the classified population was returned as engaged in industries. The proportion had risen to 5 per cent. at the census of 1887, and over 6 per cent. in 1897. The manufacturing industries of Spain had developed in the decade 1874–84, and they continued prosperous until 1892, when the existing ultra-protectionist tariff caused a much more important development, no longer confined to the maritime provinces. The principal manufacture is still that of cotton. In 1879–83 Spain stood seventh among European nations in regard to the average import of raw cotton for home consumption, not only in amount, but in regard to population, 6 ℔ per head, against United Kingdom 41·7 ℔, Holland 23·6 ℔, Switzerland 18·7, Belgium 9·9, France 8·2, and Germany 8·2. The average import of raw cotton into Spain was 79,690,000 ℔ in 1874–78, 100,300,000 ℔ in 1879–1883, 124,832,716 ℔ in 1896, 167,111,689 ℔ in 1897, and 143,616,578 in 1898. The products of this branch of industry do not yet suffice to meet the wants of the population, and every year there is a considerable import of cotton goods—in fact, the figures were £400,000 on an average in 1896–98. The exports of Spanish cotton goods were hardly worth mentioning outside the colonial markets, which took an average of two millions sterling in the decade 1888–98. This outlet is now almost closed, as the new masters of Cuba, Porto Rico, and the Philippines will cease to protect Spanish imports against European and American competitors. The cotton industry had until late years been principally centred in Catalonia, and mainly in the province and town of Barcelona, famed also for their manufactures of lace, woollen, and linen goods. The Basque provinces, especially Guipuzcoa and Biscay, Navarre and Asturias, have followed in the wake of Catalonia for linen and cotton industries, and for paper mills. Flax-spinning is confined to Galicia. The customs statistics show that Spain had to import £12,099,813 of raw materials for her industries, including fuel, in 1896 and £12,693,000 in 1897, but the war with the United States and the loss of the colonies

caused this class of imports to decline to £7,478,000 in 1898. The silk industry, though inadequate to meet the home demands, is active in Valencia, Murcia, and Seville. Metal industries, at first limited to the Basque provinces, particularly around Bilbao, have spread to Asturias, Almeria, Galicia, near the great ore-beds and in the vicinity of many coal-mines. In the same Asturian districts the Government has its foundries and factories for making arms at La Trubia and Oviedo, Toledo, far south, being only now famous for its blades and decorative work. The manufacture of leather is carried on in many provinces, but the formerly celebrated Cordova leather is a thing of the past. Gloves are made in Seville and Madrid, shoes in the Balearic Isles, chiefly for the colonies, which used to take about a million sterling a year of these exports. The esparto is twisted into cords and ropes and the staple matting so common on the floors of Spanish houses of all classes, the *estera*. The refining of cane and beetroot sugar has become one of the most lucrative of Spanish industries in many provinces. Soap, chocolate, and cork are among the prosperous industries. The same may be said of charcoal, both for heating and mechanical purposes. The making of porcelain, formerly well known in Madrid, is now carried on at Seville. Olive oil is a thriving industry that exported £2,292,790 of its products in 1898. The war of tariffs between France and Spain since 1892 was an inducement for an extraordinary development in the making of brandy and liqueurs of every kind, of fruit preserves, potted meats, and many other articles in North Spain, above all in Navarre, the Basque provinces, Catalonia, and even in Valladolid and Andalucia. Foreign as well as native capital took an active part in the establishment of such industries. Special mention must be made of the manufacture of tobacco, which is a royal monopoly, farmed out for 30 years to a company that has increased the factories from 7 to 12, and which began by paying the Treasury £3,400,000 annually, and gradually more, up to £4,800,000 stipulated for 1900.

The loss of all her possessions on the American mainland in the early part of the 19th century dealt a severe blow to the foreign commerce of Spain, from which it only recovered about 1850, when imports and exports began to increase. The following table shows the onward march of her trade, and the figures given include those of her exports to and imports from the colonies, Cuba, Porto Rico, and the Philippines:—

Commerce.

Year.	Imports.	Exports.
	£	£
1870 . .	20,876,464	15,981,888
1880 . .	28,481,852	25,998,727
1885 . .	30,590,306	27,920,001
1890 . .	37,645,517	37,510,395
1895 . .	33,539,796	32,198,084

After the restoration of the Bourbons in 1875, the first Cabinet of Alphonso XII.'s reign stopped the operation of the tariff law of the Revolution and reverted to protection. In 1882 a Liberal Cabinet not only revived the system of a gradual reduction of import duties to a fixed maximum, but made very good commercial treaties with France and several other nations, which were followed by a treaty with Great Britain in 1886. The foreign commerce of Spain rapidly developed in the decade 1882–92, Great Britain, France, and the United States figuring at the head of the imports, Great Britain and France at the head of the exports on an average for 63 per cent. The rapid increase of the demands of France for Spanish wines, when the phylloxera, mildew, and other plagues had heavily reduced her vintages, caused in Spain a great development of the vineyards, and the exports of Spanish wines to France alone amounted to £12,000,000 annually. When France and other European nations abandoned free trade for protection towards 1890, a strong movement set in in Spain in favour of protection. In 1890 the Conservative Cabinet of Señor Canovas raised the duties on agricultural products, in 1891 it denounced all the treaties of commerce that included most favoured nation treatment clauses, and in 1892 a new tariff law established considerably higher duties than those of 1882—in fact, duties ranging from 40 per cent. to 300 per cent. This tariff is still in force, and has been slightly modified only by treaties of commerce with Holland, Sweden and Norway, and Switzerland, that were concerted on the principle of reciprocity of concessions on a very limited number of articles. Great Britain, France, Italy, Germany, Austria, Russia, and some other countries which made no treaties of commerce with Spain after 1892, negotiated simple agreements, under which their imports are granted the same footing as those of Switzerland, Holland, Norway and Sweden. Portugal has a special reciprocity treaty with Spain, on the understanding that the commercial and navigation régime thus created shall not be extended to other nations.

Spain very soon felt the effects of protection in the sharp decline of her trade in 1892, 1893, 1894, when her exports suffered more than her imports. The high duties on foreign agricultural products did not check the influx of American and Russian corn whenever the crops of the Peninsula were insufficient, as happened in four years since 1890. Economical causes of depression and of alterations in the foreign commerce of Spain were aggravated in 1895, 1896, 1897, and 1898 by the Cuban rebellion first, then by the Philippine insurrection, and by the war with the United States. The total figures of exports and of imports in those years remained high in appearance, because they included the large amounts of bar silver imported for the Treasury and for the Mint, and the bullion passing to and fro between the colonies and the Peninsula; for instance, £4,823,406 in silver being received from the colonies and £6,433,237 having been sent out in 1897. In this period the figures were:—

Year.	Imports.	Exports.
	£	£
1895 . . .	33,539,796	32,198,044
1896 . . .	36,383,570	40,930,098
1897 . . .	36,381,546	42,995,344
1898 . . .	38,937,774	36,757,728
1899 . . .	37,461,455	28,995,150
1900 . . .	34,495,865	28,954,715

During the years 1895–99 Spanish imports of manufactured goods steadily increased, whilst imports of raw materials and "alimentary substances" showed a marked decline, particularly in 1898. A bad crop in 1899 caused a great increase in imports of bread-stuffs, especially corn, which gave an increase of £600,000 in the proceeds of the customs duties on foreign corn and cereals. The exports of ores of every kind and other raw materials had constantly increased from 1895 to 1898, though not so remarkably as the exports of agricultural products, chiefly oils, oranges, and raisins. In 1899 all the exports of Spain showed a sudden and marked decline. The wine trade began to pick up a little in 1898. The loss of the colonies in that year explains the heavy decrease in exports of manufactured goods, for which Spain virtually seemed to have no other market worth mentioning. This decrease amounted to £2,000,000 in 1898 alone, and in 1899 the exports of goods to the quondam colonies was insignificant. Great Britain figured in the imports of Spain in 1897 for £6,203,059 and in 1898 for £5,682,495, and in the exports for £10,545,743 in 1897 and £10,099,973 in 1898—the first being chiefly coal and coke, iron, machinery, jute, hemp, and chemicals; the latter comprising minerals, wines, raisins, oranges, and esparto grass. France stood next with £5,874,278 in the imports of 1897 and £4,706,445 in 1898, and £10,178,380 in the exports of 1897 and £12,870,440 in 1898—the first including wool and woollen goods, silks, machinery, and chemicals; the latter mostly wines, oils, and fruits. The United States ranked third in imports, in majority, cotton and cereals. Portugal, Germany, Italy, Russia and Belgium came some way behind the next group in imports, ranging from £1,600,000 to £1,750,000. The same countries, with Norway and Holland, ranked next to Great Britain and France in exports. The trade of Spain with the South American republics is comparatively small, though steadily increasing, being the 40th part of the exports and less in imports. The loss of Cuba, Porto Rico, and the Philippines very seriously affected the export trade of Spain in every respect, though the American peace treaty of December 1898 secured for Spain most favoured nation treatment in her lost possessions.

Shipping and navigation.

Spain has 21 seaboard provinces, with more than 120 ports of some importance. The merchant navy of Spain, far from decaying through the loss of her colonies in 1898, seems to have been given fresh impetus since, by firms and companies which bought abroad and nationalized many English and French steamers for the carrying of exports and imports to foreign countries and for trade on the coast of Spain. At the close of 1899 Spain had 377 steamers of 550,887 tons, being an increase of 22 steamers and 68,494 tons on the figures of the previous year, though 18 steamers of 31,316 tons had been lost during the year. Besides the above steamers ranging over 100 tons each, Spain had at the same date 77 steamers, each of less than 100 tons, for her coasting trade, and of 10,505 tons all told. Spain ranks sixth among the merchant navies in regard to steamships. Her sailing vessels are decreasing in numbers in the exterior trade, but not in the coasting trade, which is decidedly developing and occupying more craft. Her fishing fleet, chiefly sailing boats, is also important, and manned by a hardy and active coast population. In 1897 the total number of vessels entered with cargoes was 10,705 of 3,115,826 metric tons, and in 1900 (inclusive of coasting trade), 17,722 vessels of 14,172,872 tons. The following

table gives an abstract of the entrance and clearance, in metric tons, under the principal flags in 1897 :—

	Steamers.		Sailing Vessels.	
	Entrance.	Clearance.	Entrance.	Clearance.
National	753,333	1,539,184	70,629	56,913
British	1,547,371	6,578,933	19,687	49,733
French	135,888	593,526	8,030	115,973
Norwegian	114,074	233,650	11,006	4,591
Greek	69,731	35,310	5,303	2,351
German	67,593	226,774	1,389	430
Italian	50,361	28,402	69,536	23,859
Austrian	28,361	38,295	2,284	9,133
Belgian	25,827	132,313	...	...
Danish	25,106	23,830	1,992	3,832
Russian	23,561	10,074	27,074	20,299
Swedish	20,037	27,694	10,353	2,015
Total	2,877,209	9,777,361	238,617	290,877

The coasting trade of Spain is considerable. The statistics for 1897 showed that the number of vessels entered under the head of "coasting trade" was 37,875, with a total of 11,266,195 metric tons, and the number of vessels cleared was 38,572, of 11,420,028 metric tons.

Internal communications.

At the end of December 1896 there were 20,320 miles of State roads, all well built and well kept up, and 2468 miles in course of construction. The aggregate length of the provincial roads at the same date was 4270 miles, and that of the municipal roads 12,094 miles. The length of railways open for traffic on 1st January 1898 was 8020 miles. The average annual increase in the last ten years of the 19th century was 205 miles. All the Spanish railways belong to private companies, most of which have received State subventions, and the Spanish railways will revert to the Government mostly at the end of a term of 99 years. In granting a concession for a new railway the practice is to give it to the company that offers to construct it with the lowest subvention. The total amount of the subventions for railway construction up to the end of 1896 was £30,150,960. For strategical reasons the Spanish gauge was made different from that of France. Of narrow-gauge railways in 1896 Spain had 1302 miles open to traffic, 230 in course of construction, and 1000 planned, under concessions duly granted. Spain has 120 miles of steam tramways, 24 miles of electric tramways, out of a total of 332 miles at the close of 1896. Seventy per cent. of the railways of Spain, and an even larger proportion of the tramways and narrow-gauge railways, especially in mining districts, have been constructed and worked with foreign capital.

Telegraphs.—The length of State telegraph lines increased from 6665 miles on 1st January 1883 to 19,885 at the close of 1899, and the length of wires from 16,256 miles in 1883 to 46,670 miles on 31st December 1899. The number of messages in 1899 was 5,058,104, of which 3,748,805 were inland messages and 1,123,957 from or to foreign countries. In 1897 Spain derived a revenue of £322,538 from the telegraph service. The number of telegraph offices in 1898 was 1428.

Post Office.—Exclusive of official correspondence, the total number of letters and post-cards that passed through the post office in 1898 was 91,800,924 for the interior of the kingdom, 13,410,166 for letters sent to or received from foreign countries, 196,715 in transit, and 356,442 for the parcel post. The number of printed papers and samples for internal service was 95,572,000, and foreign 25,627,000. There were 3047 post offices. In 1898 there were 54 urban telephone systems and 533 inter-urban circuits; the total length of telephone line was 5980 miles, and of wire 27,640 miles.

Colonial possessions.

By the relinquishment of Cuba and the cession of Porto Rico, the Philippine and Sulu Islands, and Guam, the largest of the Ladrones, to the United States, as a consequence of the war of 1898, and of the remaining Ladrone or Marianne Islands, together with the Caroline and Pelew Islands, to Germany by treaty of 8th February 1899, the colonial possessions of Spain were reduced to about 100,000 square miles. Ceuta, Melilla, and one or two other small states on the north coast of Morocco, are part of Spain rather than colonies. The colonies or protectorates are Rio de Oro and about 80,000 square miles in the interior of the south of Morocco, Ifni near Cape Nun, the islands of Fernando Po, Annobon, Corisco, Elobey, San Juan, and a section of the mainland of West Africa between the rivers Muni and Campo. By an arrangement with France in 1900, Spain agreed to forego her claim to a large portion of the Adrar interior, south of Morocco, on condition that France agreed to allow her a portion of the territory claimed by Spain on the Muni and Campo.

The Spanish colonial possessions now stand as follows, though the areas and populations are necessarily rough estimates :—

Colonial Possessions.	Area, Square Miles.	Population.
Rio de Oro and Adrar	80,000 ?	50,000 ?
Ifni	27	6,000
Fernando Po, Corisco, Elobey, San Juan	850	30,000
Muni-Campo Region	10,000 ?	100,000 ?
Total (about)	90,877	186,000

Rio de Oro and Adrar are under the governorship of the Canary Islands, with a sub-governor at Rio. For administrative purposes the Canary Islands are considered part of Spain.

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II. RECENT HISTORY.

Spanish recuperative power.

No country in Europe has had a more varied and chequered historical evolution than Spain. This evolution has exhibited throughout some remarkable and persistent traits of national character and of natural resources which inspire the recuperative power displayed after every period, long or short, of reverses, invasions, decay, and depression. These traits have existed in the races which have successively peopled the soil of the Peninsula from the prehistoric ages, from the times of the autochthonal tribes that inhabited the country before the Peninsula became a battlefield for Carthaginians and Romans down to the 19th century. A sort of fatalistic stubbornness and an indomitable spirit have made them face adversity first, and afterwards attempt to recover, with wonderful energy and not a little success, when the mistakes, errors, and shortcomings of their rulers are taken into consideration. If these qualities had not existed, Spain could not have weathered the many vicissitudes of the past which constitute the stages of her historic evolution. Strangely enough, at each stage some element seems to have survived which served for the foundations of the body politic that ultimately was to grow out of the mediæval ages later. Rome, for instance, did not write the lasting record of her conquests and of many centuries of occupation and wise, beneficial rule upon the noble ruins of cities and camps, of strategical highways and aqueducts, of villas, amphitheatres, and temples alone, but in the municipal administration, in the laws, in the habits that long prevailed in Visigothic Spain and through six centuries of Moorish rule down to the eve of the Renaissance. The hardy and warlike invaders who swept over the Peninsula during the decline of Imperial Rome, and who were soon converted to early Christianity, also left much behind that was comparatively progressive and beneficial during their two and a half centuries of rule, in which the Visigothic princes with their incipient feudalism, the Church with its

councils, its schools, its monasteries, and its civilizing influences and care for the chronicles and intellectual lore of the past, the municipalities with their still Roman organization and vitality, prepared the people for the future resistance to the passing wave of Saracenic invasion.

The "Reconquista."

This wave swept over Spain in the early part of the 7th century with an ease and rapidity that seem to us extraordinary, but not utterly inexplicable, given the conditions of Spain at the time and the incoherent state of her powers of resistance. It cannot be denied that the Arabs and Moors governed their conquests in a wise, far-seeing, and conciliatory way that in great part explains why they were so long able to hold their own. In the beginning, it was chiefly owing to their own divisions and to the rivalries of their leaders that they succumbed. It would have been almost impossible otherwise for the last remnants of Visigothic and Christian Spain to effect the first part of their "Reconquista." If they had not been confronted by a sorely divided Moslem commonwealth, if that commonwealth had not allowed the vanquished to preserve much of their primitive faith, their laws, their municipal institutions, their customs in Moorish territory, the task of the Catholic princes would have been very much more difficult. Even so, the kingdoms of Asturias, Leon, Castille, Navarre, and Aragon had a long and bloody struggle before they succeeded in driving the Moors slowly southwards and eastwards, until the "Reconquista" came to a lull that lasted a couple of centuries, more or less, after Christain Spain had in some sort been consolidated into the kingdoms of Castille and Aragon and Navarre at the close of the 13th century. During the reconquest, Spain had evolved much in her growth that resembled the rest of mediæval Europe, and some of those essential characteristics that subsequently prevailed in her national history. Like the rest of Europe during the 10th, 11th, 12th, and 13th centuries, Spain witnessed a parallel development of powerful nobles, prosperous cities and boroughs, the Church, and religious orders of both sexes, that the sovereigns of yet incomplete and disorganized kingdoms, permanently menaced by the Saracens, could not yet dream of treating too despotically. Like the rest of Europe in the 12th and 13th centuries, the Christian states of the Peninsula had in their commons and their representative Cortes much of the spirit of self-government that could have founded quite a different state of things to that which ultimately came out of the Spanish "Reconquista" in its last stage. Even more curious and more interesting in those dark and troublous times was the display in the ranks of the people and gentry, and even among priests, friars, and nuns, of the inclination for what was afterwards styled heterodoxy, but which really amounted to heresy much akin to the tenets of Wycliffe, the Lollards, Huss, and the early Continental reformers who heralded the dawn of Protestantism in Europe. The purely Spanish characteristics of these four centuries were the widespread religious fanaticism, the hate of the alien, the love of adventure, the warlike instincts, the boundless confidence in themselves, the intolerant dispositions that contributed so much to the steady development of the power of the Church and the religious orders, though both already showed a strong inclination to help the monarchy in checking and curtailing the power and influence of the nobles and of the great military orders of Calatrava, Santiago, and Montesa, and in checking even the Cortes, which played a singularly important part in the annals of Spain in the Middle Ages.

When the "Reconquista" culminated in the conquest of Granada, the last Moorish kingdom in the Peninsula, by the Catholic sovereigns Ferdinand of Aragon and Isabella of Castille, the unity of Spain was realized at last, and her sovereigns, rid of foreign preoccupations, were able to turn their attention to the work of centralizing and consolidating all the powers of the State in their own hands. At the same time they reorganized the administration and the system of taxation, and revised grants and titles of property in a way that soon provided the exchequer with a revenue twenty times greater than that which they found at their accession. Undoubtedly the system of government was an improvement in some sense, but, on the other hand, it started Spain in the direction of absolutism and religious intolerance which, under the two immediate successors of Ferdinand and Isabella—Charles I. and Philip II.—became so sweeping and so complete that useful national forces were first stunted and finally crushed. Some excellent auxiliaries of the Crown up to the 16th century were not properly husbanded and managed, as in other European countries; the nobles were turned into courtiers, favourites, and State officials; the commons were gradually reduced to silence and impotence in Cortes packed to suit the aims of the Crown, and finally were not even consulted about taxation decreed and levied by royal mandate. In this work of destroying public liberty and popular initiative the first two princes of the House of Austria, Charles and Philip II., were constantly assisted by the Church and by the Inquisition, both naturally subservient to an autocratic rule that displayed an ever-zealous disposition to further the interests of the Vatican and of the Catholic Church, not only in Spain but in the Old and New World, by a vigorous external policy that drew its resources mainly from the Peninsula. There was so much stamina yet in the inhabitants of Spain, so much willingness to contribute to the expenditure involved in Castilian Imperialism, that, despite the shortsighted and cruel expulsion of Jews and Moors, the country grudged no effort and no sacrifice to give both these sovereigns enough to wage war in central Europe, Flanders, Italy, and France against many Powers in succession, and, with less success, to try to dispute the supremacy of the seas with the England of the Tudor period, besides prosecuting the enterprise of colonization in America. For such purposes they drained Spain of men and money, and wasted both the resources accumulated by their predecessors and the first fruits of their discoveries and conquests in Central and South America. Directly the reins of government passed from the strong hands of Charles and Philip, backed by able generals, statesmen, and Churchmen, into the grasp of a brainless bigot like Philip III., a careless voluptuary like Philip IV., and an incapable, short-witted invalid and fanatic like Charles II., Spain sped fast on the downward incline of irremediable decay. That course was not checked by any military or diplomatic success abroad, and was hastened by many reverses in her colonies, and by the wreck of her naval power at the hands of the British and Dutch navies. The 17th century was the gloomiest epoch in Spanish annals, though some of the ministers and favourites of the three decadent kings did manifestly attempt to stem the tide of disgrace and national exhaustion. In the rarely summoned Cortes, too, the Third Estate now and then raised its voice vainly to demand redress of grievances, and to remonstrate against reckless waste and unproductive expenditure, showing that the old spirit of the "Communeros" of Castille still lurked in the towns of the Peninsula.

The House of Bourbon succeeded to the House of Austria in extremely difficult circumstances, and had to fight for several years in Spain itself to consolidate the throne of Philip V. at the beginning of the 18th century. It cannot be denied that the first three Bourbon kings,

Philip V., Ferdinand VII., and above all Charles III., did their best, and not without success, to raise their adopted country from the deplorable condition into which it had fallen at the close of the 17th century. The finances and public works received the special attention of these sovereigns and their able ministers Alberoni, Ripperda, Florida-Blanca, and Count Aranda. Industries, agriculture, trade, education, learned societies, and academies were promoted and received State and legislative assistance, and the relations with the colonies were developed. There was a large increase in the population. The administration was recast on French models, and the home policy of the monarchy much resembled that of the French Bourbons in its autocratic ways in regard to taxation and public liberties, and even in its dealings with the Church and Church privileges and property. Mortmain was curtailed and the Jesuits were expelled by Charles III. Unfortunately, just as Imperialism had been the bane of Spain under the House of Austria, so family ties and the famous pact between the two branches of the House of Bourbon, the inclination of Italian-Bourbon queen-consorts to interfere in the affairs of Naples, Sicily, and Parma, led Spain once more into costly and useless wars that impoverished her exchequer, increased her taxation, arrested her renascent prosperity, imperilled her colonies, damaged her transoceanic trade, and undid all that the Bourbons had attempted towards making her again a naval Power. In this way, on the eve of the French Revolution, Spain had once more ceased to be a Great Power, and both in the Peninsula and in her vast colonial empire the signs of decay and disorder had reappeared just when Charles III.'s death placed on the throne a weak and irresolute prince, Charles IV. Though he at first frowned upon the French Revolution and joined the Continental coalitions against the new state of things in France, Charles IV. was not a king of the stamp to prevent the Revolution exercising considerable influence upon his subjects. He displayed as little decision in checking the profligacy of his Court and of his wife and her paramour Godoy as he did in resisting the dictates of Napoleon I., into whose hands he abdicated his throne in favour of Joseph Bonaparte, without any regard for the rights of his own son and heir, Ferdinand, Prince of the Asturias. Amidst the Napoleonic invasions, the Peninsular war, and the struggle for independence, the fortunes of Spain, but for the assistance of Wellington and his armies, would have declined even more than they did in those dark days of bankruptcy and utter disorganization. It is impossible to conceive a country where there was more justification for applying the principle of the *tabula rasa* than in Spain in the second decade of the 19th century. The Cortes of Cadiz, assembled behind the last bulwark of their independence in 1810, had thought this possible in the teeth of foreign invaders, regardless of the persistent forces of reaction that had survived very naturally in a nation which Church and monarchy, habit and tradition, racial and historical influences had blended into the average type of Spaniard, who had little in common in thought, ideas, and aspirations with the brilliant minority that gallantly strove to take the lead from 1813 to 1868. This was the secret of the ups and downs of progress and civilization in Spain in the 19th century, and of many glaring eccentricities and contradictions, under the outward forms and phraseology of constitutional and parliamentary government, even in the last quarter of that century. This contention can best be illustrated by facts. So little was the reform movement of the Cortes of Cadiz in touch with the feelings of the majority of Spaniards, that the unscrupulous despot and bigot, Ferdinand VII., whom they call the worst of their modern kings, had no trouble in setting aside the Constitution of 1812 and in restoring the old régime of absolute monarchy and religious intolerance, including the Inquisition, which helped him to send to the scaffold many of the heroes of the War of Independence. He persevered in his revival of the worst features of the rule of the Houses of Austria and Bourbon down to 1820, when he had to bow to a revolutionary rising which gave Spain three years of Liberal and parliamentary government, while the sovereign, behind the scenes, was conspiring with Continental Powers to secure means of revenge. The French Bourbons granted him 100,000 soldiers to carry out his policy mercilessly from 1823 to 1832, when he died.

The Bourbon kings.

With a view to secure the throne for his infant daughter Isabella II., Ferdinand VII. set aside the Salic law, which had been introduced by Philip V., the first Bourbon king, and had been constantly afterwards the law of succession. The brother of Ferdinand, Don Carlos, at once protested, and unfurled the flag of legitimacy in the north of Spain, thus opening up the era of civil wars which so much contributed to the establishment of constitutional and parliamentary forms of government in Spain, and to the progress of Liberalism and of Democracy. All the most retrograde elements of Spanish society, chiefly rural, military, noble, political, and clerical, steadily stood by successive pretenders. On the other hand, the Liberals of 1813 and 1820 returned from exile and from native hiding-places to join the partisans of the child Queen and of the Queen-Regent, Doña Christina. They leavened the resistance to Carlist absolutism and theocracy with English and French principles of government, reform, and toleration. The Liberal movement went so far that the religious orders were suppressed and their property confiscated. The Church property was treated in the same way, being commuted for annual credits in the budgets of Spain. Parliaments, composed of a Senate and House of Deputies, were created to vote supplies and taxation, and legislation was taken out of the hands of the sovereign. After the defeat of Carlism in 1841 and up to the end of the reign of Isabella II., Spain was, on the surface, a monarchy akin to those of France, Belgium, and Great Britain. Below the surface, as soon as the dynastic peril had subsided and the throne of the Queen was put on a firmer basis, the old reactionary undercurrent set to work. A novel and powerful instrument of reaction—militarism—appeared on the scene and made Spain sadly famous. Its interference in politics and its *pronunciamientos* were fatal to discipline and, what was far worse, to the sense of respect for parliamentary legality which is the corner-stone of modern institutions. It must be said that Castilian militarism somewhat atoned for its interference in politics by using its extraordinary influence quite as often in the cause of liberty and of progress as in defence of reactionary Cabinets and Palace favourites. It will suffice to say that Marshal Espartero acted thus from 1836 to 1843 to crush the first Carlist risings, and to check the caprices of the Regent Doña Christina, and then, in 1854–56, again stepped in to check another reaction. Marshal O'Donnell from 1856 to 1866 was the champion of a Moderate Liberalism which might have preserved the crown of Queen Isabella had she not always harboured preferences for retrograde statesmen and generals. Marshals Prim and Serrano, too, were in the van of the Progressists and Advanced Liberals who would fain have served their Queen, but went over to revolution and conspiracies at last in sheer disgust. Such names can well be set against those of the military champions of political reaction

Rise of Carlism.

and religious intolerance—Marshals Narvaez, Cheste, Novaliches, and Calonje. Spaniards grew accustomed to think that no great party could expect to seize the reins of government or get a hearing at the Palace without the alliance of a popular and distinguished general, considering that everybody knew that elections were a farce and that the Cortes never expressed public opinion. Personal government necessarily continued under the cloak of modern institutions; when the military did not interfere to make a Cabinet fall, a Palace intrigue was resorted to, and even stern soldiers like Narvaez or O'Donnell often left royal antechambers as crestfallen as they had walked in haughtily. The Queen, all through her reign, imposed absolute religious intolerance upon the people, though many of the enlightened and educated classes vainly protested. Nevertheless, the material interests of the country progressed from 1843 to 1868, particularly foreign and home trade, public works, canals, railways, and education. The finances alone were still woefully mismanaged, with increasing expenditure always much in excess of possible revenue. The national debt was more than doubled, and the interest on the external and internal debt was several times reduced, and now and then altogether stopped.

The Revolution of 1868. Prince Amadeo accepts the throne.

The Revolution of 1868 was the outcome of the unanimous conviction of the Liberals, Democrats, Radicals, and Republicans, and, indeed, of not a few Moderate Conservatives, that it was hopeless to endeavour to induce Queen Isabella and her inner circle of advisers to listen to the aspirations of the better and more enlightened classes. She provoked the movement by two years of reckless and blind reaction, 1867 and 1868, which combined all the disaffected in sheer self-defence. Led by Marshals Prim and Serrano, the revolution began in September 1868 with a naval *pronunciamiento* by the fleet under Topete at Cadiz, soon followed by a military and popular rising, which proved successful after a single battle at the bridge of Alcolea, in Andalucia, where the army of Isabella II. was utterly defeated. Isabella fled to France with her children and a few courtiers. Almost immediately, it was seen that the men of the revolution did not agree about the objects to be pursued after this overthrow of the ancient monarchy and dynasty. The Republicans alone indulged in the illusion that the logic of events must make their ideal form of institutions the goal of the progressive movement that had swept away the throne of Queen Isabella II. All the others—the numerous followers of Prim, Serrano, Topete, Rivero, Rios Rosas, Sagasta, Martos, and Ruiz Zorilla—very soon showed that they had chiefly intended to change the dynasty only, but not to alter the traditional form of the institutions. As soon as the work of the constituent Cortes of 1869 was deemed sufficiently advanced, they looked about for a prince to place at the head of the commonwealth. As there was in their eyes no native Spanish prince eligible, and as they cared nought for the ambitious brother-in-law of the late Queen, the ever-intriguing Duke of Montpensier, German and Portuguese royal candidates were discussed until Marshal Prim mooted the idea of asking an Italian Prince, Amadeus of Savoy, a son of Victor Emmanuel, to accept the throne. No selection could have been better calculated to displease the majority of Spanish Catholics, the Church, and the religious orders, than that which made the son of the king who had just put an end to the temporal power of the Popes the ruler of the most bigoted Catholic nation in Europe. This mistake was one of the principal factors in the rapid decline of the Spanish revolution, as it was the most popular pretext of the pretender Don Carlos for plunging Spain into a long and bloody war; and it was also one of the favourite arguments of the partisans of his rival, the Alphonsist pretender, the son of Isabella II. King Amadeus took a little over two years to convince himself that the Constitution of 1869 could not work, and that the generals, statesmen, and parties, Constitutionalists, Radicals, and Progressists, who had invited him to come to Spain, each in turn simply wanted to make him their tool in order to govern the country for their own ends. He did not find in their ranks, any more than he did in the army and navy, the loyal and patriotic assistance necessary to cope with the Carlists in arms in a dozen provinces, with the Federal Republicans frequently rebelling in southern Spain, and with the spread of the Alphonsist propaganda and conspiracy in all classes, especially in the staff of the army. It required no great effort of intellect for the Italian king to comprehend that universal suffrage was an electoral system which could only work if the Governments and authorities were allowed to manipulate the register, the polls, and the returns at discretion, and to pack the Cortes with majorities and minorities to suit their convenience and keep up the appearance of parliamentary institutions. Amadeus perceived that 80 per cent. of his subjects cared nothing for, and hardly knew how to make use of, trial by jury, liberty of the Press, nearly unlimited rights of association, meeting, and public demonstration, all the reforms made by the Constitution and laws of the revolution, and, above all, liberty of conscience, which the Church denounced as the very abomination of the period. Amadeus abdicated, and his last Cortes, at the instigation of their Republican minorities, proclaimed a Federal Republic on 11th February 1873.

Proclamation of a Federal Republic.

The new régime, which did not last long, was marked by one long struggle against the federal and cantonal Republicans of the south and of the Mediterranean seaboard, and its successive Presidents, Figueras, Pi y Margall, and Salmeron, had not a little trouble in managing the unruly and revolutionary Cortes elected in the spring of 1873. Castelar took the helm in September 1873. He displayed great energy and tact in reorganizing the army and conciliating the Church on the one hand, while on the other hand he showed equal firmness and resolution in dealing with the Carlists, and in striving to put down the disgraceful rebellions of the advanced Republicans at Cartagena, Seville, Cadiz, Malaga, and Cordova. His beneficial rule terminated with the recess. He was perfectly aware that the Federals in the Cortes proposed to defeat him, as they did by an adverse division on 2nd January 1874, which served as the desired pretext for General Manuel Pavia to make his famous *pronunciamiento* at dawn on the following day. At the head of the Madrid garrison, the Captain-General of the capital turned the members of the Cortes into the streets, dismissed the Government, including the War Minister, and dissolved Parliament. He then profoundly surprised his fellow-countrymen by declining to use his dictatorship as a stepping-stone to power. For the first time in Spain, the victorious leader of a *pronunciamiento* invited the leaders of all parties to form a Government to restore and maintain peace. Castelar naturally declined. Canovas del Castillo, the chief agent of the Alphonsist propaganda, held aloof because he saw that events were playing into his hands. Marshal Serrano, with Sagasta and Martos, consented to form a nameless provisional Government, which attempted for eleven months to reorganize Spain, first crushing the Republican risings in the south, and then vigorously attacking the Carlists in northern and central Spain. Serrano had gone to assume the chief command of the Liberal armies in the

Ebro valley in December 1874, when the generals who had long been conspiring to restore the Alphonsist branch of the Bourbons determined to make their *pronunciamiento* before the Marshal-President of the Executive could score a decisive victory over the Carlists. The action of Generals Martinez Campos, Jovellar, Primo de Rivero, and Laserna, at Sagunto, Valencia, Madrid, and Logrono was, in fact, the premature unmasking of a carefully worked combination of forces converging by different channels towards the same goal. Queen Isabella II. had been wisely advised during her exile to abdicate in favour of her only son, at the time a minor, the Prince of the Asturias, afterwards Alphonso XII. He was educated partly at the Theresianum College in Vienna, and partly at the British Military Academy at Sandhurst, where he was a cadet when he issued, in 1874, the manifesto drawn up by his principal adviser, Señor Canovas del Castillo, which was profusely distributed in Spain in order to place his programme of a limited Monarchy and Parliamentary government before his future subjects. Canovas did not recommend the publication of this document until he had nearly completed the organization of the heterogeneous elements which he had skilfully united from 1870 to 1874, as fast as he perceived that the revolution was going at such a pace towards self-destruction that not a few of its soundest and most influential groups unhesitatingly went over to the Alphonsist ranks in disappointment and disgust. He endeavoured to enlist the capitalists, the great landowners and protectionists, all the bishops and clergy not too compromised in favour of Carlism, and the middle and upper classes, weary of civil wars and national bankruptcy in the wake of a general decline of trade and commerce. In short, the most eminent statesman of the revolutionary movement was convinced that he would be in a position to restore the monarchy and dynasty peacefully and legally, through the action of the constituent Cortes, about the time when Alphonso would come of age in 1875. It was singular that Spain's greatest soldier, Marshal Manuel Concha, Marquis del Duero, who was killed in battle by the Carlists near Estella on 27th June 1874, had also conceived the same idea as Canovas—the restoration of the Bourbons by a Parliament elected after a decisive campaign against the Carlists. It is no wonder, therefore, that Canovas and the other statesmen who were thus preparing the restoration at first expressed astonishment and displeasure when they heard that a then obscure general at the head of a force actually at the seat of war had made a premature *pronunciamiento, more majorum*, at Sagunto on 29th December 1874.

Restoration of the monarchy.

When the *pronunciamiento* assumed an irresistible and victorious aspect, Canovas and the Supreme Junta of Alphonsism in Madrid immediately adhered to the military rising and produced the instructions entrusted to Canovas by the King himself, to which, of course, the generals bowed. Canovas gazetted himself President of the interim Council of Ministers until the arrival of his sovereign, to whom he conveyed by telegraph the loyal congratulations of the army and navy, and of a people who quickly and gladly submitted to the change, because all believed that a great and decisive step had thus been taken in the direction of the much-desired re-establishment of peace and regular government in Spain. The progress of the young monarch through Barcelona and Valencia, and thence all the way to Madrid, was marked by a hearty welcome on the part of all classes. The loyal demonstrations in the capital contrasted with the comparatively cold greeting extended a few years before to Amadeus of Savoy. The first act of Alphonso XII. was a royal decree confirming the appointment of Canovas del Castillo as Prime Minister. A strong Conservative administration was formed, to which Canovas admitted some men of the old parties of Queen Isabella's reign side by side with men who had played a part in the revolution before they became his active auxiliaries in the Alphonsist propaganda in 1872 and 1873. This Cabinet gave its chief attention for fifteen months to the pacification of the Peninsula, adopting a Conservative and Catholic policy which contributed quite as much as the great display of military resources to make the Pretender lose adherents and prestige from the moment that his cousin reached Madrid. The Church, the nobility, and the middle classes soon pronounced for the new state of things. The Alphonsist armies, led by Marshals Campos and Jovellar, swept the Carlist bands from the right bank of the Ebro to the Pyrenees, and took their last strongholds in the eastern provinces, Cantavieja and Seo de Urgel. Not a few of the Carlist leaders accepted bribes to go abroad, and others put their swords at the disposal of the Government for employment against the Cuban rebels. Then all the forces of King Alphonso under Marshal Quesada gradually closed round the remainder of the Carlist army in Navarre and in the Basque provinces at the beginning of 1876. The young King himself was present at the close of the campaign, which sent his rival a fugitive across the French frontier, with the few thousand faithful followers who had clung to his cause to the very end.

The Cuban insurrection.

Directly the Carlist war was over, the Government used part of the large army at its disposal to reinforce the troops which had been fighting the Cuban insurgents since 1869. Marshal Jovellar was sent out to Havana as governor-general, with Marshal Martinez Campos as commander-in-chief of the forces. In about eighteen months they managed to drive the rebels into the eastern districts of the island, Puerto Principe and Santiago de Cuba, where by some successful expeditions and clever parleying they induced all but a few irreconcilable chiefs to accept a convention that became famous under the name of the Peace Treaty of Zanjon. Marshal Campos, who very soon succeeded Jovellar as governor-general of Cuba, for the first time held out to the loyalists of the island the prospect of reforms, fairer treatment at the hands of the mother country, a more liberal tariff to promote their trade, and self-government as the crowning stage of the new policy. He also agreed to respect the freedom of the maroons who had fled from their masters to join the Cubans during the ten years' war, and this led to Spain's very soon granting gradual emancipation to the remainder of the slaves who had stood by their owners. Marshal Campos was not allowed to carry out his liberal and conciliatory policy, which the reactionary party in the colony, *el partido Espanol*, resented as much as their allies in the Peninsula. Nevertheless, before he left Havana the seed was sown among the Creoles for the home-rule movement which developed so rapidly in the 'eighties.

Internal changes.

Though much of his time and energies had been devoted to the re-establishment of peace at home and in the colonies from 1875 to 1880, Señor Canovas had displayed considerable activity and resolution in the reorganization of the monarchy. Until he felt sure of the early termination of the struggle with the Pretender, he ruled in a dictatorial manner without the assistance of Parliament. Royal decrees simply set aside most of the legislation and reforms of the Spanish revolution. Universal suffrage alone was respected for a while, and used as the means to call into existence the first Cortes of the restoration in 1876.

The electors proved, as usual, so docile, and they were so well handled by the authorities, that Canovas obtained a Parliament with great majorities in both Houses which voted a limited franchise to take the place of universal suffrage. Immediately afterwards they voted the Constitution of 1876, which was virtually a sort of compromise between the Constitution of 1845 in the reign of Isabella and the principles of the Democratic Constitution of the revolution in 1869. For instance, liberty of conscience, established for the first time in 1869, was reduced to a minimum of toleration for Protestant worship, schools, and cemeteries, but with a strict prohibition of propaganda and outward signs of faith. Trial by jury was abolished, on the plea that it had not worked properly. Liberty of associations and all public meetings and demonstrations were kept within narrow limits and under very close surveillance of the authorities. The municipal and provincial councils were kept in leash by intricate laws and regulations, much resembling those of France under the Second Empire. The political as well as the administrative life of the country was absolutely in the hands of the wire-pullers in Madrid; and their local agents, the governors, the mayors, and the electoral potentates styled *los Caciques*, were all creatures of the Home Secretary at the head of Castilian centralization. The Constitution of 1876 had created a new Senate, of which half the members were either nominees of the Crown or sat by right of office or birth, and the other half were elected by the provinces of the Peninsula and the colonies, the clergy, the universities, and the learned societies and academies. The House of Deputies, composed of 456 members, was elected by the limited franchise system in Spain and by an even more restricted franchise in the colonies, five-sixths of the colonists being deprived of representation. From the beginning of the restoration the great statesman, who was nicknamed at the time the Richelieu of Alphonso XII.'s reign, established a system of government which lasted for a quarter of a century. His idea was that the restored monarchy, much as it had retraced its steps towards the régime that existed before the revolution, must be worked on the same surface lines as in other European countries which possessed two great dynastic parties who were in a position to succeed each other in the councils of the sovereign, and who might tacitly assist each other in checking both dissentients from their own ranks and the anti-dynastic parties like the Carlists and Republicans. With a view to attain this object, in 1875, a very few months after the restoration, he encouraged the men of the revolution who wanted to bow to accomplished facts and make the best of the restricted amount of liberty remaining, to start afresh in national politics as a Dynastic Liberal party. From the moment that such former revolutionists as Sagasta, Ulloa, Leon y Castillo, Camacho, Alonzo Martinez, and the Marquis de la Vega de Armijo declared that they adhered to the restoration, Canovas did not object to their saying in the same breath that they would enter the Cortes to defend as much as possible what they had achieved during the revolution, and to protest and agitate, legally and pacifically, until they succeeded in re-establishing some day all that the first Cabinet of Alphonso XII. had altered in the Constitution of 1869. The Premier not only approved Sagasta's efforts to gather round him as many Liberals and Democrats as possible, but did not even oppose the return of Emilio Castelar and a few Republicans. He also countenanced the presence in the Cortes for the first time of 15 Senators and 42 Deputies to represent Cuba and Porto Rico, including a couple of home rulers. Thus Canovas meant to keep up the appearance of a Constitutional and Parliamentary Government with what most Spaniards considered a fair proportional representation of existing parties, except the Carlists and the most advanced Republicans, who only crept into the House of Deputies in some later Parliaments. Canovas ruled his own coalition of Conservatives and Catholics with an iron hand. A Cabinet Minister who had shown insubordination received the first intimation of his displeasure in the shape of the *Gazette* containing royal decrees dismissing him and appointing his successor. On another occasion an important group of Conservatives, headed by two prominent statesmen, Gamazo and Alonzo Martinez, were sternly requested to consider themselves expelled from the ministerial ranks because they had dissented from the Premier's views. In this way Canovas managed the affairs of Spain for six years with only two short interruptions, when he stood aside for a few months, just long enough to convince the King that the Conservative party could not retain its cohesion, even under such men as Marshals Jovellar and Campos, if he did not choose to support them.

In the early years of the restoration the King and Canovas acted in concert in the two most delicate matters that required their constant attention. Young as he was, Alphonso XII. agreed with his chief counsellor as to the expediency of keeping military men away from active politics. They were given to understand that the King could not tolerate that interference which had developed and kept up the influence of militarism during the reign of Queen Isabella and during the revolution. Canovas boldly declared in the Cortes that the era of *pronunciamientos* had been closed by the restoration, and the King reminded the generals more than once that he intended to be the head of the army. The King and his Prime Minister were equally agreed about the necessity of showing the Vatican and the Church sufficient favour to induce them to cease coquetting with the pretender Don Carlos, but not so much as to allow the Pope and the clergy to expect that they would tolerate any excessive Ultramontane influence in the policy of the restoration. In regard to foreign policy, the King and Canovas both inclined to assist national aspirations in Morocco, and jealously watched the relations of that empire with other European Powers. This desire to exercise a preponderant influence in the affairs of Morocco culminated in the Madrid Conference of 1880, presided over by Canovas himself. The outcome of it was the treaty which has since regulated the consular protection extended to the subjects of his Shereeffian Majesty, and the relations generally of Morocco with foreign Powers and their subjects. In all other points of foreign policy Canovas advocated a policy of strict and vigilant neutrality, though his sovereign hardly concealed that he considered he had monarchical and dynastic reasons for courting, if not alliances, at least close relations with Germany, Austria, and Italy.

Marriage of Alphonso XII.

In 1878, in spite of the well-known hostility of his mother to the Montpensiers, and in spite of his ministers' preferences for an Austrian match, King Alfonso insisted upon marrying the third daughter of the Duke of Montpensier, Doña Mercedes, who only survived her marriage five months. Barely seventeen months after the death of his first wife, his Majesty listened to the advice of Canovas and married, in November 1879, the Austrian Archduchess Maria Christina of Hapsburg. In general matters the King allowed his ministers much liberty of action. From 1875 to 1881, when not too much engrossed in more pressing affairs, his Governments turned their attention to the reorganization of the finances, the resumption of payment

of part of the debt coupon, and the consolidation of the colonial and imperial floating debts. They swerved from the mild free trade policy which was inaugurated by Señor Figuerola and by Prim at the beginning of the revolution, and to which was due the remarkable progress of the foreign trade. This went on almost continuously as long as the régime of moderate tariffs and commercial treaties lasted, *i.e.*, until 1890.

Liberal administrations.

In 1881 the Dynastic Liberals began to show impatience at being kept too long in the cold shade of Opposition. Their chief, Sagasta, had found allies in several Conservative and Liberal generals—Campos, Jovellar, Lopez-Dominguez, and Serrano—who had taken offence at the idea that Canovas wanted to monopolize power for civil politicians. These allies were said to be the dynastic and monarchical ballast, and in some sort the dynastic guarantees of Liberalism in the eyes of the Court. Canovas came to the conclusion that it was expedient for the restoration to give a fair trial to the quondam revolutionists who coalesced under Sagasta in such conditions. He arranged with the King to moot a series of financial projects the acceptance of which by his Majesty would have implied a long tenure of office for the Conservatives, and so Alphonso XII. found a pretext to dissent from the views of his Premier, who resigned on the spot, recommending the King to send for Sagasta. The Liberal administration which that statesman formed lasted two years and some months. The policy of Sagasta in domestic affairs resembled that of Canovas, as the King considered that it was too early to think of altering the Constitution and the laws made after the restoration. The Liberals had to act cautiously and slowly, because they perceived that any premature move towards reform or democratic legislation would not be welcome at Court, and might displease the generals. Sagasta and his colleagues therefore devoted their attention chiefly to the material interests of the country. They made several treaties of commerce with European and Spanish-American Governments. They reformed the tariff in harmony with the treaties, and with a view to the reduction of the import duties by quinquennial stages to a fiscal maximum of 15 per cent. *ad valorem*. They undertook to carry out a general conversion of the consolidated external and internal debts by a considerable reduction of capital and interest, to which the bondholders assented. They consolidated the floating debt proper in the shape of a 4 per cent. stock redeemable in 40 years, of which £70,000,000 was issued in 1882 by Señor Camacho, the greatest Spanish financier of the century. Sagasta was not so fortunate in his dealings with the anti-dynastic parties, and the Republicans gave him much trouble in August 1883. The most irreconcilable Republicans knew that they could not expect much from popular risings in great towns or from the disaffected and anarchist peasantry in Andalucia, so they resorted to the old practice of barrack conspiracies, courting especially the non-commissioned officers and some ambitious subalterns. The chief of the exiles, Don Manuel Ruiz Zorilla, who had retired to Paris since the restoration, organized a military conspiracy, which was sprung upon the Madrid Government at Badajoz, at Seo de Urgel, and at Santa Domingo in the Ebro valley. This revolutionary outbreak was swiftly and severely repressed. It served, however, to weaken the prestige of Sagasta's administration just when a Dynastic Left was being formed by some discontented Liberals, headed by Marshal Serrano and his nephew, General Lopez-Dominguez. They were joined by many Democrats and Radicals, who seized this opportunity to break off all relations with Ruiz Zorilla and to adhere to the monarchy. After a while Sagasta resigned in order to let the King show the Dynastic Left that he had no objection to their attempting a mildly Democratic policy, on condition that the Cortes should not be dissolved and that Sagasta and his Liberal majorities in both Houses should grant their support to the Cabinet presided over by Señor Posada Herrera, a former Conservative, of which the principal members were General Lopez-Dominguez and Señores Moret, Montero Rios, and Becerra. The support of Sagasta did not last long, and he managed with skill to elbow the Dynastic Left out of office, and to convince all dissentients and free lances that there was neither room nor prospect for third parties in the State between the two great coalitions of Liberals and Conservatives under Sagasta and Canovas. When Posada Herrera resigned, the Liberals and Sagasta did not seem much displeased at the advent to power of Canovas in 1884, and within a few months almost all the members of the Dynastic Left joined the Liberal party.

Foreign policy.

From 1881 to 1883, under the two Liberal administrations of Sagasta and Posada Herrera, the foreign policy of Spain was much like that of Canovas, who likewise had had to bow to the King's very evident inclination for closer relations with Germany, Austria, and Italy than with any other European Powers. Alphonso XII. found a very willing Minister for Foreign Affairs in the person of the Marquis de la Vega de Armijo, who cordially detested France and cared as little for Great Britain. The Red-books revealed very plainly the aims of the King and his minister. Spanish diplomacy endeavoured to obtain the patronage of Italy and Germany with a view to secure the admission of Spain into the European Concert, and into international conferences whenever Mediterranean and North African questions should be mooted. It prepared the way for raising the rank of the representatives of Spain in Berlin, Vienna, Rome, St Petersburg, and London to that of ambassadors. In Paris the country had been represented by ambassadors since 1760. The Madrid Foreign Office welcomed most readily a clever move of Prince Bismarck's to estrange Spain from France and to flatter the young King of Spain. Alphonso XII. was induced to pay a visit to the old Emperor William in Germany, and during his stay there, in September 1883, he was made honorary colonel of a Uhlan regiment quartered at Strasburg. In vain did German and Spanish diplomatists and the press of both countries do their best to explain away and minimize the significance of this appointment, and to prove that it was only a compliment usually paid to foreign sovereigns. The French people resented the act very much, and the Madrid Government was sorely embarrassed, as the King had announced his intention of visiting Paris on his way back from Germany. Nothing daunted by the ominous attacks of the French people and press, King Alphonso went to Paris. He behaved with much coolness and self-possession when he was met in the streets by a noisy and disgraceful demonstration. The President of the Republic and his ministers had to call in person on their guest to tender an apology, which was coldly received by Alphonso and his Minister for Foreign Affairs. After this untoward event, the King naturally shortened his stay in Paris and proceeded rapidly home, where the conduct of the Parisians had made as bad an impression as it had in the rest of Europe. On his return to Madrid he was received with unprecedented enthusiasm and demonstrations of loyalty and indignant protest against the insults of the French mob, which had aroused the susceptibilities of the majority of Spaniards, even of many who were not Royalists. Shortly after the King's return, the German Emperor sent his son the

Crown Prince, the husband of the Princess Royal of England, with a brilliant suite, to the Spanish capital, where they were the guests of the King for several days. The Crown Prince was welcomed with many imposing demonstrations of sympathy, in which the royal family, the Court, the Government, the dynastic Opposition, the army, and all classes took part. Until the end of his reign Alphonso XII. kept up his friendly relations with the German Imperial family and with the German Government.

The close of the reign of Alphonso XII. was marked by much trouble in domestic politics, and by some great national calamities and foreign complications, while the declining health of the monarch himself cast a gloom over the Court and governing classes. The last Conservative Cabinet of this reign was neither popular nor successful. Canovas del Castillo did not take into consideration that though he had returned so quickly to the councils of the monarchy, chiefly through the divisions of Liberalism, it would have been wise to recollect that the men of the revolution who had gradually adhered to the restoration thought they had reason to complain of the persistent favour shown to the Catholics and Conservatives. In fact, the latter ruled Spain under Alphonso XII. for eight years and a half out of the eleven years of his reign. The general election of 1884 was conducted with such insincerity, such disregard for the aspirations of the Opposition, that both Liberals and Republicans entered the Cortes in anything but a pleasant frame of mind, as the Cabinet soon discovered. Resistance and criticism in Parliament and in the press irritated Canovas, and he fancied that he could treat the adversaries of his policy in the high-handed and arbitrary way in which he had dealt with all discontent eight years previously at the beginning of the restoration. He did not listen to any warning, and paid no attention to the many symptoms indicating that times had changed, and that his reactionary methods only stirred up the growing resistance of Democracy and Liberalism. He committed not a few mistakes in financial and commercial questions, allowing public expenditure to increase, putting no check on the growth of the floating debt, and developing the relations of the Treasury with the Bank of Spain, thereby obliging the latter to start upon an uninterrupted increase of its note issue. When cholera appeared in France, quarantine was so rigorously enforced in the Peninsula that the external trade and railway traffic were grievously affected. On Christmas night, 1884, an earthquake caused much damage and loss of life in the provinces of Granada and Malaga. Many villages in the mountains which separate those provinces were nearly destroyed. At Alhama, in Granada, more than 1000 persons were killed and injured, several churches and convents destroyed, and 300 houses laid in ruins. King Alphonso went down to visit the district, and distributed relief to the distressed inhabitants, who everywhere showed their gratitude to his Majesty, who exposed himself to fatigue and hardship in the depth of winter, despite his visibly failing health. He held on gallantly through the greater part of 1885 under great difficulties. In the Cortes the tension in the relations between the Government and the Opposition was growing daily more serious. Outside, the Republicans and Carlists were getting troublesome, and the tone of their press vied with that of the Liberals in their attacks on the Conservative Cabinet. Then, to make matters worse, an outbreak of cholera occurred in the eastern provinces of the kingdom. The epidemic spread rapidly over the Peninsula, causing great havoc in important cities like Granada, Zaragoza, and Valencia. The authorities confessed that 105,000 persons died of cholera in the summer and autumn of 1885, being on an average from 41 to 56 per cent. of those attacked. The epidemic was not very severe in Madrid, only ranging up to 48 deaths a day, though it lasted several weeks; but at Aranjuez, a royal seat on the banks of the Tagus, a few leagues from the capital, 2000 victims were swept off in a week. Notwithstanding the opposition of his ministers, the King insisted upon visiting Aranjuez and Murcia, where also cholera was raging. The Court left Madrid later than usual in the summer to go to the residence of the Spanish Bourbons in the hot months of the year, La Granja de San Ildefonzo, in the picturesque mountains of Segovia. During the stay of the royal family at the Castilian Versailles founded by the first Bourbon, Philip V., the King, whose health had been long undermined, got worse, and the condition of his throat and lungs made Queen Maria Christina and the ministers very anxious. The latter had adopted a system of silence and concealment of the sad reality of the situation, in which they persevered for several months. The nation was kept in a state of ignorance of the fast approaching end of the sovereign; a few had an inkling of the truth, which had not been kept from the members of the royal family who were abroad, nor from the Courts of Berlin and Vienna.

In September, when the King was beginning to rally from a painful crisis in his illness, a conflict arose between Spain and Germany which had an adverse effect upon his health. Prince Bismarck looked upon the rights of Spain over the Caroline Islands in the Pacific as so shadowy that he sent some German warships to take possession of a port in the largest island of the group, though the naval and colonial authorities in those distant archipelagoes at once protested. The news of this move on the part of Germany caused great indignation in Spain, and popular feeling rose so high in Madrid that imposing demonstrations were made, in which people of all classes took part. The Government got alarmed when the Madrid mob one night attacked the German embassy, tore the arms of the empire from the door of the consulate, and dragged the escutcheon to the Puerto del Sol, where it was burnt amid much uproar. The troops had to be called out to restore order, and the ministers advised the King to return to the capital. Alphonso alone remained cool, and would not listen to those who clamoured for a rupture with Germany. He told his ministers that he would not on any account plunge his country into a hopeless struggle. He elected to trust to diplomacy; and Spain made out such a good case for arbitration, on the ground of her ancient rights of discovery and early colonization, that the German Emperor, who had no desire to imperil the dynasty and monarchy in Spain, agreed to submit the whole affair to the Pope, who eventually gave judgment in favour of the Spanish pretensions.

Death of Alphonso XII.

After his return to Madrid the King showed himself in public less than usual; and on his last appearance, at the autumn races in October, everybody who saw him in the paddock was unfavourably impressed with his looks. A few days later it was whispered that his state of health would probably oblige him to spend the winter on the Spanish shores of the Mediterranean. He did not consent to do so, because he wanted to avoid creating alarm, but went to a royal seat close to Madrid, El Pardo, a sort of hunting-box in the midst of the woods, and there his complaint made rapid progress. Nevertheless, in Madrid, Canovas would not allow the press to say a word. Indeed, in the ten months before the death of Alphonso XII. the Conservative Cabinet displayed unprecedented rigour against the newspapers of every shade. The Dynastic, Liberal, and Independent press, the illustrated papers, and the satirical weeklies,

fared no better than the Republicans, Socialists, and Carlists, and in 60 days 1260 prosecutions were ordered against Madrid and provincial papers. The police chased the hawkers of papers about the streets as roughly as they had chased the students of the universities and schools, who also had incurred the displeasure of the reactionary Cabinet. At last, on 24th November, the truth had to be sprung upon the capital, where the greatest consternation reigned when it was admitted that Alphonso XII. was dying at El Pardo. The Queen, his sisters, his little daughters, and his ministers had all hurried down in consequence of the peremptory summons of the physicians and of the Lord High Chamberlain. A little after eight o'clock in the morning of 25th November 1885 the King expired. Dr Camison, who attended him throughout his illness, pronounced it to be laryngeal phthisis.

Alphonso XII. was undoubtedly intelligent, anxious to play his part as King with energy and regardless of peril or personal sacrifice, as he did in the flooded districts of Murcia, in the earthquake-stricken provinces of Granada and Malaga, in the hotbeds of cholera in 1885. He always insisted on being informed of all affairs of State by his ministers and by the leading statesmen of the Opposition. He wished to be considered a ruler after modern ideas and constitutional principles of government, only the old Bourbon inclination for personal government cropped up when he overawed the too ambitious generals, when he assumed responsibility for all matters concerning the army, when he vetoed the re-establishment of universal suffrage and other democratic legislation, and when he determinedly took into his own hands the direction of the foreign policy of the country. He was a patron of arts and literature, of the turf and of the national bull-fights, and he spent much of his personal income in charities. A sincere Catholic, he was neither a bigot nor priest-ridden. He led an active life, rising early, devoting much time to riding, driving, shooting, hunting, and walking in summer in the highlands of Segovia. He was gifted with great conversational powers; was courteous and gallant, like his Bourbon ancestors, to the fair sex; easily approachable by all his subjects; and both amiable and hospitable to foreign princes and visitors, though ever kingly, with a touch of haughtiness in his manners. He had the luck to escape criticism at the hands of the dynastic Oppositions of his eleven years' reign. They invariably assailed his successive Cabinets, which shielded him loyally, even when perfectly aware that they were not infrequently blamed for acts which the King had dictated in a manner that brooked no resistance or remonstrance.

Regency of Queen Christina.

When such a ruler disappeared from the scene, it was no wonder that Spaniards and foreigners should have felt extremely anxious about the prospects of the monarchy. Alphonso XII. left no male issue. He had two daughters, the Princess of the Asturias, born in 1880, and the Infanta Maria Theresa, born in 1882. At the time of his death it had not been officially intimated that the Queen was *enceinte.* The *Official Gazette* did not announce that fact until three months after the demise of the sovereign, when the nation was duly informed, according to ancient usage. On 17th May 1886, six months after the death of Alphonso XII., his posthumous son, Alphonso XIII., was born at the Palace of Madrid. Six months before this event definitely settled the question of the succession to the throne, the royal family and its councillors assembled to take very important decisions. There could be no doubt that under the Constitution of 1876 the widowed Queen was entitled to the Regency. Doña Maria Christina on this first occasion displayed her characteristic self-possession and resolution by simply acting from the beginning as if she considered her right to govern Spain during the minority of the future sovereign to be entirely undisputable. She calmly presided over this solemn council, listening to the advice of Marshal Campos, always consulted in every great crisis; of Captain-General Pavia, who answered for the loyalty of the capital and of its garrison; of the Duke de Sexto, the chief of the household; of Marshal Blanco, the chief of the military household; and of all the members of the Cabinet and the Presidents of the Senate and Congress assembled in the presence of the Queen, the ex-Queen Isabella, and the Infanta Isabella. All were deeply impressed with the gravity of the situation, and looked chiefly to Marshal Campos and Canovas del Castillo for statesmanlike and disinterested advice. The question was whether it would be expedient to continue the policy of the late King and of his last Cabinet. This would have been tantamount to ushering in a long minority and the Regency of a foreign Queen with a Conservative and reactionary policy which had much impaired the prestige and popularity of the monarchy during the last 18 months of the reign of Alphonso XII., and had so exasperated the various groups of the Opposition that their discontent constituted one of the most serious embarrassments of the situation. Canovas del Castillo assured the Queen-Regent that he was ready to undertake the task of protecting the new state of things if it was thought wise to continue the Conservative policy of the late King, but in the circumstances created by his death, he must frankly say that he considered it advisable to send for Señor Sagasta and ask him to take the reins of government, with a view to inaugurate the Regency under a Liberal, progressive, and conciliatory policy. Canovas added that if this suggestion were adopted he was in a position to promise that the new Government would not be combated or obstructed by the Conservatives, whose loyalty naturally would make them co-operate in everything calculated to consolidate the monarchy and the dynasty. Marshal Campos and General Pavia endorsed the suggestion. They were also of opinion that Sagasta would soon checkmate the intrigues of the Republicans, by proving that the Government of the Regency could perfectly carry out all the reforms advocated by Spanish Liberalism and by those Democrats who were not irreconcilable revolutionists. Sagasta was summoned to El Pardo, and the result of his interview with the Queen-Regent, Canovas, and the generals was the understanding ever afterwards known as the pact of El Pardo, the corner-stone of the whole policy of the Regency, and of the two great statesmen who so long led the great dynastic parties and the Governments of Doña Christina. It was agreed that during the first years of the Regency, Canovas and Sagasta would assist each other in defending the institutions and the dynasty, that they would discourage indiscipline and dissent in the ranks of the two monarchical parties, and that the Parliaments should as far as possible last their full legal term of five years, in order to avert frequent general elections and the political agitation naturally aroused by such appeals to the country. Sagasta made no secret of the fact that it was his intention to alter the laws and the Constitution of the monarchy so as to make them very much resemble the Constitution of the revolution of 1868, but he undertook to carry out his reform policy by stages, and without making too many concessions to Radicalism and Democracy, so that Canovas and his Conservative and Catholic followers might bow to the necessities of modern times after a respectable show of criticism and resistance. The generals assured the Queen-Regent and the leaders of the dynastic parties that the army might be counted upon to stand by any Government which was sincerely determined

to uphold the restoration against Republicans and Carlists, and that it would assist the Alphonsist officers in checking the revolutionary propaganda still visible in the barracks among the sergeants and the officers who had risen from the ranks. Sagasta left the Palace to form the first of several Cabinets over which he presided continuously for five years. He took for colleagues some of the strongest and most popular statesmen of the Liberal party, virtually representing the three important groups of men of the revolution united under his leadership—veteran Liberals like Camacho and Venancio Gonzalez; Moderates like Alonzo Martinez, Gamazo, and Marshal Jovellar; and Democrats like Moret, Montero Rios, and Admiral Beranger. The new Cabinet convoked the Cortes elected under the administration of Canovas in 1884, and the Queen-Regent appeared before the Estates of the realm assembled in the Congress Hall, with her two little daughters and Court, all in deep mourning, and there, with her hand on the crucifix and Gospels, she took the constitutional oath. The Conservative majorities of both Houses, at the request of Canovas, behaved very loyally, voting supplies and other Bills necessary to enable the Government to be carried on until another Parliament could be elected in the following year, 1886.

Republican and Carlist intrigues.

Pending the dissolution and general election, Sagasta and his colleagues paid most attention to public peace and foreign affairs. A sharp look-out was kept on the doings of the Republicans, whose arch agitator, Ruiz Zorilla, in Paris displayed unusual activity in his endeavours to persuade the Federals, the Intransigents, and even the Opportunists of Democracy that the times were ripe for a venture. Ruiz Zorilla found no response from the Republican masses, who looked to Pi y Margall for their watchword, nor from the Republican middle classes, who shared the views of Salmeron, Azcarate, and Pedregal as to the inexpediency of revolutionary methods. Castelar, too, raised his eloquent protest against popular risings and barrack conspiracies. The Carlists showed equal activity in propaganda and intrigues. They did not attempt to conceal the fact that they only awaited a signal from the pretender Don Carlos to rise again in their usual provincial haunts. The emissaries of the pretender were constantly passing to and fro between the Peninsula and the abode of the exiled representative of absolutism and religious intolerance. Sagasta derived much benefit from the divisions which made Democracy powerless; and he was able to cope with Carlism chiefly because the efforts of the pretender himself abroad, and of his partisans in Spain, were first restrained and then decisively paralysed by the influence of foreign Courts and Governments, above all by the direct interference of the Vatican in favour of the Spanish Regency and of the successor of Alphonso XII. Don Carlos could not afford to incur the displeasure of the Austrian Imperial family, or of the Italian Government, which allowed him to reside unmolested in Venice, much less that of the Pope, whose mandate he knew had gone forth that the clergy, high and low, and the religious orders of both sexes, were to refrain from abetting civil war in the Peninsula. The young and most impatient adherents of Carlism vainly pleaded that such an opportunity would not soon be found again, and threatened to take the law into their own hands and unfurl the flag of *Dios*, *Patria*, *y Rey* in Northern and Central Spain. Don Carlos once more showed his well-known lack of decision and dash, and the Carlist scare passed away. Pope Leo XIII. went even farther in his patronage, for he consented to be the godfather of the posthumous son of Alphonso XII., and he never afterwards wavered in the steady sympathy he showed to Alphonso XIII. He was too well acquainted with the domestic politics of the Peninsula to suppose that Carlism could ever do more than disturb for a while the tranquillity of Spain. He did not wish to stake the interests of the Church on a cause which could only revive against her the old animosities of Spanish Liberalism and Democracy, so roughly displayed in 1836 and 1868. He was perfectly aware that the Church could expect even better treatment at the hands of the Austrian Archduchess who had become Queen-Regent than had been received from her late husband. Doña Christina, apart from the dictates of gratitude towards the head of her Church for the kindness shown to her son and Government, was a zealous Catholic. She proved all through her Regency that she not only relied upon the support of the Vatican and of the prelates, but that she was determined to favour the Church and the religious foundations in every possible way. Whenever she distributed bounties on royal birthdays and saints' days, the lion's share went to religious charities and institutes. Her purse was always open to assist convents, monasteries, and religious works and societies, and the building of churches, chapels, nunneries, colleges, schools, foundling hospitals, and night refuges, as long as they were under the management of the Church and the orders. Her influence was ever exercised, in Cabinet Councils and in private conferences with her ministers, to further the views of the Church in matters of education, in questions affecting religious toleration, and even in foreign relations. Doña Christina became Regent just when Spain had felt the consequences of the expulsion of the Jesuits and other religious orders from France after the famous Jules Ferry laws, which aimed at placing these orders more under State control, to which they declined to submit. They selected Spain as an excellent field of enterprise; and it must be said that all the Governments of the Regency showed so much indulgence towards the Catholic revival thus started, that in less than a decade the kingdom was studded with more convents, monasteries, Jesuit colleges, Catholic schools, and foundations than had existed in the palmy days of the Houses of Austria and Bourbon in the 17th and 18th centuries. A wave of Clericalism and ultra-Catholic influences swept over the land, affecting the middle classes, the universities and learned societies, and making itself very perceptible also among the governing classes and both dynastic parties, Liberals and Conservatives. The Vatican was thus more than rewarded for securing the Regency twelve years' comparative truce from the Carlists. Nevertheless, it had once more to step in to check the pretender and his partisans when the disasters of the war with the United States seemed to have furnished Don Carlos a last opportunity to become an active element in Spanish politics.

Europe and the Regency.

Next in importance to Papal protection was the favourable attitude of all the European Governments towards the Queen-Regent and, later, towards her son. The Court and Government of Germany, despite the award of the Pope in the arbitration on the rival claims of Spain and Germany over the Caroline Islands, vied with the Austrian and Italian royal families and Governments in showing sympathy to the widow of Alphonso XII. Republican France and the Tsar made as cordial demonstrations as Queen Victoria and her Government, and Switzerland, Belgium, Holland, and others followed suit. The Spanish Foreign Office received every assurance that friendly Governments would watch the Carlists and Republicans, to prevent them from using their territories as a basis for conspiracies against the peace of Spain. The statesmen of both dynastic parties, from the beginning of the Regency, did

not conceal from the Governments of Europe that they considered it unadvisable to continue the foreign policy of the late King. From every point of view it was better that the Regency should observe strict neutrality in European affairs, in order to avoid complications fraught with evil consequences for the monarchy and the dynasty in the unsettled state of the country. This neutrality was maintained until the close of the 19th century. It was criticized during and after the colonial wars and the war with America, which led to the loss of the colonies in 1898, when a few Conservatives like Silvela, as well as the Republicans, who were always prone to French alliances, proclaimed that presentiment and foresight had made them dissent from the policy of neutrality and isolation which prevailed from 1885 to 1898.

Policy of Sagasta.

Sagasta conducted the first general election in 1886 much after the usual precedents. The Long Parliament of the Regency was composed of considerable Liberal majorities in both Houses, though Sagasta had allowed a larger share than Canovas was wont to do to the minorities, so much so that on the Opposition benches the Republicans of various shades were represented by their most eminent leaders, the Carlists had a respectable group, and the Conservatives a strong muster, flanked by a group of dissentients. The first Cortes of the Regency in five sessions did really good and substantial work. A civil code was carefully drawn up by Señor Alonzo Martinez, in order to consolidate the very heterogeneous ancient legislation of the monarchy and the local laws of many provinces, especially Catalonia, Aragon, Valencia, Navarre, and the Basque territory. Trial by jury was re-established for most crimes and offences. The laws regulating the rights of association and public meeting, the liberty of the press, and other rights of the subject were reformed on liberal and more tolerant lines. Finance and trade received attention. Some commercial treaties and agreements were made, including one with Great Britain, which proved highly beneficial to home trade, and the tariff was altered, in spite of much resistance on the part of the Protectionists. In his progressive policy Sagasta was actively and usefully supported by the chief of the Moderate Republicans, Emilio Castelar, who not only eloquently defended all the liberal projects of the Government, but repeatedly declared in Congress and at public meetings that Democracy had no longer any grounds for agitating the country from the moment that a Liberal administration was virtually restoring all the principal features of the Constitution of the Spanish revolution. He went so far as to recommend his partisans to vote on every division with the Liberal party, because he confessed that bitter experience had taught him that liberties and rights were better attained and made stable by pacific evolution than by revolution. He laid most stress upon this axiom when, in September 1886, Ruiz Zorilla suddenly sprang upon Sagasta a military and revolutionary movement in the streets and barracks of the capital. This failed, but it was found that the conspiracy had contaminated in the Madrid and other garrisons many regiments which did not actually break out into insurrection. The military authorities acted with vigour and promptitude, the rebels being pursued, dispersed, and arrested. General Marina and several other officers were condemned to death by court-martial, but Queen Christina commuted the sentence into penal servitude, and the Ministers of War and Marine retired from the Cabinet in consequence. Very shortly afterwards, another War Minister, General Castillo, attempted to strike at the root of military insubordination, and simultaneously in every garrison of the kingdom the senior sergeants, more than 1000 in all, were given their discharge and ordered to start for their homes on the spot. The lesson produced a good result, as no trace of revolutionary work revealed itself among the non-commissioned officers after 1886. As time wore on, Sagasta found it difficult to maintain discipline in the ranks of the Liberal party. He was obliged to reconstruct the Cabinet several times in order to get rid of troublesome colleagues like General Cassola, who wanted to make himself a sort of military dictator, and Camacho, whose financial reforms and taxation schemes made him unpopular. He had oftener to reorganize the Government in order to find seats in the Cabinet for ambitious and impatient worthies of the Liberal party—not always with success, as Señor Martos, president of the Congress, and the Democrats almost brought about a political crisis in 1889. Sagasta cleverly affected to resign and stand aside, so that Señor Alonzo Martinez might vainly attempt to form an intermediary Cabinet. Canovas, who was consulted by the Queen when Alonzo Martinez failed, faithfully carried out the pact of El Pardo and advised her Majesty to send for Sagasta again, as he alone could carry out what remained to be done of the Liberal programme. Sagasta reconstructed his ministry for the last time, and announced his intention to make the re-establishment of universal suffrage the crowning act of the Liberal policy, knowing very well that he would thus rally round him all the Liberals, Democrats, and Republicans in the last session of the Long Parliament. The Suffrage Bill was carried through the Senate and Congress in the spring of 1890 after protracted debates, in which the Conservatives and many military politicians who had previously been regarded as the allies of Sagasta did their best to obstruct the measure. Marshals Campos, Jovellar, and Novaliches, and Generals Pavia, Primo de Rivera, Daban, and others, were angry with Sagasta and the Liberals not only because they deemed their policy too Democratic, but because they ventured to curb the insubordinate attitude of general officers, who shielded themselves behind the immunities of their senatorial position to write insolent letters to the War Minister on purely professional questions. Spanish generals of *pronunciamiento* fame thought it perfectly logical and natural that sergeants and subalterns should be shot or sent to penal servitude for acts of indiscipline, but if an insubordinate general was sent to a fortress under arrest for two months they publicly demonstrated their sympathy with the offender, made angry speeches against their hierarchical chief, the War Minister, in the Senate, and dared to call upon the Queen-Regent to make representations, which unfortunately were listened to, according to the worst precedents of the Spanish monarchy. The increasing violence of the Conservative press and Opposition, the divisions developing in the ranks of Liberalism, and the restlessness of the agricultural protectionists, led by Señor Gamazo, did not weigh so much in the balance at Court against Sagasta as the aggressive attitude of the military politicians. Sagasta held on as long as was necessary to secure the promulgation of the universal suffrage law, but he noticed that the Queen-Regent, when he waited upon her for the despatch of public business, showed almost daily more impatience for a change of policy, until at last, in July 1890, she peremptorily told him that she considered the time had come for calling the Conservatives and their military patrons to her councils. Sagasta loyally furnished the Queen with a constitutional pretext for carrying out her desire, and tendered the resignation of the whole Cabinet, so that her Majesty might consult, as usual, the party leaders and generals on the grave question of the expediency of entrusting to new ministers or to the Liberals the mission of testing the new electoral system.

Queen Christina on this occasion acted exactly as she henceforth did in all ministerial crises. She slowly consulted the magnates of all parties with apparent impartiality, and finally adopted the course which it was an open secret she had decided upon *in pectore* beforehand. Her late husband had impressed her with the advisability of keeping up the outward forms of constitutional and Parliamentary government, though the total lack of sincerity at the elections made it necessary that the royal prerogative should be exercised whenever the sovereign thought such interference indispensable in the interests of the dynasty and the country. Doña Christina certainly displayed more disposition for personal government than Alphonso XII., and, singularly enough, she was more often humoured in this respect by her Liberal ministers than by haughty Canovas, who did not hesitate at times to point out to the mother of Alphonso XIII. that the monarchy, as well as the Conservatives and Catholics who were its councillors, must shape its conduct in accordance with modern ideas.

Canovas gathered round him most of the prominent Conservative and Catholic statesmen. The first step of the new Cabinet was calculated to satisfy the protectionist aspirations which had spread in the kingdom about the same time that most Continental countries were remodelling and raising their tariffs. The Madrid Government used an authorization which Sagasta had allowed his Long Parliament to vote, to please Señor Gamazo and the Liberal representatives of agricultural interests, empowering the Government to revise and increase all tariff duties not covered by the then existing treaties of commerce. This was the case with most of the products of agriculture and with live stock, so Canovas and his Finance Minister made, by royal decree, an enormous increase in the duties on these classes of imports, and particularly on bread-stuffs. Then, in 1891, they denounced all the treaties of commerce which contained clauses stipulating most-favoured-nation treatment, and they prepared and put in force in February 1892 a protectionist tariff which completely reversed the moderate free trade policy which had been so beneficial to the foreign commerce of Spain from 1868 to 1892. Not a few nations retaliated with higher duties upon Spanish exports, and France raised her wine duties to such an extent that the exports of wines to that country dropped from £12,500,000 before 1892 to £2,400,000 in 1893 and the following years. The effects of a protectionist policy verging upon prohibition were soon sharply felt in Spain. Foreign exchanges rose, exports decreased, the railway traffic declined, and the commercial classes and consumers of foreign goods and products were loud in their protests. Industrial interests alone benefited, and imported more raw materials, chemicals, and coal and coke, which naturally influenced the exchanges adversely. Spain only attempted to make new treaties of commerce with Holland, Norway, Sweden, Denmark, and Switzerland. The Great Powers contented themselves with securing by agreements the same treatment for their commerce in Spain as that granted by those five treaties. The protectionists in 1893 wrecked a treaty of commerce with Germany in the Senate; and Spain subsequently persevered in her protectionist policy, without any new treaties of commerce, until the close of the 19th century, with the result that foreign trade ceased to move forward with great strides, as it had done all through the 'eighties under the régime of commercial treaties and a moderate tariff. During his two and a half years' stay in office Canovas had not so much trouble with the Opposition as with the divisions which sprang up in the Conservative ranks, though he fancied that he had managed the general election in 1891 so as to secure the customary docile majorities. The split in the Conservative camp originated in the rivalry between the two principal lieutenants of Canovas, Romero Robledo and Francisco Silvela. The latter and a strong and influential body of Conservatives, chiefly young politicians, dissented from the easy-going views of Romero Robledo and of Canovas on the expediency of reforms to correct the notorious and old-standing abuses and corruption of the municipalities, especially of Madrid. When Canovas found himself deserted on so delicate a matter by a numerous section of his party, he resigned, and advised the Queen to send for Sagasta and the Liberals. Canovas's tenure of office was marked by some occurrences worthy of notice at home and in Morocco. The Anarchists of Barcelona, on a great local *fête* day, threw a bomb at the feet of the Captain-General of Catalonia, Marshal Campos, which wounded several people and caused a great panic; and a few months later another Anarchist threw a bomb into the Liceo Theatre at Barcelona, and more than thirty persons were killed or badly wounded. In both cases some of the authors of the outrages were apprehended, tried, and executed, and their accomplices sent to penal servitude. A terrible explosion occurred in November 1893, at Santander, on board a large Spanish steamer laden with dynamite and anchored alongside the quay. An enormous amount of damage was done to many houses, public buildings, and churches. The local authorities put down the number of victims at more than 1000, and many missing were never accounted for.

A protectionist régime.

Sagasta took office very reluctantly, as he considered a change of policy premature. He conducted the general election with much regard for the wishes of the Opposition, and out of 456 seats in the Lower House allowed them to have more than 170, the Conservatives getting nearly 100 and the Republicans 30. He had to settle some knotty questions, foremost a conflict with Morocco, which was the consequence of the aggression of the unruly Riff tribes upon the Spanish outposts around Melilla, a Castillian station on the Mediterranean coast of Morocco. Reinforcements were tardily sent out; and in a second attack by the Arabs the Spanish forces lost heavily, and their commander, General Margallo, was killed. Public opinion was instantly fired, and the press called so loudly for revenge that the Government sent to Melilla no less a personage than Marshal Campos, at the head of 29 generals and 25,000 men. The Sultan of Morocco lost no time in censuring the behaviour of the Riff tribes, and in promising that he would chastise them. Marshal Campos was sent to Fez to make a treaty, in which he obtained ample redress and the promise of an indemnity of £800,000, which Morocco punctually paid.

Difficulty with Morocco.

Colonial affairs gave Sagasta much to do. He had given seats in his Cabinet to Señor Maura as Colonial Secretary and to Señor Gamazo, his brother-in-law, as Finance Minister. These two Moderate Liberals acted in concert to grapple with colonial questions, which in 1894 had assumed a very serious aspect. Spain had received many ominous warnings. Marshal Campos, on returning from Cuba in 1879, had advocated some concessions to satisfy the legitimate aspirations of the majority of the colonists, who wished for a less antiquated and less arbitrary rule. In 1886, in the first Parliament of the Regency, Cuban autonomist Deputies divided the House on a motion in favour of home rule and of an extension of the franchise in Cuba. This motion was negatived by all the Conservatives, by most of the Dynastic Liberals, and by some Republicans. On that occasion a prophetic warning was given

The Cuban question.

by a Cuban home ruler, Señor Montoro, in an eloquent speech imploring Spain not to play into the hands of the separatists and their American patrons, who made capital out of a policy which was simply suicidal on the part of Spain. The mother country, in fact, had persisted in looking upon the colonies as a privileged field of enterprise for Spanish capital, commerce, adventurers, and officials, supported in Cuba particularly by an oligarchy of reactionary colonists and Spaniards settled in the island, who were able to have entirely their own way owing to a very limited franchise. The majority of Spaniards were kept by the Government and the press quite in the dark about the growth of disaffection in Cuba, so that they were loth to listen to the few men, soldiers and civilians, courageous enough to raise the note of alarm during the ten years before the final catastrophe. For no other reason did the Minister for the Colonies, Señor Maura, in 1894 fail to convince the Cortes, and even the Liberal party, that his very moderate Cuban Home Rule Bill was an indispensable and wise, though tardy, attempt to avert a conflict which many plain symptoms showed to be imminent in the West Indies. Maura was warmly supported in Congress by the Cuban home rulers and by some far-sighted Liberals and Republicans. Nevertheless, his Bill did not find favour with the Conservatives or the majority of the Liberals, and Sagasta, trimming according to his inveterate habit, found a pretext to get rid of Maura and Gamazo. In the place of Maura he found a more pliant Minister for the Colonies, Señor Abarzuza, who framed a Cuban Reform Bill so much short of what his predecessor had thought an irreducible minimum of concessions, that it was censured in Havana by all the colonial Liberals and home rulers, and by their representatives in Madrid. The latter at the last moment recorded their votes in favour of the Abarzuza Bill when they perceived that a strange sort of eleventh-hour presentiment was about to make all the Spanish parties vote this insufficient reform. Before it could be promulgated, the tidings came of a separatist rising in the old haunts of Creole disaffection near Santiago de Cuba. Sagasta sent about 12,000 men to reinforce the 15,000 soldiers in Cuba under General Callaga, and was preparing more when a characteristically Spanish ministerial crisis arose. The subalterns of the Madrid garrison took offence at some articles published by Radical newspapers, and they attacked the editorial offices, maltreated the staff, and created a scandalous disturbance. Neither the War Minister nor the commanders of the garrison chose to punish the offenders, and sooner than endorse such want of discipline, Sagasta and the Liberal party once more made way for Canovas. A very few days after he assumed office Canovas received information concerning the spread of the rising in Cuba which induced him to send out Marshal Campos with 30,000 men. The Conservative Government spared no effort to provide the new governor-general with the means to cope with the ever-increasing insurrection, which swept over the island from the east to the extreme west, up to the very suburbs of Havana. Canovas allowed Marshal Campos much liberty of action, but dissented from his views on the expediency of allowing him to offer the loyalists of Cuba as much home rule as would not clash with the supremacy of Spain. The Prime Minister declared that the Cubans must submit first, and then the mother country would be generous.

Before a year had passed, in view of the signal failure of Marshal Campos, the Madrid Government decided to send out General Weyler, who had made himself famous in the Philippines and at Barcelona for his stern and cruel procedure against disaffection of every kind. He showed the same merciless spirit in dealing with the Cubans; and he certainly cleared two-thirds of the island of Creole bands, and stamped out disaffection by vigorous military operations and by obliging all the non-combatants who sympathized with the rebels in arms to elect between joining them in the bush, La Manigua, or residing within the Spanish lines.

General Weyler's campaign.

This system might probably have succeeded if the United States had not countenanced the sending of supplies of every kind to the rebels, and if American diplomacy had not again and again made representations against Weyler's ruthless policy. Canovas so fully comprehended the necessity of averting American intervention that he listened to the pressing demands of Secretary Olney and of the American Minister in Madrid, Mr Taylor, and laid before the Cortes a Bill introducing home rule in Cuba on a more liberal scale than Maura, Abarzuza, and Sagasta had dared to suggest two years before. Canovas did not live to see his scheme put into practice, as he was assassinated by an Anarchist at the baths of Santa Agueda, in the Basque provinces, on 9th August 1897. The Queen-Regent appointed General Azcarraga, the War Minister, as successor to Canovas; and a few weeks later President McKinley sent General Woodford as representative of the United States at the Court of Madrid. At the end of September 1897 the American Minister placed on record, in a note handed by him at San Sebastian to the Minister for Foreign Affairs, the Duke of Tetuan, a strongly worded protest against the state of things in Cuba, and demanded in substance that a stop should be put to Weyler's proceedings, and some measures taken to pacify the island and prevent the prolongation of disturbances that grievously affected American interests. Less than a fortnight after this note had been delivered, the Conservative Cabinet resigned, and the Queen-Regent asked Sagasta to form a new administration. The Liberal Government recalled Weyler, and sent out, as governor-general of Cuba Marshal Blanco, a conciliatory and prudent officer, who agreed to carry out the home rule policy which was concerted by Señor Moret and by Sagasta, with a view to obtain the goodwill of the President of the United States. If things had not already gone too far in Cuba, and if public opinion in the United States had not exercised irresistible pressure on both Congress and President, the Moret home rule project would probably have sufficed to give the Cubans a fair amount of self-government. All through the winter of 1897–98 the Madrid Government took steps to propitiate the President and his Government, even offering them a treaty of commerce which would have allowed American commerce to compete on equal terms with Spanish imports in the West Indies and defeat all European competition. But the blowing up of the American cruiser *Maine* in the port of Havana added fuel to the agitation in the United States against Spanish rule in Cuba. The time had really gone by for a diplomatic settlement. When Congress met in Washington the final crisis was hurried on. Spain appealed in vain to European mediation, to the Pope, to Courts and Governments. All, with the exception of Great Britain, showed sympathy for the Queen-Regent and her Government, but none were disposed to go beyond purely platonic representations in Washington.

At last, on 20th April 1898, when the Spanish Government learned that the United States Minister, General Woodford, had been instructed by telegraph to present an ultimatum demanding the cessation of hostilities in Cuba, with a view to prepare for the evacuation of the island by the Spanish forces, Sagasta decided to give General Woodford his passports and to break off official relations with the United States. It was an open secret that this grave decision was not

War with the United States.

taken, at the Cabinet Council presided over by the Queen, without a solemn protest by Señor Moret and the Ministers of War and Marine that the resources of Spain were totally inadequate for a struggle with the United States. These protests were overruled by the majority of the ministers, who invoked dynastic and monarchical considerations in favour of a desperate stand, however hopeless, in defence of the last remnants of the colonial empire of Spain. Reckless as was the course adopted, it was in touch with the feelings of the majority of a nation which had been to the very end deceived by the Government and by the press not only in regard to its own resources, but also in regard to those of the United States and of the colonists in arms in Cuba and in the Philippine Islands. The sequel is soon told. The Spanish fleet in the Far East was defeated in Manila Bay by Admiral Dewey. Admiral Cervera's squadron was destroyed outside the Bay of Santiago de Cuba by the American fleet under Admirals Sampson and Schley. All communication between Spain and her colonies was thus cut off. An American expedition landed near Santiago, and the Spanish garrison surrendered after a fortnight's show of resistance. Very shortly afterwards, at the end of July, Spain sued for peace through the mediation of French diplomacy, which did not obtain much from President McKinley. It was agreed that hostilities should cease on sea and land, but that Spain should evacuate Cuba and Porto Rico pending the negotiations for a peace treaty which were to begin in Paris at the end of September 1898. In the meantime Manila and its garrison had surrendered to the Americans. The agreement of 9th August, signed by M. Cambon, the French ambassador in Washington, in the name of Spain, clearly stipulated that her rule in the New World must be considered at an end, and that the fate of the Philippines would be settled at the Paris negotiations. Unfortunately, Spain indulged in the illusion that America would perhaps respect her rights of sovereignty in the Philippine Islands, or pay a considerable sum for their cession and recognize the debts of Cuba and of the Philippines. The American Commission, presided over by Secretary Day in Paris, absolutely refused to admit the Spanish contention that the United States or the new administration in Cuba and the Philippines should be saddled with several hundred million dollars of debts, contracted by the colonial treasuries, and guaranteed by Spain, almost entirely to maintain Spanish rule against the will of the Cubans and Filipinos. Spain could not help assenting to a treaty by which she renounced unconditionally all her rights of sovereignty over Cuba and Porto Rico and ceded the Philippine and Sulu Islands and the largest of the Marianne Islands in consideration of the payment of four millions sterling by America. Thus ended a struggle which only left Spain the Carolines and a few other islands in the Pacific, which she sold to Germany in 1899 for £800,000, and a couple of islands which were left out in the delimitation made by the Paris peace treaty of 12th December 1898, and for which America paid £20,000 in 1900.

Financial and political reorganization.

The consequences of the war and of the loss of the colonies were very serious for Spanish finance. The national debt, which consisted before the war of £234,866,500 of external and internal consols and redeemable debts and £24,250,000 of home floating debt, was increased by £46,210,000 of Cuban and Philippine debts, which the Cortes had guaranteed, and by £60,000,000 of debts contracted at a high rate of interest, and with the national guarantee, to meet the expenses of the struggle with the colonies and of the war with the United States. These additional burdens rendered it necessary that taxation and the budget should be thoroughly reorganized. All parties faced the problem with resignation and courage, declaring that the nation would not in any case repudiate its engagements, and intended to resort exclusively to sacrifices which would be asked of the home bondholders and the taxpayers. Sagasta and the Liberal party would gladly have undertaken the reorganization of Spain and her finances, but the issue of the war and the unavoidable peace treaty had so evidently damaged their popularity in the country and their credit at Court, that the Government seized the pretext of an adverse division in the Senate to resign. The Liberals left office after having done all that was morally and materially possible during the gravest crisis in the annals of Spain and her monarchy, considering the extremely difficult, indeed inextricable, situation in which they found the country in October 1897. The task of reorganization was confided by the Queen-Regent to Señor Silvela, who had been universally recognized as the leader of the Conservatives and Catholics after the death of Canovas del Castillo. Silvela endeavoured to unite in what he styled a Modern Conservative party the bulk of the followers of Canovas; the Ultramontanes, who were headed by General Polavieja and Señor Pidal; the Catalan Regionalists, whose leader, Duran y Bas, became a Cabinet Minister; and his own personal following, of whom the most prominent were the Home Secretary, Señor Dato, and the talented and energetic Finance Minister, Señor Villaverde, upon whose shoulders rested the heaviest part of the task of the new Cabinet. Silvela lacked the energy and decision which had been the characteristics of Canovas. He behaved constantly like a wary and cautious trimmer, avoiding all extreme measures, shaking off compromising allies like the Ultramontanes and the Regionalists, elbowing out of the Cabinet General Polavieja when he asked for too large credits for the army, taking charge of the Ministry of Marine to carry out reforms that no admiral would have ventured to make for fear of his own comrades, and at last dispensing with the services of the ablest man in the Cabinet, the Finance Minister, Señor Villaverde, when the sweeping reforms and measures of taxation which he introduced raised a troublesome agitation among the taxpayers of all classes. Villaverde, however, had succeeded in less than eighteen months in giving a decisive and vigorous impulse to the reorganization of the budget, of taxation, and of the home and colonial debts. He created a comprehensive income tax which produced several millions sterling, thus helping the budget, which the cost of colonial and foreign wars had swelled to more than £36,000,000 a year. He reduced expenditure, despite the resistance of his own colleagues in the Cabinet and of all the vested interests in the army, navy, civil service, and Church, which still make reforms so difficult in Spain. Villaverde did not omit a single device that could serve his purpose of increasing the revenue in order to meet the irreducible expenditure of the State. He resolutely reformed all existing taxation, as well as the system of assessment and collection, and before he left office he was able to place on record an increase of close upon three millions sterling in the ordinary sources of revenue. His reorganization of the national debt was very complete; in fact, he exacted even more sacrifices from the bondholders than from other taxpayers. The amortization of the home and colonial debts was suppressed, and the redeemable debts of both classes were converted into 4 per cent. internal consols. The interest on all colonial debts ceased to be paid in gold, and was paid only in pesetas, like the rest of the internal debts, and like the external debt held by Spaniards. Alone, the external debt held by foreigners continued to enjoy exemption from taxation, under the agreement made on 28th June 1882 between the Spanish Government and the council of

foreign bondholders, and its coupons were paid in gold. The Cortes authorized the Government to negotiate with the foreign bondholders with a view to cancel that agreement. This, however, they declined to do, only assenting to a conversion of the 4 per cent. external debt into a 3½ per cent. stock redeemable in sixty-one years.

After parting with Villaverde, Silvela met with many difficulties, and had much trouble in maintaining discipline in the heterogeneous ranks of the Conservative party. He had to proclaim not only such important provinces as Barcelona, Valencia, and Bilbao, but even the capital of Spain itself, in order to check a widespread agitation which had assumed formidable proportions under the direction of the chambers of commerce, industry, navigation, and agriculture, combined with about 300 middle-class corporations and associations, and supported by the majority of the guilds and syndicates of taxpayers in Madrid and the large towns. The drastic measures taken by the Government against the National Union of Taxpayers, and against the newspapers which assisted it in advocating resistance to taxation until sweeping and proper retrenchment had been effected in the national expenditure, checked this campaign in favour of reform and retrenchment for a while. It had, nevertheless, stirred public opinion very deeply, and aroused in the middle classes, which are the backbone of a nation, a strong and healthy disposition to revolt. Silvela's position in the country had been much damaged by the very fact of his policy having fallen so much short of what the nation expected in the shape of reform and retrenchment. At the eleventh hour he attempted to retrieve his mistake by vague promises of amendment, chiefly because all the Opposition groups, above all Sagasta and the Liberals, announced their intention of adopting much the same programme as the National Union. On the whole, the 19th century closed in Spain with a visible and promising awakening of forces outside the merely political and official world. The nation, conscious of its vast natural resources, undaunted by its past and recent reverses, and confident of its recuperative power, made no secret of its desire to concentrate its energies at home, and of its determination to exact from its rulers a stricter account of the affairs of the nation. There were also in the depths of Spanish society, in its working classes, in its *bourgeoisie*, and among its intellectual *élite*, many symptoms of a disposition to live henceforth more in touch with the rest of Europe as regards economic, social, scientific, and political progress.

The enthronement of the young King Alphonso on 17th May 1902 helped to clinch this reassertion of Spanish virility and self-confidence. At the opening of the new century, Spain, released from the exhausting obligations of colonial troubles, found the international situation one which promised to restore some of her weight in the councils of Europe. In the Mediterranean and in north-west Africa her influence had great possibilities, and there were obvious signs that more than one Great Power would find the friendship of Spain of almost vital importance. (A. E. H.)

III. Literature.

Unchanged and apparently unchangeable in so many respects—religious, political, and social—Spain has not contrived to escape altogether from the various currents which swept through the general sea of European literature during the last decades of the 19th century. The familiar saying that Africa begins at the Pyrenees finds some slight justification in the older literature of Spain, for it has a force of its own and a peculiar savour which correspond to nothing in the rest of Europe. These qualities, innate to the Spanish genius, were developed by isolation, but the isolation of former times is no longer possible. The acceptance of the Bourbon dynasty involved a certain breaking with the past; intercourse with France has become closer as well as more frequent, and the literary effects of this intellectual commerce are to be seen in the Spanish imitation of French classicism, French romanticism, and French naturalism. It is a question whether Spain has, from the literary point of view, lost or gained by compromising with modern ideas. The aim has been to assimilate the foreign elements and to create, as has been said, "a new literature which should be truly national and no longer a mere echo of that beyond the Pyrenees." It would be an exaggeration to say that this ambition has been realized in any large measure; but, if the attempt has not completely succeeded, it may fairly be urged that a century and a half is but a brief space in literary history, and that Spain is at present less under French influence than she has been. Rivas, Espronceda, Zorrilla, López de Ayala, Tamayo y Baus owe much more to foreign models than does Ramón de Campoamor y Campoosorio, the Nestor of Spanish poets, in whom foreign critics are often tempted to think that they recognize a disciple of Heine. Nothing could be more erroneous, for Campoamor, though he vaguely suggests to cosmopolitan readers something of Heine's condensation and pathos, is continuing in his own semi-philosophic style a national tradition which is of immemorial antiquity—that tradition of expressing lyrical emotion in four or eight lines which finds its most homely, popular manifestation in the innumerable *coplas* collected by Francisco Rodríguez Marín in his five volumes entitled *Cantos populares españoles*. It is true that Campoamor is distinguished for his wit, his grace, his lightness of touch, and for an attention to form which we rarely find in the anonymous *copleros*; but these are not exclusively German possessions, and the analogy with Heine goes no farther. The gay, innocent scepticism of Campoamor hardens into sombre doubt in the poems of Gaspar Núñez de Arce (b. 1834), who is no less a national poet—national in theme, in spirit, and in execution. In his case also foreign readers are frequently at fault and prone to under-estimate the singer. Doubtless Núñez de Arce is not a profoundly original thinker with a prophetic message to deliver; but, with him as with Tennyson, though the sentiment and reflection be often commonplace, the artistry is of irreproachable finish. His most popular and probably his most enduring performance is *Gritos del combate* (1875), a series of impassioned lyrical exhortations to peace uttered during the last civil war, and it is not a little curious to remark an ineffectual politician deserting oratory, finding his true medium, and producing a decided, permanent, political impression with a volume of songs. In a very different key are the unaffected simplicity of his *Idilio* (1878) and the minute observation conspicuous in *La Pesca* (1884), both of which are more valuable than the melodramatic eloquence of *La última lamentación de Lord Byron* (1878), and than the prosodic ingenuity of *La Selva oscura* (1879). Silent during the closing years of the century owing to failing health and to political disappointments, Núñez de Arce found a follower of considerable accomplishment in Emilio Pérez Ferrari (b. 1853), who in *Pedro Abelardo* and in *Dos cetros y dos almas* recalls the dignity, but not the impeccable correctness, of his model. Another pupil in the same school was José Velarde (d. 1892), whose best work has been brought together in his *Voces del Alma*, some numbers of which indicate a dainty and interesting talent. A poet of distinct individuality was Vincent Wenceslao Querol (d. 1889), a mere name to all but vigilant critics like Valera. Querol's busy commercial life did not allow him to improvise at

ease in the exuberant fashion of his race, and, though he suffered for his frugality, he chose the better part in disdaining popular applause. He is represented by a single volume of poems as remarkable for their self-restraint and melody as for a deep tenderness which is admirably phrased in the *Cartas á María*, in the poignant stanzas *Á la muerte de mi hermana Adela*, and in some few Catalan verses. The temptation to sound the pathetic note so beautifully audible in Querol's subdued harmonies proved irresistible to Federico Balart (b. 1831), a critic and humorist of repute who, late in life, astonished and moved the public with a sequence of elegiacs which bear a formal resemblance to *In Memoriam;* but though the fancy and fluency of Balart's *Dolores* are obvious enough to explain its great popularity, its sincerity is doubtful, and in *Horizontes* the unmistakable absence of genuine feeling results in an agreeable but effeminate prettiness. The *Andantes y Allegros*, the *Cromos y acuarelas* of the Andalusian poet, Manuel Reina (b. 1860), together with his dramatic monologue *El dedal de plata* and his *Vida Inquieta*, have a delightful southern effusiveness, charm, and metrical elegance that conceal some monotony of method and frivolity of thought. An older singer, Manuel del Palacio (b. 1840), was believed at one time to have a great future, and, as he combines imagination and mordant wit with signal technical dexterity, the expectation was reasonable; but it must be definitely relinquished, for circumstances have compelled him to write so much and so rapidly that he has frittered away his various talent, and, with the exception of a few humorous sallies and perhaps a dozen sonnets of exquisite workmanship, he will leave no perennial memory behind him. Palacio's sonnets have, as M. Boris de Tannenberg has pointed out, some resemblance to the sonnets of the French Parnassians. This resemblance is a result less deliberate than was the attempt of Joaquín María Bartrina to transplant the pessimistic spirit of Leconte de Lisle to Spanish soil. Bartrina's crude materialism is antipathetic and has made him the object of so many unjust attacks that he barely escaped becoming the fashion for a moment; yet his substance is less censurable than his form, which is wholly wanting in the stately impassibility of his exemplar. The school of religious, doctrinal poetry, which continues the orthodox traditions of Luis de León and St Theresa, counts numerous pupils, and, though none of them has risen to the height of the argument, it would be unjust to omit the name of Luis Ramírez Martínez y Guertero (d. 1874), who, under the pseudonym of Larmig, unites the Christian ideals with a despairing melancholy which finally led him to commit suicide. Among the latest writers, Vicente Medina and Ramon D. Perés have both brought a new note into Spanish poetry. The facility with which verses and rhymes of a kind can be written in Spanish has made the country a nest of singing-birds; but the chief names have been already mentioned, and, at the risk of overlooking some youthful promise, no others need be recorded here.

Drama. Campoamor has written plays which are interesting in the study as expressions of a keen intelligence put into the shape of dialogue, and Núñez de Arce has collaborated with Antonio de Hurtado (1878) in pieces—*Herir en la sombra* and *La jota aragonesa*—that have met with moderate appreciation. His original efforts, *Quien debe paga* and *El Haz de leña*, are brilliant exercises in versification rather than dramatic conceptions. But, as happens with Tennyson, Núñez de Arce in the weakest of his plays remains an authentic poet. The Spanish theatre of the present day can show no name of greater importance than the successor of Tamayo y Baus, José Echegaray y Eizaguirre (b. 1832), a very learned mathematician and apostle of free trade, who failed in politics and turned to the drama in 1874, when *El Libro talonario* was given under an assumed name. Since that date Echegaray has produced at least sixty pieces. It does not appear that he had ever published a line of verse before he was forty; and yet Campoamor, who had often heard Echegaray in the tribune, had not read twenty lines of the new play before he identified Echegaray as the author. This testifies to the author's marked individuality, but it does not imply the faculty of intellectual suppleness which accompanies real dramatic genius. Since 1874 Echegaray has produced plays with almost incredible profusion: romantic pieces such as *La Esposa del vengador* and *En el puño de la espada;* tragedies such as *Cómo empieza y cómo acaba* and *Ó locura ó santidad;* melodramatic dramas such as *El gran galeoto* and countless more; comedies such as *Iris de paz* and *Correr en pos de un ideal;* modern problem-plays such as *El Hijo de Don Juan*, which has been followed by the more successful *Mariana*, by *Mancha que limpia* and by the very recent *El Hombre negro* (1898), *Silencio de muerte* (1899), and *El loco Dios* (1900). There does not exist, indeed, any form of dramatic composition which Echegaray has not attempted during his long career, and his ambition is worthy of all respect. He is an exceedingly clever playwright, skilful in construction, a master of stage effects; he is not embarrassed by pedantic dramatic theories, is open to ideas, and has both imagination and intellectual curiosity. Moreover, he has laid to heart the aphorism of the manager in the prelude to *Faust*, "Die Masse könnt ihr nur durch Masse zwingen." It is as a literary artist that Echegaray fails to satisfy, and it is precisely as a literary artist that posterity will judge him. He does not create character; his verse has but slight variety of cadence and no natural magic; his prose dithyrambs are impartially allotted to all his personages; he is, for a Spaniard, strangely wanting in humour; and, an incurable romantic, he constantly confounds the vast with the sublime. But, numerous as are his failures, he has had the gift of interesting audiences and of moving them to enthusiasm, so that in Spain and out of it he is frequently considered a great dramatist. During the last few years of the century, however, his popularity waned, and one of his latest successes, *María Rosa*, is translated direct from the Catalan of Ángel Guimerá (b. 1847). To Echegaray's school belongs Eugenio Sellés (b. 1844), whose *Nudo gordiano* shows so much finer a poetic talent than that of his chief, that high hopes were conceived which, save in *El cielo ó el suelo*, have not been realized. His prose play, *La Mujer de Loth*, is a powerful dramatic study containing scenes of a refreshing originality which cannot be overlooked. A third author, whose name is habitually associated with the names of Echegaray and Sellés, is Leopoldo Cano y Masas (b. 1844), a colonel on the general staff of the army, a scientific soldier, and a *beau sabreur* in his day. Cano's symbolism and didactic purpose are brought forward too insistently in *La Mariposa* and in *Gloria;* but in *La Pasionaria* the concise dialogue makes it regrettable that an author of such individual endowment should, even for a time, have surrendered his personality to the keeping of Echegaray. Fortunately this influence diminishes as Cano's gifts develop. The *Hermenegildo* of Francisco Sánchez de Castro (d. 1878) is a most scholarly effort to modernize the methods of Lope de Vega, Tirso de Molina, and Calderón: it is no reflection on Sánchez de Castro to say that his cause is irremediably lost, and that the most minute scholarship in the world is impotent to vivify the traditional drama of the 17th century. Among the many authors of high or low comedies and farces it is only necessary to name Miguel Echegaray y Eizaguirre (b.

1848), whose cleverness is indisputable and whose buoyant humour is in quaint contrast with his elder brother's sepulchral gloom; while among the hopes of the future are Vital Aza (b. 1844), Ricardo de la Vega (b. 1858), Jacinto Benavente (b. 1866), Serafín Alvarez Quintero (b. 1871) and his brother Joaquín (b. 1873)—all of whom excel in witty fancy.

Romance. In *libros de entretenimiento* Spain has always been rich, and during little more than a single century she conferred upon Europe a succession of masterpieces—the *Celestina*, *Amadís de Gaula*, *Lazarillo de Tormes*, *Guzmán de Alfarache* and *Don Quixote*. There is nothing to match that series in modern times, but since 1850 there has been a notable renascence of the Spanish novel. The *Gaviota* of Fernán Caballero (d. 1877) is a fascinating, truthful picture of Andalusian village life in the first half of the 19th century, and it happens to be exempt from the sermonizing and the tearful sensibility which make many of her latest books insufferably tedious. Yet, though the *Gaviota* has marked limitations, and though Fernán Caballero expended years in composing inferior variations upon her first performance, she is entitled to a most honourable place in literary history, inasmuch as in her own modest, feminine, intuitive way she helped to revive the native realism which had been neglected during the supremacy of romanticism. In all that concerns truth, conscience, and art she is at least much superior to the once popular Manuel Fernández y González (d. 1888). It has been said that Spain should erect a statue to him and should burn his novels at the foot of it; and the saying has much point. Fernández y González is often called the Spanish Dumas, and he equals, if he does not excel, the French author in fecundity, in invention, and resource. Some of his tales—for example, *El Cocinero de su Majestad*, *Los Minfíes de las Alpujarras*, and *Martín Gil*—are written with an irresistible verve which time does not stale; but poverty drove him into becoming a mere literary hack, into working upon two or three books at a time, and into piling one absurdity upon another till at last his puerilities became intolerable. A writer who was once universally read, and who is still esteemed in his native province of Biscay, is Antonio de Trueba (d. 1889). He followed Fernán Caballero in observing local customs and in poetizing them with a delicate sentimental grace which attracted local patriots and uncritical readers everywhere. Beginning with the *Cuentos de color de rosa* and the *Cuentos campesinos*, Trueba wrote incessantly till the last months of his life. He had no gift of delineating character, and he neglected to provide himself with plots; still he has passages of vivid landscape, and it is to his credit that, except in *Las Hijas del Cid* (a feeble imitation of Sir Walter Scott), he copies nobody, but goes independently on the road of incorrigible optimism. His contemporary Pedro Antonio de Alarcón is responsible for *El Sombrero de tres picos*, a peculiarly Spanish piece of picaresque malice which its author never quite succeeded in reproducing, often as he attempted it. Unluckily, Alarcón was led away into the region of the half-political, half-religious, entirely controversial novel, and lost a great part of the reputation which his brilliant miniature had won him: he was clearly intended to work on a small scale, and on a small scale he is a keen, swift, mischievous observer. Neither Trueba nor Alarcón could ever, under any circumstances, have developed into great artists; the first is too sentimental, the second is too rhetorical (save in his one most excellent tale), and both are too careless and haphazard. Trueba marred his chances by idealizing country life into a pale idyll of Arcadia, and he frowned upon one of his neighbours who preferred realism to pastoralism. The northerner, José María de Pereda, is the parent of the actual, authentic, naturalistic Spanish novel, and the boldness of his experiment startled, if it did not shock, a generation of readers accustomed to Trueba's rather oily conventionalism. Moreover, the very fact that Pereda was the partisan of a lost political cause, and that he was believed, not without reason, to advocate reaction in many forms, told heavily against him at a time when Liberal ideas and a vague expectation of the millennium were in the air. But the power which stamps his *Escenas montañesas* was at once appreciated in the northern provinces, and, though the Madrid critics were slow of conversion, a series of great books following closely one upon the other at last compelled them to admit that their first judgment was mistaken. So long as Pereda deals with country folk, with sailors, with the aspects of land and sea, he is incomparably excellent, for he sympathizes with the poor, understands them, and hits upon the true mean between conventional portraiture and degrading caricature. His hand is less certain when his sitters are of the city type, and his hatred and contempt for towns and townsmen often trouble his vision: it is a mistake to class him, however, as a mere provincial sea and landscape painter, for he is a creator of character, of individuals and of types, and in the common vulgar things of life his art is continually revealing points of novelty. Much as Dickens is pitted against Thackeray in England, Pereda is continually pitted against Juan Valera y Alcalá Galiano in Spain, and in both cases the opposition or comparison seems somewhat unprofitable and even unnecessary. The systems, aims, ideals, and temperaments of the two great Spanish novelists are absolutely unlike. Pereda is realistic and he is real. Valera is not, in the restricted sense of the word, realistic; but he is not a whit less real in his own different and much wider province, while though he has neither Pereda's sturdy energy nor his intense austerity of purpose, he has a far finer, more infallible taste and tact, a wider experience of men and women, and his gracious pagan raillery is as effective a moral commentary on the characters as is his rival's inflexible Christian pessimism. The most popular of Valera's novels are *Pepita Jiménez* and *Doña Luz*, and with Pereda's *Sotileza* we have a trio of Spanish women who deserve all their fame; but Valera's wit, subtlety, and charm of style are equally conspicuous and perhaps more mature in his shorter stories—in *Genio y Figura* and in *Morsamor*. Pereda's is the more vigorous, full-blooded talent, as Valera's is the more enchanting and patrician, yet both of them are essentially native in the quality of their genius, phrasing, and system. At a later date, when the wave of French "naturalism" reached Spain, there arose a school of naturalists who forsook the good example of Pereda and Valera, and followed the Gallican fashion much too closely; but before the time of that school came, the right Spanish tradition was taken up by Benito Pérez Galdós (b. 1845), who, after publishing two novels entitled *El Audaz* and *La Fontana de oro* in 1871–72, gave a new life to the politico-historical novel in a double series of romances—the *Episodios nacionales*, thirty volumes covering the period of history between the battle of Trafalgar and the death of Ferdinand VII. The name of the Spanish series may have been suggested by the *Romans nationaux* of Erckmann-Chatrian, but with the name all resemblance ceases. The colouring of the *Episodios nacionales* is so brilliant, their incident is so varied and full of interest, their spirit is so manful and stirring, that it is difficult for a born Spaniard to examine them in the cold light of criticism: he is reluctant to admit their frequent prolixity, their sweeping digressions, their insistence on minute details, their loose construction, their uneven style. The fact that a volume of the *Episodios nacionales* appeared punctually every quarter for

many years is an explanation of these weaknesses, but, taken as a whole, the *Episodios* are a great achievement which has so completely succeeded that the author felt justified in undertaking a third series. On the other hand, there is no such unanimous approbation of the politico-religious novels—*Doña Perfecta*, *Gloria*, and *León Roch*—written by Pérez Galdós between 1876 and 1878: these are discussed from a purely political point of view, praised by Liberals and censured by Conservatives, both of whom are more concerned with the thesis than with the writer's art. In these three remarkable books, Pérez Galdós proves that he can create character and that he can subordinate his polemics to a higher, more exquisite purpose: the point may be emphasized, for Pérez Galdós is frequently wanting in tact, as when in his prose play *La de San Quintín*—which is simply a novel in dialogue—he marries a duchess to the conventional virtuous workman. The quick response which Pérez Galdós gives to external stimulus of any kind, his sensitiveness to every change in the literary atmosphere, made it inevitable that he should come under the influence of French naturalism, as he does in *Lo prohibido* and in *Realidad;* but his conversion was temporary, and he recovered his individuality in two forcible romances of contemporary social life—*Fortunata y Jacinta* and *Angel Guerra*—which mark the third stage in the development of an impressionable talent. The latest leader of the naturalistic school in Spain is Armando Palacio Valdés (b. 1853), whose precise vision of the visible world and whose faculty of artistic selection were first shown in his novel *El Señorito Octavio*. The surprising advance made in *Marta y María* and in *La Hermana San Sulpicio*, where the characters are seen, observed, understood, and rendered with unflinching fidelity, raised hopes that, in Palacio Valdés, Spain has discovered a novelist of the first order to succeed Pereda and Valera; but in *La Espuma* and in *La Fe*, two social studies which caused all the more sensation that they were said to include portraits of well-known personages, the author followed the French lead too closely, and almost ceased to be national without becoming cosmopolitan. His latest work, *La Alegría del Capitán Ribot* (1899), shows that Palacio Valdés has recognized his danger, for herein he returns to his first and better manner of direct observation in a humbler sphere of society. Another novelist who for a time almost divided honours with Palacio Valdés as a naturalistic writer, is the Señora Quiroga (b. 1851), who published under her maiden name of Emilia Pardo Bazán. Her great energy, courage, and versatility have led her to found a journal of literary criticism which she calls the *Nuevo teatro crítico* in memory of her countryman, the Galician Feijóo. Here she undertakes single-handed to review the literature of Europe, and, sitting constantly at the receipt of custom, she is naturally familiar with the main currents of literary developments. But she was a novelist long before she became a critic, and her *Pascual López*, the autobiography of a student of medicine, is a simple tale which might have been written thirty years earlier, and gives no hint of the constructive power, the outspoken reality of *Los Pazos de Ulloa*, nor of the emphatic animalism of *La Madre Naturaleza*. The strong, frank, repellent pictures of country people abandoning themselves to their primitive instincts are set off by very graphic descriptions of landscape; but the censures passed upon the painful theme of *La Madre Naturaleza* may have alarmed the writer, and induced her to choose a less objectionable subject in *Una cristiana*. Here, as in later works, there is a diminution of interest and truth, but the style of Emilia Pardo Bazán is constantly happy, and the unquenchable local patriotism which inspires *Insolación*, *Morriña*, and *De mi tierra* secures her a high place in literature as a collector of "documents." Leopoldo Alas (1851–1901), who used the pseudonym of "Clarín," is better known as a critic than as a writer of romances; yet one of his novels, *La Regenta*, is certain to live as an original psychological study of the relation between spurious mysticism and illicit passion. The author, who has made many enemies as a candid literary critic, has perhaps allowed himself to be discouraged by their violent attacks, and his later stories are few in number and slighter in value. Jacinto Octavio Picón (b. 1852), who has deserted novel-writing for literary and art criticism, has displayed much insight and finesse in *Lázaro*, the story of a priest who finds himself compelled to lay down his orders; in *Juan Vulgar*, in some measure the Spanish equivalent of *Bouvard et Pécuchet;* in *El Enemigo*, a spirited exposure of clerical tyranny; and in *Dulce y sabrosa*, which has been vehemently denounced by the orthodox party. With these domestic quarrels and with the general thesis maintained by Picón, foreign readers have no concern; they may, however, join with all impartial critics in admiring the author's power of awakening sympathy and interest, his minute analysis of emotion, and the sustained beauty of his style. The suspicion of heterodoxy and something more than the suspicion of dealing with risky subjects attach to Palacio Valdés, Emilia Pardo Bazán, Alas, and Picón. Neither charge can be brought against Manuel Polo y Peyrolón, who has written indefatigably on all manner of subjects, but whose charming story, *La tía Levítico*, is a captivating and finished performance much more likely to survive than the *Pequeñeces* of the Jesuit Luis Coloma (b. 1851), a caricaturist of society foibles, who came into notoriety with that *roman à clef*. Coloma's health has broken down, and he has apparently no intention of trying to repeat his ephemeral triumph. Two young writers of the richest promise died prematurely: Ángel Ganivet (d. 1898), the author of a semi-philosophical romance, *Los Trabajos del infatigable creador Pío Cid*, a book rich in ideas and felicitous in expression, though lacking in narrative interest; and Juan Ochoa (d. 1899), whose two short stories, *El amado discípulo* and *Un alma de Dios*, are of the highest order. Ochoa is indeed a born teller of stories, and *Un alma de Dios* is a treasure of sympathetic observation. Ganivet's is the finer, more cultivated intelligence: but he appears to have used the novel without any real vocation, as a convenient vehicle for transcendental ideas which would have attracted less attention in any other form. Among the younger novelists may be mentioned Ricardo Macías Picavea (d. 1899), author of *La Tierra de Campos*, and Vicente Blasco Ibáñez, whose *Flor de Mayo* and *Arroz y Tartana* are acute and truthful pieces of impressionism.

History and criticism.

No new Mariana is discernible among the numerous students who have applied themselves to the study of history. Modesto de Lafuente's work, useful as it is in default of anything better, is now obsolete, and the opportunity for an author capable of writing history in the modern sense is a great one; but the tendency of Spanish historical students is rather in the direction of collecting the raw material of history than in the writing of it. Antonio Cánovas del Castillo (d. 1897) had an exact and wide knowledge of the period concerning which he wrote, and his *Ensayo sobre la Casa de Austria en España* is ample in information and impartial in judgment; but his devotion to politics absorbed him, and possibly deprived literature of a great historical work. Aureliano Fernández-Guerra y Orbe, a many-sided scholar who did good service in other fields, collaborated with a younger and more brilliant man, Eduardo de Hinojosa, in the *Historia de los Visigodos*, which illuminates an obscure

but important period. The veteran Francisco Cárdenas, in his *Historia de la propriedad territorial en España*, and in his studies on the history of Spanish law, has done for Spain much that Maine did for England. Hinojosa's histories of Roman and Spanish law are authoritative in substance and elegant in manner; Eduardo Pérez Pujol's *Historia de las instituciones de la España goda* supplements the work of Fernández-Guerra and Hinojosa; the Jesuit Fidel Fita y Colomé is an accomplished epigraphist, whose name justly ranks with that of Emil Hübner; Joaquin Costa's *Estudios ibéricos* has been acclaimed by experts for its extraordinary learning, but his *Poesia popular española y Mitologiá y Literatura celto-hispanas*, a brilliant effort to reconstitute literary history, is of more general interest. The monographs of Francisco Fernández y González, Marcos Jiménez de la Espada, Julián Ribera, Manuel Colmeiro, José Pella, Gumersindo Azcárate, Cesareo Fernández Duro, and many others are valuable contributions to the still unwritten history of Spain. A most useful beginning, on the lines of John Richard Green, has been made by Rafael Altamira y Crevea (b. 1866). Literary criticism in Spain is too often inspired by intolerant party spirit which judges authors according to their political labels, and, as most Spaniards are party men, the result is extremely depressing. Antonio Valbuena, a humorist of great gifts, finds it difficult to do justice to any writer who is an academician, an American, or a Liberal; Leopoldo Alas was scarcely less severe in criticizing reactionaries, but his intention was always good, and his wide culture and insight were of inestimable worth. Emilia Pardo Bazán is encyclopædic, and resents any departure from the literary standards of Castelar to which she professes, though she does not practise, an adherence. Pascual de Gayangos y Arce (d. 1897) and Manuel Milá y Fontanals (d. 1884) escaped from these petty quarrellings by confining themselves to the historical criticism of the literature of the past; and Marcelino Menéndez y Pelayo (b. 1858) has gained a European reputation in the same province. He has passed from the narrow view of *La Ciencia Española* to the luminous catholic tolerance which is expressed in his *Historia de las ideas estéticas en España*, a work which is still unfinished, though its first volume appeared many years ago. Ramon Menéndez Pidal, a pupil of Menéndez y Pelayo, has already produced in *La Leyenda de los Infantes de Lara* a distinguished piece of reconstructive criticism which has extorted the admiration of eminent experts like M. Gaston Paris and M. Alfred Morel-Fatio. A third scholar whose research and accuracy gained him a chair in the Academy at an early age is Emilio Cotarelo, whose monographs on Enrique de Villena, Villamediana, and Ramón de la Cruz are models in their kind.

AUTHORITIES.—The *Histoire de la littérature contemporaine en Espagne* (Paris, 1876), by M. GUSTAVE HUBBARD is now practically obsolete. An Augustinian monk, FRANCISCO BLANCO GARCÍA, has published *La Literatura española en el siglo xix.* (Madrid, 1891–96), which should be used with caution, as the writer is swayed by party spirit. The various volumes of literary criticism by LEOPOLDO ALAS may be consulted with profit, and the preface to the first volume of JUAN VALERA's *Florilegio de poesías castellanos del siglo xix.* (Madrid, 1901–02) abounds in acute, if indulgent, criticism. M. BORIS DE TANNENBERG's *La poésie castillane contemporaine* (Paris, 1889) is a slight but interesting survey. (J. F.-K.)

Spalato, a city of the Austrian province of Dalmatia, 200 miles south-east of Trieste, over against (north from) the island of Brazza. Population of the town proper (1890), 15,697, and of the commune, 22,752; (1900), 27,198, chiefly Serbo-Croatian and almost exclusively Catholic (about 9 per cent. Italians). The harbour has been extended and improved by a dam completed in 1882. It is a station of the Austrian Lloyd, and has the largest trade of any Dalmatian town. The number of ships entering and departing annually is over 7500, with a total tonnage of about 1,355,000.

Spandau, a town of Prussia, at the confluence of the Spree and the Havel, 7½ miles west by north of Berlin by rail. The town has 4 Protestant churches, a Catholic church, a gymnasium, a higher-grade, a girls', and a boys' school, and a school for musketry. The Red Tower (Juliusthurm) still contains the war chest of £6,000,000, reserved for military purposes from the indemnity paid by France after the war of 1870–71. The town has of recent years made marked progress, its trade being enhanced by an excellent railway service with Berlin and improved navigation on the Havel. There is a monument (1889) to Elector Joachim II., and another (1892) to the Emperor Frederick III. Population (1885), 31,463; (1895), 55,813; (1900), 65,014.

Spanish-American War.—By the end of 1897 the insurrection which had existed in Cuba for three years had, according to the report to his Government of Mr Fitzhugh Lee, the United States consul-general, brought matters to an *impasse*, in which, while the insurgents were powerless to eject the Spanish forces from the island, the authorities were equally helpless to put down the rebellion. A decree, known as the order of reconcentration, promulgated by Captain-General Weyler in the early part of 1897, had caused, wherever the Spanish authority prevailed, the assembling of all the country people within the limits of the Spanish posts. The consequence, through the inability of the Spanish authorities to support such a multitude, was terrible distress and famine, with the final result of an appalling loss of life. Consul-General Lee cites as an instance of this mortality that of the town of Santa Clara, the capital of Santa Clara province, where in January 1897 the deaths were 78; the order of reconcentration went into effect in February, and the deaths rose to 1037 in November and to 1011 in December. There were in this place, of a normal population of 14,000 inhabitants, 6981 deaths during this year, chiefly of people who had been driven in from the surrounding districts. The insurgents had pursued a steady policy of destruction of property, as had the Spaniards one of destruction of life, and the only outcome in existing circumstances was the complete ruin of all social organization. The 12th and 13th January 1898 had been marked by serious military riots in Havana, due to the opposition of the Spaniards, both in the army and in civil life, to the new Governor-General Blanco, who came as a pacificator and with the intention of putting into effect the law signed in November 1897 by the queen-regent, establishing a system of autonomy. This was strongly opposed by the Spanish residents, the army, and by the Cubans themselves. In view of the danger to American citizens on account of the riotous state of Havana, the battleship *Maine* was sent there by the United States Government, 25th January. Her presence gave great offence to the Spaniards and Spanish sympathizers, and when on 15th February the ship was destroyed by an explosion, feeling naturally arose to a warlike pitch in the United States, it being generally believed that the explosion was due to Spanish action. A board of inquiry was ordered by the United States Navy Department, of which Captain W. T. Sampson was president. After sitting more than a month, and making an extensive examination of the character of the wreck and the circumstances attending the explosion, the board decided that it was caused by an exterior mine. A chief basis of this finding was the extraordinary upheaval of the ship's

Causes of the war.

bottom, which was lifted 34 feet at the point of greatest damage, above its normal position. The Spanish authorities also made an examination, but did not inspect the interior, the chief diver reporting that "the bilge and keel of the vessel throughout its entire extent were buried in the mud, but did not appear to have suffered any damage," a statement wholly contrary to the significant fact of the upheaval mentioned. The destruction of the *Maine* brought home to the mass of the American people the state of things in Cuba; and the intensity of sympathy aroused for the suffering there, combined with the general belief in the cause of the destruction of the *Maine*, finally led to an ultimatum signed by President McKinley, 20th April 1898, demanding the withdrawal of Spain from Cuba. Before this could be delivered by the American minister in Madrid, the Spanish Government sent him his passports on the following day. War was formally declared by Congress, 25th April, to have existed since the 21st.

Rival forces. The American Government had taken precautions as early as January, looking to possible hostilities, and had telegraphed to the naval commanders-in-chief abroad to hold time-expired men. Ships on several foreign stations had been drawn nearer home, and those in China were collected at Hong Kong. The North Atlantic squadron, the only powerful one, had been sent into the waters of Florida for manœuvres, after being held north at Hampton Roads for two years, owing to Spanish susceptibilities. After the destruction of the *Maine* the chief part of the ships in the Atlantic were concentrated at Key West; the battleship *Oregon* was ordered east from the Pacific; fifty million dollars were voted for national defence, and steps were taken to purchase auxiliary cruisers, yachts, and tugs, which were rapidly equipped. Large supplies of ammunition were ordered, and Key West became an active base of preparation. Captain Sampson, the senior officer of the North Atlantic squadron on the retirement (26th March 1898) from ill-health of Rear-Admiral Sicard, was appointed its commander-in-chief. A flying squadron composed of the armoured cruiser *Brooklyn* (flag), the battleships *Texas* and *Massachusetts*, and the fast cruisers *Minneapolis* and *Columbia*, with Commodore Schley in command, was stationed at Hampton Roads.

The following table shows the relative naval strength of the two Powers :—

	United States.		Spain.	
	Nominal.	Effective.	Nominal.	Effective.
Armoured ships .	13	13	9	4
	4 First-class battleships. 1 Second-class battleship. 2 Armoured cruisers. 6 Double-turreted monitors.		1 First-class battleship. 2 Old ironclads (done over). 6 Armoured cruisers.	
Protected cruisers .	13	8	5	4
	from 3000 to 7375 tons.		from 1045 to 4826 tons.	
Unprotected cruisers and gunboats .	21	20	9	5
	from 839 to 2089 tons.		2 of 3900 tons (old), others under 1200 tons.	
Torpedo gun vessels .	1	1	11	10
Torpedo destroyers .	0	0	6	6
Torpedo-boats . .	6	6	12	3
Small gunboats .	0	0	84	?
			from armed launches of 40 tons to gunboats of 525 tons; all but 20 were under 200 tons.	

There were excellent judges who thought the United States, after the destruction of the *Maine*, was overmatched. Spain's four armoured cruisers were fine ships of great speed, against which the United States had only two. Spain's apparent show of ten torpedo-boat destroyers against her antagonist's none was also a formidable factor to be considered. But all this was largely nominal. As we now know from documents published by Admiral Cervera, by permission of his Government, everything was unready, and the admiral expostulated in the strongest terms against attempting war, saying that Cuba was lost in any case, and that sending a squadron across the Atlantic was only to send it to destruction. Three torpedo-boats and three torpedo-boat destroyers had been started from Cadiz, 8th March, for the West Indies, under convoy of a transport, but two of the torpedo-boats had broken down after leaving the Canaries, and all had to put into the Cape Verde Islands. Cervera joined them there on 14th April, with the *Maria Teresa* and *Cristobal Colon*, and on the 19th came the *Vizcaya* and *Almirante Oquendo* from Havana. Cervera renewed his expostulations, being backed by a council of war which was of one view with himself.

On 24th April, after a consultation of all the senior officers of the navy then in Madrid, Admiral Cervera was peremptorily ordered to leave for Porto Rico, without any definite instructions or plan of campaign. The discussion at the consultation referred to and Cervera's correspondence reveal the state of Spain, which was in urgent need of money, lacked resources of every description, and, above all things, was deficient in sound judgment in her administration.

On the outbreak of hostilities, 21st April, Captain Sampson was appointed a rear-admiral, under a law enabling the President to select any one of command grade in time of war to command a squadron; with this rank he became the ranking officer in the Atlantic. Sampson left Key West early on the morning of the 22nd, and at once began the blockade of Havana and the north coast as far as Cardenas, eighty miles east, and Bahia Honda, fifty miles west. He had at that time twenty-eight vessels of all kinds, of which the armoured cruiser *New York* (flag), the battleships *Iowa* and *Indiana*, and the monitors *Puritan*, *Terror*, and *Amphitrite*, were the most important. He had six torpedo-boats. This squadron was increased to 124 vessels by 1st July, chiefly, however, by the addition of extemporized cruisers, converted yachts, armed tugs, &c.

The flying squadron was held at Hampton Roads, partially to allay popular alarm along the coast as to the attack by Spanish ships, partially on account of the real, though somewhat remote, danger of such action. Armed auxiliaries and fast cruisers were employed patrolling the coast east of New York, which could have rendered good service elsewhere, but would have been of no use in repelling an attack by Cervera's squadron had it come that way. Popular feeling, however, was too strong to be ignored.

The joint resolution of Congress of 20th April stated the relinquishment by Spain of authority in Cuba as the object of American action; the struggle thus naturally centred about the island. Further, such action gave the United States a great advantage in the fact that all operations were near at hand, the real objective in Cuba, Havana, being but eighty miles distant from her excellent base, Key West. There was also a political reason for confining action to the western Atlantic: continental European sympathy was strongly pro-Spanish, and an immediate attack upon the coasts of Spain might have aroused this into much greater activity. It was, of course, expected that an American army would be landed in Cuba, and for this purpose the whole of the regular force—the only available one until war should be declared and a volunteer force authorized—was brought to Tampa, New Orleans, and Chickamauga; but wisdom demanded that so long as the control of the sea was undecided, the army should not be moved across the strait. Cervera's fleet was thus the real objective of the navy, and had to be settled with before any action could be definitely arranged.

Dewey's squadron—the *Olympia* (flagship), protected cruisers *Baltimore*, *Raleigh*, *Boston*, small unprotected cruiser *Concord*, gunboat *Petrel*, armed revenue cutter *M'Culloch*, with a purchased collier *Nanshan*, and a purchased supply ship *Zafiro*—left Hong Kong, on account of the outbreak of hostilities at the request of the governor, and went to Mirs Bay, some miles east on the Chinese coast. Receiving a telegram at Hong Kong on the 25th, to commence operations, particularly against the Spanish fleet, which he was directed to capture or destroy, he left Mirs Bay 27th April, and arrived off Luzon 30th April, having ordered two ships during the afternoon to look

into Subig Bay for the Spanish squadron. The Spanish admiral Montojo had gone with the *Reina Christina*, *Castilla*, *Don Juan de Austria*, *Isla de Cuba*, *Isla de Luzon*, and *Marques del Duero* from Manila to Subig on the 27th, but had returned on the 29th, not finding the guns mounted there which he expected—an ignorance which in itself is a curious commentary on the conduct of Spanish affairs. He anchored in Cañacao Bay, to the eastward of the spit on which are the village and arsenal of Cavite, in a general east and west line, and kept his broadside to the northward. His force consisted of the ships just mentioned, of which the *Castilla* (an old wooden steamer) had to be towed; the *Isla de Cuba* and *Isla de Luzon* were protected cruisers of 1050 tons, the *Don Juan de Austria*, a gunboat of 1152 tons, and the *Marques del Duero*, of 500 tons. The *Don Antonio de Ulloa*, similar to the *Don Juan de Austria*, was added; two of the guns of the *Ulloa* are stated to have been ashore. The gunboats *Velasco* and *General Lezo* were in Bacoor Roads undergoing repair. The *Elcano* also seems not to have been in action. There were six guns in battery at or near Cavite, of which two were 5·87″ and one 4·7″ breech-loaders (from the *Ulloa*), and three 6·3″ muzzle-loaders. Only one of the 5·87″ breech-loaders seems to have looked northwards, and two of the 6·3″ muzzle-loaders. At Manila and the suburb, Ermita, there were thirty-six guns, of which four were effective 9·45″ breech-loaders, and eight breech-loaders converted from 4·4″ to 5·87″, but all, except those at Cavite, were from 4 to 5 miles from the field of action.

Action of Manila.

Dewey stood on during the night, and passed into the Boca Grande, which is 5 miles broad, but with a large rock, El Fraile, 1½ mile from the south side. He naturally paid no attention to rumours of torpedoes in a channel so broad and deep, and at midnight passed El Fraile, on which was a battery of three 4·7″ breech-loader guns, landed from the ships under repair. Two shots were fired at him, which did no damage. He headed for Manila, 20 miles away, timing his speed to arrive at daybreak: he was fired at by the Cavite and one of the city batteries. Sighting the Spanish squadron to the southward, he ordered his transports and the revenue cutter *M'Culloch* out into the bay, and stood down in column, the *Olympia* leading, followed, with 400-yard intervals, by the *Baltimore*, *Raleigh*, *Petrel*, *Concord*, and *Boston*. When within 5000 yards he ported his helm, and at 5.41 A.M. opened fire. He stood westwards along the Spanish line, using his port batteries, turned to starboard and stood back, gradually decreasing his distance from 5000 to 2000 yards. He passed three times to the westward and twice to the eastward. At seven the Spanish flagship made an ineffectual effort to come out and engage at short range, but was overwhelmed by the American fire and driven back. The Spanish squadron was now in very bad plight, but the seriousness of its condition was not as yet fully known to the American commander, though it was evident that it was in difficulties. At 7.35 ammunition being mistakenly reported short, Dewey withdrew, gave his men breakfast, and had a consultation of commanding officers. Being reassured as to the ammunition, he re-engaged at 11.16. The *Cristina* and *Castilla* in the meantime had broken into flames, so that the remainder of the action consisted in silencing the Cavite batteries and completing the destruction and demoralization of the smaller Spanish ships. The *Petrel* was ordered to send in and burn those still afloat.

The victory was complete. All the Spanish ships were sunk or destroyed, though three of the best were raised later, repaired, and added to the American navy list. In the interval between the two parts of the action Dewey sent word to the governor of Manila that the city batteries which kept up a useless firing must cease, or he would shell the city. They thereupon ceased, and did not reopen.

Though there was a marked disparity between the two squadrons in force, it was not such as in any wise to account for the great disparity of injury. There were on the Spanish side sixty-nine guns, from 3-pounders to 6·2″, and on the American side eighty-nine, from 3-pounders to 8″. The injury done the American ships was practically *nil*. The Spanish lost 167 killed and 214 wounded, out of a total in their crews of 1875. The Americans had 7 slightly wounded out of 1748 men in action. Admiral Montojo has been criticized for not placing his ships under the protection of the Manila batteries. He would, however, have had to lie so far off shore on account of shallow water, that these guns could not have afforded him any aid, and the result must have been the same. Dewey took possession of Cavite, parolled its garrison, and awaited the arrival of a land force to capture Manila.

Havana.

The blockade of Havana had progressed without incident, beyond the capture of a number of Spanish steamers and sailing vessels, and the shelling of some new earthworks at Matanzas, 27th April; but on 11th May an attack at Cardenas upon three Spanish gunboats, supported by a shore battery, was made by the torpedo-boat *Winslow* and the revenue cutter *Hudson*, which was repulsed with the loss of an officer and four men killed, an officer and four men wounded, and severe injury to the torpedo-boat. The *Hudson* most gallantly, under a severe fire of half-an-hour, succeeded in towing the torpedo-boat out of range. Two large American gunboats were near by, but could not come into action on account of the shallow water. The same day the *Marblehead* and *Nashville* sent in four launches, with fifty-five men, to cut the telegraph cable leading from Cienfuegos. The crews of the boats did their work under a heavy fire, cutting two cables, but failing, on account of the heavy fire at only 200 yards range, to cut a third which had been grappled. The men worked with greatest gallantry, but the boats had to retire with four men killed or mortally wounded, and an officer and five others hurt less seriously. The ships mentioned, aided by the revenue cutter *Windom*, during this time shelled the Spanish position, with serious loss to the Spaniards, the action lasting some three hours.

Spanish movement across the Atlantic.

Cervera had left the Cape Verde Islands, 29th April, with four armoured cruisers, *Infanta Maria Teresa* (flagship), *Almirante Oquendo*, *Vizcaya*, and *Cristobal Colon*, and three torpedo-boat destroyers, *Furor*, *Terror*, and *Pluton*. On hearing, 1st May, of his departure Sampson went east a thousand miles to San Juan, Porto Rico, with the *New York*, *Iowa*, *Indiana*, monitors *Puritan*, *Terror*, and *Amphitrite*, cruisers *Montgomery* and *Detroit*, and one torpedo-boat. He had also with him a collier. He left the monitors *Puritan* and *Amphitrite* off Havana, with several cruisers, five torpedo-boats, and a number of smaller craft. In going east he calculated on using a speed of 10 knots, which, if the Spaniards crossed the Atlantic at an economical speed, would enable him to reach San Juan about the time they would reach its longitude, and if they were not there, return off Havana before they could do so. If they used a speed as high as 12 knots they would certainly have to coal before reaching Havana, and the delay in so doing would also enable him to get back before their arrival. It was of very great moment that Cervera should not be able to refit at San Juan. Should he arrive there with the American squadron still at Havana, coal and get to sea, the American coast would be within easy reach, New York being only about 1400 miles away. Sampson thus felt very strongly the possibilities of the Spanish squadron using San Juan as a base for a raid against the United States coast, a move which might have serious moral and international consequences.

But the speed of the American squadron fell far short of the admiral's expectation, and he did not reach San Juan until the 12th, instead of upon the 8th as he expected. The monitors gave out continually, having to be towed a large part of the time; and the *Indiana* injured her boilers through want of fresh water. Sampson arrived off San Juan early in the morning of the 12th, and at once stood in to see if Cervera was in the harbour, and in doing so opened fire upon the fortifications. It soon became evident that Cervera was not present, but the attack was continued with the object of reducing the place, if it might be done with little effort, and thus preventing its occupation later by the enemy's squadrons. The two monitors which so seriously hampered the squadron's movements, and the large auxiliary cruiser known to be in the vicinity, could have been left in temporary effective charge. Sampson made three turns with his ships in front of the town, but the firing produced no great effect on account of the heavy rolling sea. His fire was vigorously returned without any material injury to the ships, and with the killing of one man and the wounding of seven on the American side. Sampson was of the opinion that there would be no real difficulty in reducing the place; but Cervera's squadron, the real objective, was not there, and it was thus necessary to return at once to cover the entrance to Havana. He thus at once started back for Havana with no news of the Spaniards, who at the moment were off Martinique, with specific orders to go to San Juan, but were diverted from their course, by the news received of Sampson's presence there, to Curaçoa, where they arrived 14th May, having left the broken-down torpedo-boat destroyer *Terror* at Martinique. Had Sampson been two days later in arriving at San Juan he would have found the Spanish squadron, and the decisive battle would have been fought there instead of at Santiago. Cervera was allowed by the Curaçoa authorities to receive 600 tons of coal for the *Maria Teresa* and *Vizcaya*, which each needed 700. He coaled the *Furor* from the *Colon*, and left on the evening of the 15th for Santiago de Cuba, which he reached early on the 19th, not sighted *en route* by any of the American scouts, though several were in the vicinity. Sampson stood slowly westwards owing to conflicting reports of the Spanish squadron's return to Spain, a basis for which existed, in that a telegram not received by Cervera had been sent, 12th May, from the Minister of Marine to Martinique, authorizing his return. In the uncertainty, and determined, in case the Spanish squadron had returned, to go back and take San Juan, Sampson stopped until he could communicate at Puerto Plata San Domingo by the torpedo-boat *Porter*, which brought the true state of the case on the night of the 15th, and also a telegram from the United States Navy Department directing him to proceed with all despatch to Key West, where the flying squadron was also ordered. Of the large and swift auxiliary cruisers, the *Harvard* was at Martinique, the *St Paul* directed to cruise between Jamaica and Hayti, the *Yale* at St Thomas. The fast cruisers *Minneapolis* and *Columbia* were also sent south as scouts. The *St Louis* joined the admiral on the morning of the 15th, and was sent to cut cables at Santiago and on the south side of Porto Rico. All but one of the weak squadron off Cienfuegos were ordered by the Navy Department to return to Key West. The *Marblehead*, *Nashville*, and *Eagle* were thus withdrawn.

Movements of Admiral Sampson.

Sampson reached Key West on the afternoon of the 18th, and found the flying squadron and the *St Paul* in port. The *St Paul* left the same evening on the duty assigned her, and the flying squadron —*Brooklyn* (flag), *Massachusetts*, *Texas*, and *Scorpion*—next morning (19th) for Cienfuegos, which was regarded at the moment by the Navy Department as the certain objective of the Spanish squadron. The battleship *Iowa*, the gunboat *Castine*, the torpedo-boat *Dupont*, and the collier *Merrimac* sailed to join them on the 20th, thus giving Commodore Schley a force ample enough to meet Cervera. On the same day Sampson received a telegram from the Department that a "report of the Spanish fleet being at Santiago might very well be correct, so the Department strongly advises that you send by the *Iowa* to Schley to proceed off Santiago de Cuba with his whole command, leaving one small vessel off Cienfuegos." Sampson, however, determined to hold Schley at Cienfuegos until more fully assured, but being satisfied during the same day, he directed Schley in an order dated 21st May, which was placed aboard the *Marblehead*, then coaling at Key West, that if he was satisfied they were not at Cienfuegos, to proceed with all despatch to Santiago, and, if the Spanish squadron was there, to blockade it. Sampson at the same time went off Havana, and sent thence, on the evening of the 21st, by the *Hawk*, a fast yacht, an additional memorandum impressing the necessity of movement. He then moved with the main part of his squadron into Nicholas Channel.

Commodore Schley, though he could not see into Cienfuegos, held to the opinion that Cervera was there, until Commander M'Calla, who had been off Cienfuegos previously, arrived on the morning of the 24th May in the cruiser *Marblehead*, and at once communicated with the insurgents some miles westwards, and found the truth. Schley moved that evening towards Santiago, 300 miles distant, but did not arrive in the vicinity until the afternoon of the 26th, having made a speed of only about 7 knots, on account of the inability of the yacht *Eagle* to make headway against the sea. He was then 20 miles south of the port. He sighted the scouts *Yale* and *St Paul*, which latter had captured, just outside Santiago, the *Restormel*, a British collier, with coal for the Spanish squadron. Schley stood eastwards somewhat, probably with the idea of going to Hayti to coal (though Guantánamo was within 40 miles), but suddenly turned round, signalling "Destination Key West *viâ* Yucatan Channel," and started westwards. The *Merrimac* (collier) broke down, and was taken in tow by the *Yale*, but great delay arose from the breaking of many hawsers. Early on the 27th the scout *Harvard* reached the squadron with a despatch *viâ* St Nicholas Mole, Hayti, in which was expressed the Navy Department's opinion that the Spanish squadron was in Santiago, and adding, "The Department looks to you to ascertain facts, and that the enemy, if therein, does not leave without a decisive action." Commodore Schley sent a telegram, "The *Brooklyn* alone has more than sufficient coal to proceed to Key West; cannot remain off Santiago present state squadron coal account . . . much to be regretted cannot obey orders of Department . . . forced to proceed for coal to Key West by way of Yucatan Passage." The statement regarding coal on hand was seriously at variance with the data published in official documents, which show the *Iowa* to have had on the day this telegram was sent 762 tons, and the *Massachusetts* 789—sufficient to carry them three times the distance from Santiago to Key West.

The exploit of the "Merrimac."

Sampson had gone with the *New York* to Key West, where he arrived early on the 28th May, for information and coal, having first sent the *New Orleans*, 27th May, to Schley, repeating the urgent orders to blockade Santiago, and also directing the *Merrimac* (collier) to be sunk in the entrance channel, which in parts has a breadth available for heavy ships of less than 200 feet. Schley's telegram had much disturbed the Washington offic

and when forwarded to Sampson, he telegraphed, asking to go at once to Santiago with the *New York* and *Oregon* (which had arrived 26th May in excellent condition after her voyage of 14,000 miles), proposing to turn back Schley's heavier ships. The permission came, and Sampson got under way, receiving, however, before starting, a telegram from Schley stating that he would remain off Santiago. He had, on the afternoon of the 28th, again turned east, and that evening arrived in sight of the port. As is now well known from the documents published by Admiral Cervera, his squadron was twice, in the interval preceding the 28th, on the point of leaving Santiago and going elsewhere. Fires were started on the 26th with the intention of going to San Juan, but indecision and fears for the safety of the *Colon*, on account of her draught, and a small shoal at the narrow entrance, which it was thought the prevailing swell made dangerous, overruled the intention. Next morning the *Colon* and another Spanish cruiser were seen a short distance within the entrance, and on 31st May Schley, with the *Massachusetts*, *Iowa*, and *New Orleans*, stood in and made an attack upon these and the batteries, which was naturally without result at the ranges used of 7000 to over 10,000 yards. Sampson, leaving Key West at 11 P.M. on the 30th May, picked up the *Oregon*, *Mayflower*, and the torpedo-boat *Porter* in Nicholas Channel, and leaving the squadron on the north side under command of Commodore Watson, stood for Santiago at a speed of 13 knots. He arrived early on the 1st June. The *Colon* and *Vizcaya*, which were visible on his arrival, moved out of sight up the bay. Work was at once begun on the preparations for sinking the *Merrimac*. The preparations for a quick sinking were chiefly carried out by Naval Constructor Hobson, who, on account of his zeal and the character of the work done by him, and his eagerness to go, was given command of the enterprise. As he had been educated as an officer of the combatant branch, he was fitted to handle the ship. He went in in the early morning of 3rd June, with a crew of seven men. The ship did not sink where it was intended, owing to the failure of the steering gear, and drifted with the tide far up into a broad part of the channel before being sunk by her own and the Spanish torpedoes. Had she been sunk in the proper place, egress by Cervera's squadron would have been impossible, and the main part of the American squadron would have been left for other operations, without fear of escape of the Spaniards by night, and of juncture with the *Carlos V.*, *Pelayo*, and *Alfonso XIII.*, then expected by the Americans. The full extent of the inertia of the Spaniards was not yet realized, and the peculiar narrowness of the entrance precluding any attempt to pass over the torpedoes with which it was mined, the blockade of the channel in this manner was looked upon as a short and easy method of nullifying the Spanish force within; and, as seen by Cervera's published statements, much feared by them. Cervera, in a most chivalrous spirit, sent his chief of staff, under flag of truce, to inform Sampson that Hobson and his men, who had fallen into his hands, were unhurt.

On 6th June the batteries at the entrance were bombarded and their weakness established. Sampson thereupon placed, every evening, a battleship (relieved every two and a half hours) close in, with a search-light turned on the channel, precluding, by Cervera's statement, any possibility of night egress. Guantánamo, 40 miles east, was occupied by several ships 7th June, and a battalion of marines landed 10th June, and the port was used thereafter as a base. After some firing, with a few losses on both sides, the Spaniards retired before an expedition of the marines, 14th June, with a loss of 40 killed, leaving the Americans in undisturbed occupancy. In the meantime, Admiral Sampson perfected his scheme of blockade, so that every night the semicircle of ships moved closer in, all pointing for the entrance—the search-light battleship within the semicircle, and within her, again, three converted yachts and three steam launches as pickets.

A blockade of San Juan, Porto Rico, by one or two fast ships was kept up on account of the presence there of the destroyer *Terror*, but the *Terror*, with the gunboat *Isabella II.*, coming out, 22nd June, to attack the auxiliary cruiser *St Paul*, was so badly injured by the gun-fire of the latter that she with difficulty returned to port, and was thereafter unserviceable.

On 20th June the expeditionary corps, under General Shafter, arrived off Santiago.

Military operations in Cuba.

When war was declared the total regular army force of the United States was only 2116 officers and 25,706 men, the organization comprising 25 regiments of infantry, 10 of cavalry, and 5 of artillery. Two regiments of artillery were added to this by a Bill passed but a short time before, but were not organized. The adjutant-general's returns for February 1898 showed 114,602 militia enrolled in the several states, and estimated the total number of men available for military service at 10,301,339. A Bill, approved 22nd April, authorized the President to call upon the states and territories for men in proportion to their population, the regimental and company officers to be named by the governors of the States, the general and staff officers by the President. On the next day a first call was made for 125,000 men. On 26th April additional enlistments in the regular army were authorized up to 62,597 men—such an increase of force, however, to be temporary only. The quotas were filled with extraordinary rapidity, large numbers of the best classes of young men being enrolled in the volunteers, of whom there were 124,776 in May and 216,256 in August (an increase of about 5000 over those of July, and the largest number at any time on the rolls). This number about equalled the total of the Spanish forces in Cuba. The troops were concentrated chiefly at Tampa in Florida, Chickamauga in Tennessee, and at Camp Alger in Virginia; Tampa being selected as the point for the embarkation of the expeditionary force for Cuba, though there was a strong opinion generally expressed by military authorities that no troops should be landed in Cuba until October at the earliest, on account of the unhealthiness of the summer season. Colonel W. R. Shafter, who had been made a major-general of volunteers, was given command of the expeditionary force collected at Tampa. The early successes of the navy caused a cessation of opposition to an early movement, which it was decided should take the form of reinforcements to the Cuban forces in the field. Finally, however, with the exception of scattering and unimportant small expeditions, everything was delayed until control of the sea was assured, though some thirty large steamers were held in readiness near Tampa. The arrival of Cervera at Santiago, his blockade, and the request of Admiral Sampson to send a land force for co-operation, brought an end to inaction. The troops began to embark on 7th June, and were ready on the evening of 8th June, but a start was not made until 14th June, through a report from the armed yacht *Eagle* that she had seen four of the Spanish ships in Nicholas Channel on the night of the 7th. The army was held back, despite a protest from Admiral Sampson, until the falsity of the alarm was made manifest. On 20th June the fleet of 32 transports, convoyed by the battleship *Indiana*, the cruiser *Detroit*, and nine smaller armed vessels, arrived off Santiago. The whole force consisted of 815 officers and 16,072 enlisted men, with four light batteries of four guns each, one Hotchkiss revolving gun, one pneumatic dynamite gun, four Gatlings, four 5-inch siege rifles, four 7-inch howitzers, eight field-mortars of 3·6 inches. The total number of animals taken was 2295, with 114 six-mule waggons, 81 escort waggons, and 7 ambulances. The small number

of ambulances was due to want of transport, army waggons taking their place. Eighty-nine war correspondents accompanied the expedition, and eleven foreign officers. An interview was held at once by Admiral Sampson and General Shafter with the Cuban insurgent leader Garcia, who had arrived with some 3500 men at Aserraderos, 15½ nautical miles west of Santiago, and it was agreed that disembarkation should begin on 22nd June, and that Garcia's force should be transported to the point selected by the American transports.

It had been Admiral Sampson's wish to attack and to carry the batteries at the harbour entrance, so that the mines should be taken up and the fleet enter, but General Shafter selected Daiquiri, 16 nautical miles east, for the point of landing, and the harbour entrance was disregarded. The fleet furnished all its available boats, and the operation of landing was placed in charge of Captain Goodrich of the navy, and though on a rough coast, with scarcely any shelter from the sea or conveniences for landing, the disembarkation was practically completed on the 25th with great success; Siboney, 7 miles nearer Santiago, being also used after the first day. The total force landed, including the 3500 Cubans from Aserraderos and two additional volunteer regiments which arrived, was about 22,000. The American force in the expedition was of remarkable quality, being composed, with the exception of two volunteer regiments (one the 1st Volunteer Cavalry, known as the Rough Riders, of which Theodore Roosevelt, afterwards President, was lieutenant-colonel; the other the 71st New York Volunteers), almost wholly of old and seasoned regulars, who had seen long service on the plains against the Indians. In training for such a campaign and in physique, it was an almost ideal body of men. The marksmanship, self-reliance, and powers of endurance, acquired under the burning sun of Arizona and in the winter snows of the Western plains, where campaigning was frequently carried on with the thermometer forty degrees below zero, were to tell successfully in the next few days against difficulties which would have demoralized men who had not become inured to extraordinary conditions of climate and warfare.

Landing of army in Cuba.

No opposition was made to the landing, which was covered by several ships of the navy which shelled the supposed Spanish position, though it was an ideal one for defence. The small Spanish contingent at Daiquiri and Siboney were withdrawn without their doing any damage to the railway equipment of the road which ran from Santiago to the iron mines at these points. Locomotives, cars, and coal were left untouched. The American troops pushed forward as soon as they landed on the only two roads, one a mere trail, and found a Spanish force, with a rapid-fire gun, entrenched 2½ miles beyond Siboney, where the two roads came together at a point known as Las Guásimas. The Americans engaged with a total of 964 men, and carried the position. Their loss was 16 killed and 52 wounded. The Spanish official reports give their force as about 500, and their loss 9 killed and 27 wounded. The Americans advanced 2 miles nearer Santiago, and by the 29th the lines were established on the east and by the 30th on the north side of the Spanish positions, the Cuban troops being on the right (north) flank, in preparation for the attack on 1st July against San Juan Hill, on the east, and the village of El Caney, to the north-east of Santiago; the fleet at the same time bombarding the batteries at the harbour entrance. Both positions were carried by the Americans after a most gallant defence on the part of the Spaniards.

The American loss at El Caney was 88 killed and 355 wounded, out of a force of 6654 engaged; at San Juan Hill 144 killed, 951 wounded, out of 8336, or a total of casualties of 1538—slightly over 10 per cent. of the 14,990 engaged. The Spanish force at El Caney was but 520, of whom 300 were killed and wounded, and 120 captured. Among the killed were the Spanish officer in command, General Vara del Rey, and two of his sons.

The Spanish troops in the entrenchments at San Juan are given by an excellent American authority (Lieutenant Miley, of Shafter's staff) as 750, and behind them, close to the city, 3500 soldiers, sailors, and marines. The Spanish loss at this point is uncertain, authorities being very conflicting, but it was not large. Their commander-in-chief, Linares, however, was seriously wounded, and had to relinquish the command to General Toral; and Captain Bustamante, Cervera's chief of staff, present with over a thousand men from his squadron, was mortally wounded. There were in the Spanish lines this day a total of about 9500 men (besides the men of the fleet), increased that night by about 1000 more under General Escario from Manzanillo, whose entry the Cubans on Shafter's right flank failed to prevent.

Though victorious, the American army was not in a pleasant situation: the men had undergone great fatigue under a tropical sun by day, and the time spared at night from digging trenches was spent on a rain-soaked ground covered with thick vegetation. With a soldier's recklessness, their blankets and heavy clothing had been cast aside, and thus without protection, with insufficient food—due to the difficulty of hauling supplies over the single road in an execrable condition leading from the base at Siboney—there was imminent danger of the force being weakened through sickness. Action was urgent and there was even discussion of retiring to a point nearer the supplies. Reinforcements were arriving, but they were all of volunteers not accustomed to hard service. Brisk firing was continued on the 2nd and 3rd July, with a considerable number of casualties to the Americans. On the morning of the 3rd a demand was sent to the Spanish commander to surrender, with the alternative of a beginning of a bombardment of the city on the 4th. This in effect had already begun on the 1st, when Admiral Sampson fired a number of 8-inch shells from a point 3 miles east of the harbour entrance over the hills into the city, using a range of about 4½ land miles. The result of this and the threat of General Shafter was an exodus of many thousands of inhabitants towards El Caney, where their support drew heavily upon the American means of supply.

Sampson by this time had begun preparation to assault the Socapa Battery at the entrance on his own account, with the marines of his fleet (amounting, with the battalion at Guantánamo, to about one thousand men), to countermine the channel and go in with his squadron. He arranged a meeting with General Shafter with regard to the combined operations at the entrance, and on the morning of the 3rd started in his flagship, with the torpedo-boat *Ericsson* and the yacht *Hist*, for which the flagship was doing some repairs, for Siboney—7 miles distant from his position, where he was intending to land and go to the front. At 9.35, when he had gone about 5 miles, the Spanish ships were seen coming out, and the *New York* at once turned and stood back.

Battle off Santiago.

The ships in front of the port were the yacht *Gloucester*, the battleships *Indiana*, *Oregon*, *Iowa*, *Texas*, armoured cruiser *Brooklyn*, and yacht *Vixen* in the order named from east to west, making a semicircle about 8 miles in length. The armed transport *Resolute*, carrying mines and a quantity of explosives which it was intended to use in clearing the entrance, was also off the port. The *Massachusetts* and *Suwanee* were coaling at Guantánamo. The *Iowa* hoisted the signal "Enemy coming out," and fired a six-pounder gun. All at once stood in toward the Spanish ships, which were standing westwards along shore, and began a heavy fire, thus promptly obeying the admiral's standing order, "If the enemy tries to escape the ships must close and

engage as soon as possible, and endeavour to sink his vessels or force them to run ashore." The *Maria Teresa* (flagship) had come out first, followed in order by the *Vizcaya*, *Colon*, and *Oquendo*. They were firing vigorously, but most of their projectiles went far beyond the American ships. The *Brooklyn* made a turn to starboard, thus causing the *Texas* to stop and back, which probably gave the *Colon* the opportunity of passing almost unscathed. The *Maria Teresa* and *Oquendo* had taken fire almost at once from the explosion of shells, and their water mains being above the protective deck, and cut, were unable to extinguish the flames: they were run ashore, 6 miles west of Santiago, burning fiercely. The *Vizcaya* and *Colon* were still standing westwards. The two torpedo-boat destroyers had come out last, with a considerable interval between them and the *Oquendo*, the last of the cruisers. They were received with a heavy fire from the *Indiana* and yacht *Gloucester*, which latter engaged them at close quarters. They attempted to close, with great bravery, but were cut to pieces, and one soon afterwards sank; the other was run ashore, but later slipped off into deep water. The *New York* had passed and fired a few four-inch shells at the destroyer, and stood on signalling the *Indiana* to go back and watch the port. The torpedo-boat *Ericsson* and the yacht *Hist* were ordered to rescue the men from the two ships ashore, and the flagship, with all the others, stood on in pursuit of the two remaining ships. The *Vizcaya* hauled down her colours off Aserraderos, 15 nautical miles west off Santiago, and was there run ashore burning. The *Iowa* was ordered to stop and rescue her men, and the *Oregon*, *Brooklyn*, *Texas*, and the flagship settled down to the chase of the *Colon*, which was some 6 miles ahead of the nearest American ship. She was, however slacking her speed, and at 12.40 the *Oregon* opened on her with her 13-inch guns at a range of 9000 yards, as did also the *Brooklyn*, with her 8-inch; the latter shot fell short, however. The *Oregon* fired five shells, the last, at a range of 8900 yards, going over the *Colon*, which then hauled down her colours and was beached at the mouth of the Rio Turquino. She floated with a rising tide, but her valves had been opened, and no endeavours on the part of the Americans could save her. The shore being very steep, and the water very deep a ship's length from it, the *New York* pushed her in until she took the ground so that she should not sink in deep water. As she sank during the evening, however, she turned on her side, making her recovery very difficult; and though one effort was made some months later to lift her, it was abortive, and she was finally abandoned. Her crew was transferred to the *Resolute*, which had arrived with a report that another Spanish ship was off Santiago, which, however, turned out to be the Austrian armoured cruiser *Maria Teresia*. Admiral Cervera was taken on board the *Iowa*, as also a large number of other officers and men, many of whom were severely wounded. The total Spanish loss was 353 killed and 151 wounded. The Americans lost one man killed.

There was the same enormous disparity of injury in this battle as in that of Manila. The Spanish were, of course, greatly outmatched. But though they had only six 11-inch guns against the fourteen 12- and 13-inch and thirty-eight 8-inch of the Americans, the Spanish ships had ten 6-inch, thirty 5-inch, and six 4·7-inch rapid-fire guns against the fourteen 6-inch ordinary, twelve 5-inch and eighteen 4-inch rapid-fire guns of the Americans, so that there was practical equality in the classes of guns which could be looked to to do the chief work against unarmoured parts. The very great differences in damage must therefore be ascribed, somewhat at least, to difference of temperament, moral, and preparation. All the prisoners were on the next day transferred to the scouts *Harvard* and *St Louis*, except forty-two of the more severely wounded, who were cared for on the hospital-ship *Solace*. A total of 86 officers and 1615 men was taken to Portsmouth, New Hampshire, where the men were detained in camp, and the officers, except some few left at Portsmouth, were cared for at the Naval Academy at Annapolis, Md.

The naval victory gave a new face to affairs ashore. The demand for surrender had resulted in a truce, which was renewed on the 6th, when it was arranged between Admiral Sampson and General Shafter that an attack should be made on the batteries, and an entrance forced if the new demand in a letter sent that day to General Toral explaining fully the situation, and giving definite information of the destruction of the Spanish fleet, was not acceded to. Some exchange of prisoners had taken place, among those released being Lieutenant Hobson, who was brought into the American lines on the afternoon of 6th July. On the 5th there had been an exodus of the populations towards El Caney until many thousands were collected there under circumstances of great distress and destitution. On the 8th Toral offered to leave Santiago and retire to Holguin if unmolested, otherwise the suspension of hostilities must cease on the 9th. Shafter forwarded the proposal to Washington, advising acceptance. The Government at once condemned the proposal, and on the 10th the bombardment by the fleet was renewed and continued during the morning of the 11th, when, upon a renewal of the demand to surrender, with an offer of transportation of the Spanish troops home, negotiations were resumed, which ended with the signing of a preliminary agreement on the 15th, and the entry of the Americans into Santiago on the 17th. The surrender included all the Spanish forces in the division of Santiago de Cuba (which extended to Cape Maysi), amounting to about 23,500, of whom about 10,500 were in the city of Santiago. The total number finally embarked for Spain, including the wives and children of officers and the priests and sisters of charity who had served in the hospitals, was 22,864; the cost of the service was $513,860. The surrender came none too soon, the exposure of the campaign having begun to tell in the sickness of the Americans. Yellow fever broke out to some extent, and not less than 50 per cent. were attacked by the milder forms of malarial fever. The army was so weakened by illness that the general officers united in urging its removal from Cuba. General Miles had arrived with reinforcements on the 12th of July, but the majority of these men were retained on board ship.

Surrender of Santiago.

The fleet and the army gathered in Guantánamo Bay, the former with a view to the preparation of a powerful squadron, part of which, under Commodore Watson, was destined for the Philippines to proceed by way of the Mediterranean, accompanied by a covering squadron under Admiral Sampson, as far as the Suez Canal. This action was due to the diversion of a Spanish reserve squadron (so-called) composed of the *Carlos V.*, *Pelayo*, *Vitoria*, destroyers *Osado*, *Audaz*, and *Proserpina*, the fast purchased German—renamed—liners *Rapido* and *Patriota*, and several transports and colliers, which had been formed toward the end of May with the intention of sending it on to the eastern coast of the United States, and thence to Cuba. Orders had been issued to this effect, but the whole force was diverted toward the Philippines, and left Cadiz, 16th June, for the East. The main part of the force, after difficulties regarding coaling, passed through the Suez Canal, 5th and 6th July, but turned back on the 8th on account of the news of the Spanish defeat at Santiago, and of the fear of the advent on the Spanish coasts of the American ships now free to act abroad. The whole reserve squadron was back home by the middle of July, and nothing came of it but a great and useless expense to Spain, which, besides the ordinary expenses of such a squadron, had paid Canal dues twice on all but the three torpedo-boat destroyers, which were sent back from Port Said.

On 7th May a telegram had been received from Dewey: "I control bay completely, and can take city at any time, but I have not sufficient men to hold . . . will ammunition be sent?" He was informed that the cruiser

Charleston would leave at once, and also the steamer *Peking* with ammunition, supplies, and troops. Dewey's estimate on 13th May of the number of men required was 5000. General Miles's recommendation included even less, but Major-General Merritt, to whom was assigned the command, began by requesting a force of 14,000, which was increased to 20,000. On 25th May the first of these, 2491 in number, under General Anderson, sailed in three transports from San Francisco, touched at Honolulu, and were convoyed thence by the *Charleston*. On 20th June possession was taken of the island of Guam, and on 30th June the ships arrived in Manila Bay. The Spaniards in Manila were besieged by the Philippine insurgents under Aguinaldo, who, leaving Hong Kong, had landed from one of the American vessels at Cavite, 19th May. On 1st July, the day of the landing of the American troops at Cavite, he had proclaimed himself president of the Philippine Republic, and instituted a civil republic in the region controlled by his forces. The political attitude which he assumed was not recognized by the American authorities. A second detachment of troops, 3586 in number, under General F. V. Greene, arrived 17th July, and on 25th July General Merritt, who had been appointed governor-general, arrived, and on the 31st the five transports with which he had left San Francisco with 4847 men, making nearly 11,000 men at Manila, with 5000 more on the way. In the earlier part of the month the known departure of the Spanish "reserve" squadron for the East had caused some natural anxiety to Admiral Dewey, who, short of ammunition, and with a squadron but two of which had any armour protection, could not, in ordinary circumstances, expect to meet successfully armoured ships such as the *Carlos V.*, *Pelayo*, and *Vitoria*. He had decided, in the event of the Spanish squadron's continuing its voyage, to leave Manila Bay and go eastwards to await the arrival of the monitors *Monterey* and *Monadnock*, and return to give battle, the army in the meanwhile to move inland and await the American squadron's return. On 22nd July, however, he received news of Camara's return to Spain, and all naval anxiety ended, particularly as the reinforcement by the *Charleston*, on 30th June, the *Monterey*, 4th August, and the *Monadnock*, 16th August, gave him a force equal to any probable emergency.

Capture of Manila.

The American general moved his forces from Cavite, and established an entrenched line within a thousand yards of the Spanish position, from which latter, on the night of 31st July, a heavy fire of musketry and artillery was opened, causing loss to the Americans of 10 killed and 43 wounded, and for the next few days night firing was frequent from the Spanish lines. On 7th August, however, Admiral Dewey having been reinforced by the arrival of the monitor *Monterey* on the 4th, a joint note from Dewey and Merritt, announcing that bombardment might begin at any time after forty-eight hours, and affording opportunity for the removal of non-combatants, was sent to the captain-general, Fermin Jaudenes, who had superseded General Augustin Davila by order from Madrid of 24th July. General Jaudenes in reply stated that he was surrounded by the insurgents, and that there was no place of refuge for the sick and for the women and children. But there was no more firing until the last day of the campaign. Instead of the expected bombardment, a second joint note was sent demanding surrender, which the Spanish commander declined, but offered to refer to Madrid. This was refused, and preparations made for an attack. There were 13,000 troops within the city fortifications, but with the strong fleet in front, and with the beleaguering force of Americans and insurgents ashore, resistance was hopeless. This was recognized, and when the assault came off there was no greater resistance than sufficed, in their view, to "save the face" of the Spanish authorities. The attack was made by the fleet and army on the 13th August. There was no reply to the fire of the fleet, which began at 9.30 A.M. and continued for three-quarters of an hour against Fort Antonio. The army then advanced, meeting an opposition at various points which continued for some time even after the white flag had been hoisted at eleven in token of surrender, and from which the Americans lost 5 killed and 44 wounded. An agreement was signed during the afternoon of a rough draft of the articles of capitulation, which was drawn in a more formal manner and signed again the next day, 14th August. The troops capitulated with "all the honours of war," and were to be regarded as prisoners of war pending the conclusion of a treaty of peace. Their arms were deposited, to be returned "when they evacuated the city, or when the American army evacuates." All questions as to the repatriation of the Spanish officers and men and their families were to be referred to the Government at Washington. The city, its defences, and all public property were turned over to the United States force. The total loss of the Americans during the whole campaign was 20 killed, 105 wounded.

On the 12th August, at about four o'clock P.M., the protocol of peace had been signed by M. Cambon, French ambassador in Washington, acting for Spain, and by Mr Day, American Secretary of State. Article III. stated: "The United States will occupy and hold the city, bay, and harbour of Manila, pending the conclusion of a treaty of peace which shall determine the control, disposition, and government of the Philippines." This indefinite status was to be the fruitful cause of difficulty with both Spanish officials and with the Filipinos. The insurgent forces, well armed and well organized, which had with difficulty been prevented from entering the city on the 13th—in which case it would, no doubt, have been the scene of savage revenge and loot—were forced to withdraw later into the outskirts, and there began the fomentation of the native movement which was to solidify into serious and long-continued hostilities.

Operations in Porto Rico.

Immediately after the surrender of Santiago, 17th July, preparations were made for the invasion of Porto Rico with 3500 troops which had been sent as reinforcements to Santiago, but not landed. They left Guantánamo, under Major-General Miles, on 21st July—the battleship *Massachusetts* and thirteen other naval vessels taking part in the expedition. The only harbour of the island which had been blockaded was that of San Juan, which had been guarded in turn by the *St Paul*, *Yosemite*, and *New Orleans*. Immediately after the arrival of the *St Paul*, 22nd June, a sortie had been made by the small cruiser *Isabel II.* and the torpedo-boat destroyer *Terror*. The former kept well inshore, but the latter headed for the *St Paul*, and was struck by two 5-inch shells, which killed three men and so disabled her machinery that she was barely able to get back into port. The island was garrisoned by 8223 regulars and 9107 volunteers. Fajardo, at the extreme north-eastern end of the island, was given out as the objective point of the expedition, but after sailing the plans were changed, and the towns on the south side were successfully occupied, practically without resistance. The attitude of the population was exceedingly friendly, and opposition was not met until advance was begun northward. Miles had been reinforced, on 31st July, by two regiments of infantry, a troop of cavalry, and two batteries of artillery from Tampa, and by 6000 men from Hampton Roads. The troops were divided into four columns, advancing from Guanica around the western end of the island to Mayaguez; from Arroyo at the eastern end to meet the San Juan road at Cayey; from Ponce by the fine military road, 70 miles,

to San Juan; and the fourth column by way of Adjuntas and Utuado, midway of the island. The various movements involved several actions which did not rise above skirmishes, the chief opposition being met by the western column, 10th August, and by the column from Ponce on the 9th—in which action the Americans lost 1 killed and 22 wounded; the Spanish, 126 killed and wounded, and over 200 prisoners. A further advance on the San Juan highway would probably have developed greater resistance, but news of the suspension of hostilities came as more serious work was to begin. The total American loss had been 3 killed and 40 wounded.

On 12th August the *Newark*, convoying the *Resolute* with a battalion of marines aboard, and with several smaller vessels, bombarded Manzanillo after a demand for surrender was refused. It is probable that the place would have yielded the next day, as it had for some time been reported ready to fall on a show of force, but during the night news arrived of the signing of the peace protocol, and of an armistice, of which the Americans were informed by the Spanish commander under a flag of truce.

With the publication of the protocol the war practically ended. The Spanish had lost Cuba, Porto Rico, and the Philippines, nearly the whole of their effective navy, a very considerable part of their merchant marine, about 500 men killed afloat, and probably an equal number ashore; 37,000 troops had been surrendered as the result of two sieges. The total American loss was—in the navy, 1 officer, 17 men killed; in the army, 29 officers, 440 men.

The health of the American fleet was kept remarkably. Its average strength during the 114 days of hostilities was 26,102; the deaths from disease during this time were 56, or at the rate of 7 per 1000 per year. As nearly the whole of the service was in the tropics, and in the summer or wet season, this is a most excellent demonstration of sanitary efficiency.

The army did not fare so well, losing by disease during May, June, July, and August 67 officers and 1872 men out of an average total of 227,494. Its larger proportion of illness must of course be ascribed, in part, to its greater hardships. The navy is, at all times, unless it has landing parties on shore, under its normal conditions; the men have their usual food and water, can change their clothing when necessary, can keep clean. An army, on the other hand, when actually campaigning, suffers from bad or insufficient food, bad water, difficulties of changing or renewing clothing, sleeps frequently upon the bare earth and often in mire, and undergoes every hardship of weather. Much of the sickness in the American army, however, must be laid at the door of the ignorance and thoughtlessness of the volunteers. The newly-fledged soldier is unable to look properly after himself; if both officer and soldier are new the conditions are greatly aggravated, and this, to a large degree, was the situation in the American forces. In nothing does training, and particularly the training of the officers, tell more than in the care of the health of an army in the field. When masses of newly-enlisted men are brought together they seem to lose their individuality and revert for a time to the primitive man, the care of person and clothing has apparently to be relearned, and unless the officers enforce cleanliness and hygiene in general, widespread disease is inevitable, whether in or out of the tropics.

Among the things which stand out prominently, from the naval point of view, in the war are the facts that scouts are not effective when employed in such small numbers as by the Americans, and that the effective cutting of telegraphic communication is much more difficult than was supposed. The *St Louis*, largely employed on this duty, did excellent work; but, though many cables were cut, communication was not wholly interrupted until about the close of hostilities. The endurance of ships was, as a rule, excellent. But this would have been greatly increased had all been able to keep their boilers supplied with fresh water; this was shown to be vital to good service, and ships in this regard, to be thoroughly efficient, should be self-supporting. (F. E. CH.)

Spanish Reformed Church.—This body of Spanish Episcopalians had its origin in a congregation which met for the first time, in June 1871, in the secularized church of San Basilio at Seville, secured for the purpose, under the leadership of the Rev. Francisco Palomares, a priest who had left the Roman communion. Before long it was joined by considerable numbers of lay people in various centres, and several clergymen, including the Rev. Juan Cabrera, an ex-Roman priest, who had for some time been a Presbyterian minister. In July 1878 a memorial was presented to the Lambeth Conference (*q.v.*) by nine congregations in Spain and Portugal (see below) asking for the episcopate, and undertaking, in case their request were granted, to place the nomination of the bishop in the hands of Lord Plunket, then bishop of Meath and subsequently archbishop of Dublin. The reply expressed the sympathy of the bishops, but only suggested that Dr Riley, recently consecrated by the Church of the United States to minister to the reformed congregations in Mexico, should be invited to visit them and ordain and confirm for them. Archbishop Tait wrote a formal letter to Bishop Riley to this effect, and the request was complied with. A second petition for the episcopate was sent to the Irish bishops in 1879, and early in 1881, at their request, Lord Plunket paid his first visit to the Spanish Reformed Church, though nothing immediately resulted from it. In 1880 the first "synod" of the Church was held, under the presidency of Bishop Riley; the principles of the Church were formally laid down, Señor Cabrera was chosen bishop-elect, the preparation of a liturgy was begun, and the Thirty-Nine Articles of Religion, with certain modifications, were formally adopted as a standard of doctrine. Archbishop Plunket continued his efforts on their behalf; and at length the Irish bishops, having again received from them a petition for a bishop, formally brought the matter before the Lambeth Conference of 1888. The Conference deprecated "any action that does not regard primitive and established principles of jurisdiction and the interests of the whole Anglican communion." The archbishop interpreted this as a modified consent; but the Irish bishops understood it otherwise, and again declined to consecrate a bishop for them. Meanwhile the movement prospered, being largely helped with money from friends in England. The foundation-stone of a new church was laid in Madrid in 1891, on the site of the *Quemadero*, where the *autos de fé* were formerly held; and after considerable legal and other difficulties, for religious toleration in Spain is still imperfect, it was dedicated and opened for service. At length, at the meeting of the Irish House of Bishops on 21st February 1894, a letter was read from the archbishop of Dublin and the bishops of Clogher (C. M. Stack) and Down (C. Welland), in which they declared their intention, unless a formal protest were made by the bishops, or by the General Synod, to consecrate bishops for the Reformed Churches in Spain and Portugal, subject to certain conditions being fulfilled by those churches. The bishops resolved, *nullo contradicente*, although the bishops of Derry (W. Alexander, subsequently primate of Armagh) and Cork did not vote, that they would not regard such action as "an indefensible exercise of the powers entrusted to the episcopate"; and the General Synod passed a resolution leaving the matter in the hands of the bishops. Accordingly, on 23rd September 1894, the three bishops laid hands on Señor Cabrera. The matter occasioned no little stir, more especially as the Old Catholic bishops (see OLD CATHOLICS) had recently refused to take any part in the matter. It called forth a letter of protest and repudiation from Lord Halifax, as president of the English Church Union, to Cardinal Monescillo, archbishop of Toledo; and this in turn evoked a letter from Cardinal Vaughan, which was widely circulated in Spain. Since then the Spanish Reformed Church has gone quietly on its way, and the choice of Bishop Cabrera has on the whole justified itself. At the present day there are between 3000 and 4000 members, and some 11 clergy in all, six of whom were ordained in the Roman communion.

The consecration of Bishop Cabrera certainly produced a somewhat anomalous state of things, and the action, or

inaction, of the Irish bishops laid them open to very just criticism from many who were not unfriendly to such movements (see, *e.g.*, Bishop John Wordsworth, *Ministry of Grace*, pp. 176–177, London, 1901). Lord Plunket did not intend to bind either the Irish Church or the Churches of the Anglican communion, nor can he be said to have done so; but his individualist action inevitably created confusion and called forth much well-grounded opposition. Objection was made to the act as contrary to Church order, and as unjustifiable in view of the nature of the Spanish Reformed Church itself. As regards the latter, it is true that the Prayer-Book of the body (first made in 1881 and published in a revised form in 1889) cannot really justify the claim made on its behalf as a "revised Mozarabic rite": it contains indeed many beautiful prayers from the Mozarabic and other offices, but it falls short of the English Prayer-Book, for example, in its doctrinal teaching, although it contains little that is open to positive objection. Again, the statements that have been made as to the lax character of the body itself have not been made out. No doubt, it has been composed out of various Protestant elements which are only by degrees growing together, and like other bodies it has a loose fringe of irresponsible adherents; but, however hasty the action of Lord Plunket and his fellow-bishops may have been, the Church has shown a capacity for quiet growth and steady development which may promise well for the future.

Lusitanian Church.—A similar movement began in Lisbon in 1867, owing to the work of a Spanish priest there, Señor Mora; and at first its success was even greater than the movement in Spain, in spite of the fact that Portuguese priests who left the Roman communion had either to leave Portugal or to become subjects of another Power. In 1875 the adherents of this movement threw in their lot with their Spanish brethren, and when Bishop Riley visited them in 1878 the Portuguese members organized themselves as the "Lusitanian Church," and the Rev. T. Godfrey Pope, D.D., the English chaplain at Lisbon, was subsequently chosen by them as president of the Synod. A request made to the Irish bishops in 1897 for the consecration of Canon Pope as their bishop led to an examination of the Lusitanian Prayer-Book, which was found to be even more defective than that of the Spanish Reformed Church. Consequently no action was taken; and the death of Archbishop Plunket in 1897, and of Canon Pope in 1902, has rendered such action more improbable in the near future. At the present time there appear to be 5 clergy and some 500 adherents.

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(W. E. CO.)

Spanish Town. See JAMAICA.

Spartanburg, a city of South Carolina, U.S.A., capital of Spartanburg county. It is in the northwestern part of the state, on the Charleston and West Carolina, the Glenn Springs, and the Southern railways, at an altitude of 680 feet. It is the seat of Woffard College, a Methodist Episcopal institution, opened in 1854, which had in 1899 a faculty of 9, and was attended by 181 students. Population (1890), 5544; (1900), 11,395, of whom 83 were foreign-born and 4269 negroes.

Spectacular Drama. See STAGE MECHANISM.

SPECTROSCOPY.

THE rapid advance of spectroscopy during the last quarter of the 19th century was due in large measure to the improvement of instruments and photographic plates. The characteristic which more than any other distinguishes the spectroscopy of the present day from that of the earlier period is the high degree of precision in measurement which has resulted from the improved means of research. The distribution of lines in the spectra of many elements, so far from being governed by mere chance, is now known to be defined by simple formulæ, which, though purely empirical, are nevertheless profoundly significant. The wave-length of spectral lines, formerly supposed to be unchangeably fixed by nature, has been found to vary with the pressure of the gas in which they are produced, and single lines have been separated into as many as nine components by the action of a magnetic field. The displacement of lines due to the relative motion of the observer and the luminous source has not only been artificially produced in the laboratory, but has rendered possible the measurement of the axial rotation of the sun and some of the planets, the demonstration of the meteoritic constitution of Saturn's rings, and the determination of the velocity of stars in the line of sight. Through the use of improved instruments and methods, the science of spectroscopy has now attained results not inferior in precision to the most refined determinations of physics or astronomy. Indeed, an intimate relationship between these two subjects has grown out of their common use of the spectroscope, and is one of the significant advances of the period. In astronomy the spectroscope has become hardly less important than the telescope, and every advance in the study of radiation is speedily applied to the solution of cosmical problems. In physics, on the other hand, the necessary limitations of laboratory practice make an appeal to stellar conditions more and more essential to progress. In many instances, of which the history of the hydrogen spectrum affords a striking example, the dependence of each subject upon the other is clearly manifest. As the union of the observatory and the physical laboratory becomes more complete, the science of astrophysics increases in scope and power. It will be advantageous to open this brief account of recent advances with a consideration of certain questions relating to instruments.

The efficiency of a spectroscope in general depends upon its resolving power, or capacity for separating lines which differ but little in wave-length. Schuster (*Ency. Brit.* vol. xxii. p. 374) has defined the purity, p, of a spectrum by the formula

$$p=\frac{\lambda}{s\psi+\lambda}r, \qquad . \quad . \quad . \quad (1)$$

where s is the slit-width, ψ the angular aperture of the collimator lens, and r the theoretical resolving power of the spectroscope, *i.e.*, the resolving power for an infinitely narrow slit and for monochromatic light. This formula is based on the assumption that two wide lines can just be separated when the angular distance between their adjoining edges is equal to the resolving power of the aperture employed in observing them. Wadsworth has recently shown this assumption to be incorrect (*Phil. Mag.* vol. xliii., 1897, p. 317). The modified formula for purity (wide-slit and monochromatic radiations) becomes

$$p=\frac{\lambda}{s\psi+\frac{\lambda}{2s\psi+\lambda}\lambda}r. \quad . \quad . \quad . \quad (2)$$

Hence when the slit is widened, the purity of the spectrum, instead of diminishing, really increases, until

$$s\psi=\frac{1}{5}\lambda.$$

The theoretical resolving power of the instrument is still realized when $s\psi=\frac{1}{2}\lambda$; beyond this point the purity diminishes. Schuster (*loc. cit.*) states that for the condition of maximum illumination, when $s\psi=\lambda$. (monochromatic source), only 50 per cent. of the theoretical resolving power is realized. The new formula shows that this should be 75 per cent. In practice the source is never strictly monochromatic, and the formula for R, the limiting resolving power in any actual case, *i.e.*, with infinitely narrow slit and with lines of finite width, becomes

$$R=\frac{\lambda}{\frac{4}{7}r\triangle\lambda+\frac{\lambda}{r\triangle\lambda+\lambda}\lambda}r. \quad . \quad . \quad (3)$$

where $\triangle\lambda$ is the physical width of the line.

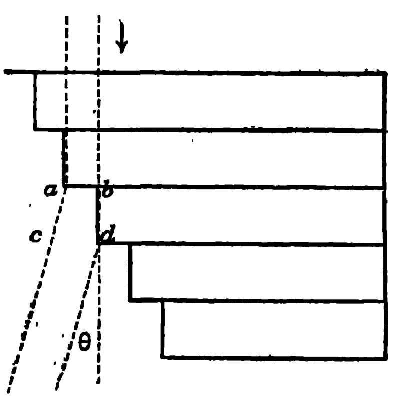
For wide slits the expression for practical purity takes the form

$$P=\frac{\lambda}{s\psi+\frac{\lambda\left(\frac{r}{R}\right)}{2s\psi+\lambda\frac{r}{R}}\lambda\frac{r}{R}}r. \quad . \quad . \quad (4)$$

This formula, which is not restricted to monochromatic radiations or infinitely narrow slits, is the one to be employed in actual work with the spectroscope. When the factor $\frac{r}{R}$, the presence of which distinguishes (4) from (2), is unity, $P=p$, or for monochromatic light the practical and theoretical purity are equal. In the article referred to, Wadsworth gives tables which show that while for narrow lines and small resolving powers the ratio r/R is very nearly unity, this is far from true for wide lines and large resolving powers. In an extreme case the value of the ratio exceeds 100 (when $\triangle\lambda=1{\cdot}00$, $r=1{,}000{,}000$, $R=9600$).

Echelon spectroscope.

The largest gratings hitherto ruled contain about one hundred thousand lines, and consequently the highest resolving power that can be obtained with their aid (as higher orders than the fourth are not ordinarily useful) hardly exceeds 400,000. It was formerly supposed that interference would no longer be possible after a retardation of over 50,000 wave-lengths, and that consequently a resolving power of 100,000 would suffice for the resolution of the closest lines in the spectrum. As a matter of fact, however, Michelson has been able with his interferometer to separate lines less than 0·01 tenth-meter apart, which appear single with the most powerful gratings, while Perot and Fabry have observed interference with the green mercury line at a difference of path of 790,000 wave-lengths. The realization of great resolving powers by the use of very high orders of spectra has hitherto failed in the case of the grating, but Michelson accomplished this result in a novel and ingenious way through his invention of the echelon in 1898. This consists of a pile of plane-parallel glass plates, of precisely equal thickness, arranged as shown in the diagram. If parallel rays pass through such a pile of plates in the direction of the arrow, the successive pencils undergo retardations proportional to the number of plates traversed. The theory of the instrument is given by Michelson (*Proc. Amer. Acad. Arts and Sci.* vol. xxxv. p. 111, 1899) as follows:—



The Echelon.

Let $ab=s$, the width of each pencil of rays; $bd=t$, the thickness of each plate; θ, the angle of diffraction; m, the number of waves of length λ corresponding to the difference of path in each plate. The common difference of path is

$$m\lambda=\mu t-ac$$
$$=\mu t-t\cos\theta+s\sin\theta,$$

or, since θ is always very small,

$$m\lambda=(\mu-1)t+s\theta. \quad . \quad . \quad . \quad . \quad . \quad (5)$$

To find the dispersion and the angular separation of the spectra, differentiate (5) with respect to λ and m.

$$\frac{d\theta}{d\lambda}=\frac{1}{s}\left(m-t\frac{d\mu}{d\lambda}\right). \quad . \quad . \quad . \quad . \quad (6)$$

$$\frac{d\theta}{dm}=\frac{\lambda}{s}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

Substituting in (6) the approximate value of $m=(\mu-1)\frac{t}{\lambda}$, we obtain

$$\frac{d\theta}{\frac{d\lambda}{\lambda}}=\left[(\mu-1)-\lambda\frac{d\mu}{d\lambda}\right]\frac{t}{s}=b\frac{t}{s}, \quad . \quad . \quad (8)$$

which measures the dispersion of the echelon.

From this we can easily obtain an expression for the resolving power. Let $e=\frac{d\lambda}{\lambda}$ for the limit. The maximum resolving power is assumed not to exceed that of the observing telescope, whose effective aperture is evidently ns, where n is the number of elements in the echelon. We may therefore substitute λ/ns for $d\theta$, whence we obtain

$$e=\frac{\lambda}{bnt}.$$

For the angular separation of the spectra, substituting $dm=$ unity in (7), we have

$$d\theta_1=\frac{\lambda}{s}.$$

The corresponding value of $\frac{d\lambda}{\lambda}=E$ is found by substituting this value of $d\theta$ in (8), whence

$$E=\frac{\lambda}{bt}=ne.$$

As the distance between the spectra is thus only n times as great as the limit of resolution, the use of the echelon is restricted to the study of narrow lines. With plates 7 mm. thick it is impossible to examine lines whose width is greater than one-fourteenth of the distance between the D lines. Moreover, as the resolving power, $\frac{1}{e}=\frac{bnt}{\lambda}$, is proportional to nt, and as experience has shown that the number of plates is limited to from 20 to 35, on account of the loss of light by successive reflections, it will be difficult to construct an echelon which combines very great resolving power with any considerable separation of the spectra. However, by immersing the echelon in some fluid such as water, the distance between the spectra will be increased, and the resolving power diminished in the same ratio. But the loss by reflection will be so much reduced that more plates can be employed to restore the resolving power to its former value. The expression for the distribution of intensities in the successive spectra shows that in general there are two spectra visible, one of which can be made to disappear by slightly inclining the echelon.

When in use, the echelon is mounted between a collimator and observing telescope of the ordinary form. A direct vision prism is usually interposed, for the purpose of cutting out all radiations except those under observation. The instrument has hitherto found its principal application in Michelson's important studies of the Zeeman effect (*Astrophys. Journ.* vol. viii. p. 37, 1898). Michelson has also constructed several reflecting echelons, but their adjustment is so troublesome that high resolving powers have not yet been obtained with their aid.

A most valuable adjunct to the spectroscope, which affords the best known means of measuring absolute wave-lengths, is the interferential refractometer or interferometer. Four forms of this instrument are in use at the present time, those of Michelson, Perot and Fabry, Hamy, and Lummer (for a description of Lummer's interference spectroscope, see *Arch. Neerlandaises des Sciences*, 1901). The first of these has already been described and illustrated in the article LIGHT (vol. xxx.). When sodium light is observed with this instrument, it is found that the clearness or visibility of the interference fringes varies with the difference of path. This is due to the presence of two sets of fringes, which give maximum visibility when exactly superposed, and minimum visibility when the bright fringes of one set fall upon the dark intervals of the other. It is only necessary to know the difference of path corresponding to these maxima and minima in order to calculate the difference in wave-length of the two components of the sodium line. The complete theory of the interferometer, and the method of reducing observations of visibility in the case of complex radiations, are given by Michelson in his memoir: *Détermination Expérimentale de la Valeur du Mètre en Longueurs d'Ondes Lumineuses*, Paris, 1894, or *Phil. Mag.* (5), xiii. p. 236, 1882. Michelson has determined the absolute wave-lengths of the red, green, and blue cadmium lines by counting the number of fringes (twice the number of wave-lengths) corresponding to the length of the standard metre at the Bureau International des Poids et Mesures. The uncertainty of his value of the wave-length in terms of tenth-metres is probably only a few units in the thousandths place, and his results are thus more accurate than the best determinations of absolute wave-length made with gratings.

Interferometers.

The interference spectroscope of Perot and Fabry is even simpler than Michelson's interferometer. It consists of two half-silvered plane parallel mirrors, mounted with the silvered sides parallel to and facing each other. The distance between the mirrors can be varied from zero to several centimetres by means of a micrometer screw. The effect of the thin silver films is to make the fringes observed by transmission much narrower and sharper than those given by unsilvered plates. If two radiations are under examination, there will be two distinct systems of fringes, one corresponding to each line. Starting from zero difference of path, the two systems of fringes, red and yellow, for example, gradually separate, until a yellow fringe falls about half-way between two red ones. They then come together again, until finally two consecutive red fringes embrace two yellow fringes. Such a coincidence is followed by separation, &c., the phenomenon repeating itself indefinitely, although a limit is set by the nature of the radiating source. Discordances occur when a given fringe falls about half-way between consecutive fringes of the other system. (For the method of determining the ratio of the wave-lengths of two radiations from observations of coincidences and discordances, see Perot and Fabry, *Ann. Chim. et Phys.* ser. 7, vol. xvi., 1899; see also the additional methods described in the same journal, ser. 7, vol. xxv., 1902.)

In Hamy's interference spectroscope, which is similar to Ebert's (*Wied. Ann.* xxxii. p. 337, 1887), a half-silvered collimating lens of long focus is used with a heavily silvered plane mirror, and the fringes are observed by reflection. A useful adjunct, which permits radiations differing but slightly in wave-length to be observed separately, is Hamy's wave-separator (*Comptes Rendus*, vol. cxxv. p. 1092, and cxxviii. p. 1380). The wave-lengths of a number of standard lines in the spectrum, referred to Michelson's absolute values for the cadmium lines, have been measured by Perot and Fabry with great accuracy.

The principal lines in the infra-red prismatic spectra of the alkali metals were mapped with a bolometer by Snow in 1892 (*Phys. Rev.* vol. i. pp. 28, 221). More accurate wave-length determinations in the infra-red spectra of lithium, sodium, strontium, calcium, silver, and thallium have since been obtained by Lewis (*Astrophys. Journ.* vol. ii. pp. 1, 106) with a radiomicrometer and concave grating spectroscope. Bolometric investigations of the infra-red spectra of flames, of absorption spectra, &c., have also been made by Rubens, Paschen, Julius, R. von Helmholtz, Nichols, and others. The radiometer, in the form used by Nichols for the exploration of the remote infra-red, possesses many advantages over most other heat-measuring instruments, and is certain to find many applications in spectroscopy. The long-standing lack of accurate wave-length determinations of lines in the visible and ultra-violet spectra of the elements has been in large degree overcome. Most of the elements whose spectra have been investigated by Kayser, Runge, and Paschen are enumerated in another section of this article. Rowland and his assistants (*Ibid.* vols. i. to vii.) have measured the lines in photographs of the arc-spectra of boron, beryllium, germanium, platinum, osmium, rhodium, ruthenium, palladium, vanadium, zirconium, and lanthanum. Hasselberg's valuable tables of wave-lengths (*Mém. de l'Acad. imp. Sci. de St Pétersbourg; K. Svenska Vetenskaps-Akademiens Handlingar*) include the spectra of oxygen, chlorine, hydrogen (second spectrum), sulphur, carbon hydride, nitrogen peroxide, iodine (absorption), bromine (absorption), aluminium oxide, chromium, titanium, cobalt, nickel, vanadium, and manganese. Liveing and Dewar, Eder and Valenta, Exner and Haschek, Hartley and Adeney, Trowbridge, Ames, Lockyer, Deslandres, Lohse, and others have also published tables of wave-lengths, most of which may be found in Watts's *Index of Spectra*. McClean (*Comparative Photographic Spectra of the Sun and Metals*, ser. i. and ii., London, 1891) and Crew (*Photographic Maps of Metallic Spectra*, Evanston, Ill., 1895) have issued photographic reproductions of the spark- and arc-spectra of various elements, and the memoirs of Eder and Valenta and of Hartley contain many excellent illustrations from their photographs. Kayser has published a valuable table of standard lines in the arc-spectrum of iron (*Ann. der Phys.* (4), vol. iii., 1900). Gramont has given special attention to the spectra of the minerals. Many of these investigations extend far into the ultra-violet, but a limit is finally set by the absorption of even a few centimetres of air. Schumann (*Sitz. K. Akad. d. Wissens. in Wien*, cii. Abth. 2, 1893) has, however, succeeded in photographing the ultra-violet spectra of hydrogen and various metals out to a point near $\lambda 1000$, by the use of a vacuum spectrograph and sensitive plates prepared by himself, without gelatine films. The principal recent determinations of absolute wave-length are those of Bell (*Amer. Journ. Sci.* vol. xxxiii., March 1887) and Thalén (*Nova Acta Reg. Soc. Sc. Ups.* ser. iii., 1898), by the grating method, and those of Michelson, by the interference method. Rowland's *Table of Solar Spectrum Wave-Lengths* is based on Bell's values. (For a discussion of methods of determining wave-lengths, see Perot and Fabry, *loc. cit.*, and Bell, *Astrophys. Journ.* vol. xv. p. 157, 1902.)

Spectra of the elements.

The most important advance in spectroscopy during the period under consideration is undoubtedly the discovery of orderly series of lines in the spectra of many of the elements. Prior to this period Balmer's formula for the series of lines in the spectrum of hydrogen, and the

known presence of numerous triplets in the spectra of zinc, calcium, and magnesium, constituted almost the whole sum of knowledge on the subject. The important

Line series in spectra.

investigations of Kayser and Runge (*Abhand. d. K. Preuss. Akad. d. Wiss.*, Berlin, 1887–93) were entered upon in 1887. In order to secure wave-length determinations of accuracy sufficient for their purpose, they found it necessary to remeasure the lines in the spectra of all the elements studied. As evidences of orderly arrangement presented themselves at the very outset, they endeavoured to find a formula which would fairly represent the lines in spectral series. After some experimenting they selected the expression

$$\lambda^{-1} = A + Bn^{-2} + Cn^{-4},$$

where A, B, and C are constants, and n takes the successive values 3, 4, 5, 6 . . . . On comparing the wave-lengths of the lithium lines computed from this formula with their observed values, the agreement is found to be very satisfactory for most of them, but for $n = 3$ the difference is 108 tenth-metres. Kayser and Runge conclude that terms containing higher negative powers of n are needed to complete their formula, but on account of the uncertainty which already exists regarding the coefficient of n^{-4}, they consider that it would be useless to introduce an additional term.

In the spectra of all the elements of Mendeléeff's first two groups (excepting gold and barium) series of lines were found which are accurately represented by the above formula. From the positions of these series the elements may be grouped as follows:—

(A) Li, Na, K, Rb, Cs.
(B) Cu, Ag, Au.
(C) Mg, Ca, Sr.
(D) Zn, Cd, Hg.
(E) Al, In, Tl.

The metals of group A apparently have three series—a *principal series*, composed of the strongest and most easily reversible lines, and two *subordinate series*, the first composed of strong, diffuse lines, the second (found for Rb and Cs by Ramage, *Proc. Roy. Soc.*, vol. lxx. p. 303, 1902) made up of much fainter but sharper lines. The lines are doublets, the frequency-difference being constant in the subordinate series, but varying inversely as the fourth power of n in the principal series. In group B two subordinate series of doublets with constant frequency-difference were found for Cu and Ag, but not for Au. A very strong reversed doublet occurs in the ultra-violet spectrum of each element, which may possibly be a part of a principal series. The two subordinate series which constitute the spectra of the elements of group C are made up of triplets. The frequency-difference between the first and second and the second and third lines in each triplet is constant for each element, as Hartley and Ames had previously found. Barium gives no series. The elements of group D also have two subordinate series of triplets, and are characterized by the presence in the ultra-violet of a very strong reversed line, discovered by Ames (*Phil. Mag.*, July 1890). This peculiarity is shared by Mg. The two subordinate series in the spectra of the elements of group D are made up of doublets. The elements Sn and Pb in Mendeléeff's fourth column, and As, Sb, Bi in the fifth column, have related lines in their spectra, but no series similar to those in the above groups. It would be difficult to overestimate the importance of this spectroscopic grouping of the elements, which agrees so closely with that based upon their chemical properties. As the atomic weight increases, the series for the elements in a given group move toward the red, but the end of the series advances steadily towards the ultra-violet in going from group A to group E. The constant frequency-difference of doublets or triplets for each element in a group is proportional to the square of the atomic weight. The impossibility of resolving some spectra into series is probably due to the high temperature required. In general, the higher the melting-point of a substance the smaller is the percentage of lines in its spectrum that can be attributed to series.

The constant B in Kayser and Runge's formula varies but little for different elements, and differs only slightly from the corresponding constant used in Balmer's formula for the hydrogen spectrum. Seven triplets of constant frequency-difference, discovered by Runge and Paschen (*Wied. Ann.*, 1897, p. 641) in the "compound line spectrum" of oxygen, together with six triplets previously found by Piazzi Smyth, constitute two series ending at the same point in the spectrum, thus corresponding with Kayser and Runge's subordinate series. Contemporaneously with Kayser and Runge's investigation Rydberg (*Kongl. Svenska Vetensk. Akad. Handlingar*, 23, 1891) made a study of spectral series, which led to numerous results of great importance. Rydberg's formula for spectral series is

$$\lambda^{-1} = A - B(n + \mu)^{-2};$$

it differs from Kayser and Runge's in the fact that the same value of B is used for all the elements. This expression represents the lines in the second subordinate series of oxygen better than the formula used by Runge and Paschen. Two triplets belonging to the first principal series, and two lines which perhaps represent a second principal series in the spectrum of oxygen, were found by Runge and Paschen through the application of Rydberg's rule, independently discovered by Schuster:—*The difference between the common limit of the nebulous (first subordinate) and the sharp (second subordinate) series and the limit of the corresponding principal series gives the wave-number of the common first term of the sharp and the principal series.* The two subordinate series which accompany the second principal series are apparently composed of double lines. Sulphur and selenium have spectra similar to that of oxygen, though in both the second pair of subordinate series is lacking. Helium has two principal and two subordinate series, and before the similar series of oxygen were discovered it was supposed to consist of two gases, called helium and parhelium (Runge and Paschen, *Astrophys. Journ.* vol. iii. p. 4). One principal and two subordinate series of helium consist of doublets, many of which have been observed in the spectrum of the solar chromosphere and in certain of the white stars. Rydberg has established certain relationships among the lines of argon, but no definite arrangement of these lines in series has yet been accomplished. In 1897 a new series of lines was discovered by Pickering (*Astrophys. Journ.* vol. v. p. 92) in the spectrum of the star ζ Puppis. This was soon found to be one of the subordinate series of hydrogen, produced under physical conditions not hitherto realized in the laboratory. The other subordinate series comprises the lines represented by Balmer's law. Having these data Rydberg (*Ibid.* vol. vi. p. 233) applied his rule and found that a strong line, the first member of the principal series, should fall at λ4687·88, the remaining lines being beyond the range of possible (astronomical) observation in the extreme ultra-violet. By far the strongest bright line in the spectra of certain stars is at λ4688, and there is a line at λ4687 in the spectra of several nebulæ.

In the great majority of the elements the series hitherto discovered comprise only a small percentage of the total number of lines. Rydberg (*Ibid.* vol. vi. p. 239) has found in the spectrum of copper a large number of triplets

of constant frequency-difference, which he was unable to arrange in series. Triplets had previously been recognized only in the spectra of biatomic elements. The strongest evidence may be adduced to show that the selection of lines to form series has not been the result of chance. Infra-red lines predicted by Kayser and Runge were found by Snow with the bolometer. Humphrey's studies of the effect of pressure on wave-length show that lines belonging to different series are shifted by different amounts. Finally, Preston (*Phil. Mag.*, 1899, p. 165) found that corresponding lines of the same series in the spectra of magnesium, cadmium, and zinc behave similarly in a magnetic field, and Runge and Paschen (*Astrophys. Journ.* vol. xv. p. 333, 1902) have obtained similar results with these and other metals.

"Banded" spectra, in contradistinction to most line spectra, offer evidence to even the most casual observer of the existence of a law governing the arrangement of the lines in the bands. In 1883 Alexander Herschel (*Micrometrical Measures of Gaseous Spectra*, C. Piazzi Smyth, Edinburgh, 1884) noticed that the lines in Piazzi Smyth's map of the green band of carbon monoxide form an approximate arithmetical progression. Deslandres (*Comptes Rendus*, 1886) subsequently found a similar relation in the nitrogen band $\lambda 3914{\cdot}6$ and in other bands. Kayser and Runge obtained an expression that represents the distribution of lines in one of the cyanogen bands, but they finally concluded that no simple and accurate formula can be deduced from observation. Thiele (*Astrophys. Journ.* vol. vi. p. 65), whose general formula for all spectral series is of the form $\lambda = f[(n+c)^2]$, has resolved into series the complex green band in the spectrum of carbon monoxide. The expression necessary for this purpose is a cumbersome one, however, and is hardly adapted for general use.

Several attempts have been made to treat the question of spectral series from a purely theoretical standpoint. Julius (*K. Akad. van Wetenschappen, Amsterdam*, 1888) has sought for lines with frequencies equal to the sum or difference of the frequencies of other lines, thus corresponding to the combinational tones of acoustics, and discovered more coincidences than would be probable on the assumption of a chance distribution of lines. But Ames (*Phil. Mag.*, July 1890) was unable to find combinational lines corresponding to some very strong lines in the spectrum of calcium. Stoney (*Trans. Roy. Soc. Dub.*, 1891) has sought to explain multiple lines on dynamical grounds. He considers the motion of a point in an orbit described under the action of one or more dominant forces, and subjected to perturbations which gradually change the position and form of the orbit. The dominant orbit, however complex, can be resolved into a number of elliptic orbits, the "partials," each of which would represent a single line in the spectrum if the moving point actually followed the dominant orbit. But in the intervals between successive encounters of the molecule the motion is constantly under the influence of disturbing forces, the effects of which may be predicted from the well-known perturbations in the solar system. Double lines would result from apsidal motion, triple lines from precessional motion, winged lines from periodic changes in the inclination of the ellipse, pairs of equal lines from periodic changes in the ellipticity, diffuse lines from periodic oscillation in any of the perturbations (nutation). Stoney then goes on to show that the conclusions drawn from this dynamical investigation may also be considered valid under the electromagnetic theory of light. This theory receives support from Preston's observations of the Zeeman effect (*Phil. Mag.* vol. xlvii., 1899, p. 176). Kövesligethy's discussion of the theory of continuous and line spectra, in the course of which he derives a formula for spectral series similar to Balmer's, may be found in his *Grundzüge einer theoretischen Spectralanalyse* (Halle, 1890). This theory leads to the important law that the wave-length of the point of maximum energy in the spectrum of a black body is to a very close approximation inversely proportional to the absolute temperature, now established on a firm experimental basis through the investigations of Paschen (*Astrophys. Journ.* vol. ii. p. 202) and others. (See also the extensive theoretical investigations of Wien, Planck, and others.)

Effect of physical conditions.

One of the most promising means of ascertaining the structure of the molecule, and of supplying data requisite for the interpretation of stellar and nebular spectra, is the investigation of the spectra of substances subjected to widely different physical conditions. A brief reference may be made to some of the more important phenomena that have been observed in this extensive field. Remarkable effects have been observed in vacuum tubes under different conditions of the electrical discharge. In his important studies of electrolysis in gases J. J. Thomson (*Proc. Roy. Soc.*, 1895, p. 244) found that at the positive electrode of a hydrogen tube the red line ($H\alpha$) was brighter than the green line ($H\beta$), while at the negative electrode the relative intensities of the lines were reversed. On reversing the coil the effect was reversed gradually. Thomson considers the difference in the spectra to be due in part to the preponderance of positively and negatively charged atoms at the opposite electrodes. Eder and Valenta have found that argon gives three distinct spectra under different electrical conditions. In passing from the "blue" to the "white" spectrum some of the lines undergo displacements toward the red of from one-half to one tenth-metre, which are not considered to be due to unsymmetrical broadening. The details of this and many other important investigations may be found in Eder and Valenta's papers in the *Denkschriften* of the Vienna Academy of Sciences. From their studies of the multiple spectra of argon and other gases, Trowbridge and Richards (*Amer. Journ. Sci.*, 1897, pp. 15 and 117) conclude that, in general, the oscillatory discharge produces line spectra, while the dead-beat discharge gives fluted spectra. Schuster and Hemsalech (*Phil. Trans.*, 1899, p. 189) have pointed out that the introduction of self-induction into the secondary circuit of an induction coil eliminates the air lines from the spark discharge in air. Hemsalech (*Journ. de Phys.*, Dec. 1889) attributes the effect to a lowering of the temperature in the oscillatory discharge. The same authors find in certain cases that different lines of the same element may be due to different particles, which move with different velocities in the electric spark. Two lines of equal intensity are not necessarily due to vibrations of equal intensity, as an intense vibration of brief duration may affect the eye or plate no more than a weak vibration which persists longer. For a full account of Hemsalech's recent work, see his *Recherches expérimentales sur les Spectres d'Etincelles*, Paris, 1901.

Lockyer (*Proc. Roy. Soc.*, 1897, p. 441) has made numerous investigations of "enhanced" lines, *i.e.*, lines whose intensity increases in passing from the arc to the spark. Crew (*Astrophys. Journ.* vol. xii. p. 167) has observed that those lines in the arc which are either enhanced or diminished when the arc is surrounded with hydrogen, in all cases occur in the spark spectrum. Lines belonging to series are not affected at all. Lewis (*Ibid.* vol. x. p. 137) finds that minute traces of impurities may effect great changes in the spectra of gases, even though they be chemically inactive. Reduction of the temperature of hydrogen gas to $-200°$ C. has been shown by

Scheiner (*Ibid.* vol. vii. p. 231) to have no effect on its spectrum. In the spark spectrum of liquid oxygen Liveing and Dewar (*Phil. Mag.*, Aug. 1894) observed a line at λ5572; this may perhaps coincide with the aurora line (λ5571·6) which must be produced under somewhat similar conditions of temperature and pressure. An investigation which may have a bearing on solar phenomena is that of Wiedemann and Schmidt (*Astrophys. Journ.* vol. iii. p. 207), who have found that when sodium and potassium vapours are exposed to concentrated sunlight they fluoresce brightly, sodium with a green, potassium with a red colour. The sodium spectrum contains continuous and fluted bands, also the yellow sodium line. The recent work of Julius (*Ibid.* vol. xii. p. 185, vol. xv. p. 28) and Wood (*Ibid.* vol. xiii. p. 63; *Phil. Mag.* ser. vi. vol. iii. p. 128) on the anomalous dispersion of sodium and other vapours may perhaps aid in explaining certain peculiarities in the spectrum of the chromosphere.

Pressure and wave-length.

While measuring Rowland's concave grating photographs of the solar spectrum, Jewell noticed that the arc lines of the comparison spectrum in many cases did not exactly coincide with the corresponding Fraunhofer lines. This led to the investigations of Humphreys and Mohler (*Astrophys. Journ.* vol. vi. p. 169), on the spectrum of an enclosed arc under pressures varying from one to fifteen atmospheres. From measurements of the spectra of fifty-three elements it was found that all isolated lines are shifted by pressure towards the red end of the spectrum. The amount of the shift is directly proportional to the increase of pressure; it depends upon the total pressure, not upon the partial pressure of the vapour or gas producing the lines, and it is apparently independent of temperature. Lines in bands (of cyanogen and aluminium oxide) are not appreciably shifted. For a given element the shifts of similar lines are proportional to their wave-lengths. Lines belonging to different series are shifted by different amounts, the ratios of the reduced shifts for the principal, first subordinate, and second subordinate series being approximately as 1 : 2 : 4 respectively. For the same element lines of similar character are shifted equally. For different elements the shifts of similar lines are ordinarily in the inverse ratio of the absolute temperature of the melting-points, and also are to each other as the products of the coefficients of linear expansion and the cube roots of the atomic volumes of the respective elements. The shifts of similar lines of elements belonging to the same half of a Mendeléeff group are proportional to the cube roots of their respective atomic weights. The shifts are greatest for substances whose coefficients of linear expansion are greatest. For similar lines of different elements the shift is a periodic function of atomic weight.

In Lommel's theory of absorption the following theorem appears: "An increase in the density or the pressure of a radiating gas causes a broadening of the bright lines in its spectrum, and at the same time displaces them toward the red." After a discussion of this theory Wilsing (*Ibid.* vol. vii. p. 317) concludes that it agrees with observation in so far as it requires a displacement toward the red to result from increased damping. At the same time, however, observation shows no such great increase in the width of the lines as the theory demands. Taking into account Bessel's extension of the theory of damped vibrations, Wilsing is able to show that Humphrey's and Mohler's observations can be fully explained as resulting from a damping of the vibrations, if the quantity which expresses the damping may be regarded as a function of the pressure which is constant for a given series of vibrations of the same gas, but which varies for different series and different gases.

From measurements of the displacements of lines in the solar spectrum, Jewell, Humphreys, and Mohler (*Astrophys. Journ.* vol. iii. p. 138) have found the pressure in the Sun's reversing layer to vary from two to seven atmospheres, the observed pressure depending upon the height of the absorbing vapour above the photosphere. Thus the lines in the spectra of stars of the solar type may have an average displacement of about 0·02 tenth-metres, which at λ4000 corresponds to a velocity of 1·5 kilometres per second in the line of sight. As this is not far from the limiting accuracy attained in the best line of sight work, it is probable that pressure displacements can at present have no important effect in velocity determinations, at least in the case of stars whose atmospheric pressure is not much greater than that of the Sun.

The spectrum of the spark between iron poles in water and other liquids has recently been investigated by Hale (*Ibid.* vol. xv. p. 132, 1902). By varying the length of spark, capacity of the condenser, &c., or by replacing the water by a salt solution, he found that the spectrum can be changed by successive steps from a bright-line spectrum to one consisting almost wholly of dark lines. Wilsing, who was the first to make a serious study of the spectrum of the spark in water, has pointed out (*Ibid.* vol. x. p. 113) that the composite dark and bright lines thus obtained resemble the lines which are characteristic of the spectra of temporary stars. In the spectrum of hydrogen, obtained by passing a spark between carbon poles moistened with water, Wilsing (*Ibid.* vol. x. p. 269) finds the line Hβ to be displaced about 1·1 tenth-metres toward the red and greatly widened. Mohler's (*Ibid.* vol. x. p. 202) observed displacements of the cadmium lines produced by a spark discharge at atmospheric pressure vary from 0·026 to 0·088 tenth-metres, increasing with the capacity in the circuit. The corresponding pressures produced by the discharge itself range from $3\frac{1}{4}$ to 11 atmospheres. The much higher pressures deduced by Haschek and Mache (*Ibid.* vol. xii. p. 50) are ascribed by them to the different electrical conditions under which their spark was produced. The great displacements of certain lines of argon and sulphur, observed by Eder and Valenta (*loc. cit.*) in vacuum tubes at pressures of about 20 mm., and the displacements observed by Ebert in flames, are probably not to be attributed to the direct effect of pressure. Ebert considers his results as due to unsymmetrical widening toward the red. For a discussion of the effect of a magnetic field in breaking up spectral lines into several components (Zeeman effect) see MAGNETO-OPTICS.

Dissociation.

Lockyer maintains that at stellar temperatures the elements no longer exist as we know them on the Earth, but are broken up into finer forms of matter. Much of the evidence adduced by him in favour of this view has proved to be untrustworthy, but several recent investigations point to the possibility that the chemical atom consists of many parts, which may not always be associated in the same way. Some of the principal arguments which favour this view may be summarized as follows:—

1. There is reason to suppose that under certain conditions the different particles whose vibrations produce the different series of lines in the spectrum of a single element may exist independently of one another. For example, the series of hydrogen lines in the star ζ Puppis has not yet been produced in the laboratory. The H and K lines of calcium are observed at the highest elevations reached by solar prominences, where their only associates are the lines of the very light gases helium and hydrogen. Huggins has shown that if the density of calcium vapour is low, the H and K lines may appear without the blue line at λ4226·9, but in the Bunsen flame, where the blue

line is strong, the H and K lines cannot be produced, no matter how dense the vapour.

2. The velocity of metallic vapours, projected from the poles in the electric spark (Schuster), and occasionally that of iron in solar phenomena, is not the same for all lines of the spectrum.

3. The relationship between different elements suggested by the periodic law is emphasized by the law of spectral series. Lines in the same series are equally displaced by pressure, but, as stated above, lines in different series are differently displaced. By a given pressure the calcium line at λ4226·9 is displaced twice as much as H and K.

4. For corresponding lines in the second subordinate series of cadmium and magnesium, zinc and mercury, &c., observed simultaneously in a magnetic field, the distances of corresponding components on the scale of vibration-frequency are the same. From this, Preston (*Nature*, vol. lx. p. 165) and Runge and Paschen (*Astrophys. Journ.* vol. xv. p. 336, 1902) think it possible that atoms of related elements are composed of the same kind of ions, and that the properties of these elements are determined by the arrangement of the ions in the atom.

5. Thomson's work on gaseous discharges at low pressure has led him to conclude that the negative electrification is carried by "corpuscles" which are the same for different elements, and the mass of which is about one one-thousandth of that of the hydrogen atom. In his opinion the simplest way of accounting for the facts is based on the view that the atoms of the chemical elements are different aggregations of the same kind of particles (*Phil. Mag.* vol. xliv. p. 311, 1897).

Although this array of evidence seems to make out a fairly strong case in favour of some form of dissociation, it would be wise to defer a final conclusion until further investigations have been made. Crew has studied the spectrum of a spark-discharge through vapours intensely heated by an electric arc, and in these circumstances he finds the H and K lines of calcium to be very faint, while the line at λ4226·9 is greatly enhanced (*Astrophys. Journ.*, September 1902). Again, Schuster has pointed out that as the density of any substance cannot be increased by pressure much beyond its density when in a liquid state, and as the density of liquid hydrogen is only about one-fifteenth of the average density of the Sun, the interior of the Sun cannot be composed of hydrogen or of any constituent of hydrogen. So far as its density goes, the interior of the Sun might well be composed of the elements as we know them on the Earth ("The Evolution of Solar Stars," *Proc. R. Phil. Soc. Glasgow*, 1901–02).

Solar spectrum.

The infra-red solar spectrum has been mapped by Abney to λ27,000, by Becquerel, by Lommel to λ9500, and by Langley to λ53,386 (*Publ. Smithsonian Astrophys. Observ.* vol. i.). Higgs's photographic map of the solar spectrum (*The Photographic Normal Solar Spectrum*, Liverpool, 1896) extends from λ2988 in the ultra-violet to λ8346 in the infra-red. Abney used a special emulsion of silver bromide and collodion, while Becquerel and Lommel employed phosphorescent screens. Lommel's map is from a photograph made by placing a sensitive plate in contact with a phosphorescent screen after the latter had been exposed to the spectrum. Langley's map, which contains 740 lines between λ7601 and λ53,386, is now the chief source of our knowledge of this region. It was made from "bolographs," obtained by causing the spectrum to move at a uniform rate across a fixed bolometer, the spot of light reflected from the galvanometer mirror being simultaneously photographed upon a moving plate. Rowland's great *Photographic Map of the Normal Solar Spectrum* (Baltimore, 1888), made with a powerful concave grating spectroscope, and extending from λ3000 to λ6950, and his *Table of Solar Spectrum Wave-Lengths* (Chicago, 1898), which contains accurate measures of some twenty thousand lines, have been accepted by common consent as standards of reference. Müller and Kempf's map, drawn from an excellent series of wave-length determinations, is not commonly used, as it does not possess the advantages of a photograph. The accuracy of Rowland's determinations of relative wave-length is due to his employment of the method of coincidences. This method depends upon an exceptional quality of the concave grating, which permits two overlapping spectra of different orders to be photographed side by side on the same plate without change of focus. Then if the absolute wave-length of a line in one of the spectra is known, the wave-length of a coincident line in the other spectrum follows at once from the relation

$$\lambda = \frac{\lambda_1 n_1}{n},$$

where λ_1 is a known wave-length of order n_1. Michelson's determinations of absolute wave-length indicate that the system on which Rowland's Table is based could be improved, and many of the wave-lengths also require correction because the shifts due to pressure in the solar atmosphere were neglected. But these corrections would be slight, and the table is so much superior to any other that it is likely to remain the standard for some years to come.

Maps of the telluric lines, due to the absorption of the Earth's atmosphere, have been published by Cornu, Thollon, Becker, McClean, Müller, and Spée. Thollon's map (*Ann. de l'Observ. de Nice*, 1890), unfinished on account of his death, but completed by Spée (*Région. b.-f. du Spectre Solaire*, Bruxelles, 1899), was drawn from visual observations, with a large spectroscope containing carbon disulphide prisms. Unfortunately it is not provided with the scale of wave-lengths indispensable for convenient use. Becker's and Müller's maps (*Trans. Roy. Soc. Ed.* vol. xxxvi. part 1; *Potsdam Publicationen*, vol. viii.) are also drawn from visual observations, but McClean's (*Comparative Spectra of the High and Low Sun*, London, 1890) is photographic. Many of the maps of the solar spectrum extend far into the ultra-violet, but a limit is finally set by the general absorption of the Earth's atmosphere. Cornu's determination of this limiting wave-length, made from photographs of the solar spectrum taken by Simony at an altitude of 3700 m., is λ2922 (*Comptes Rendus*, 1890). Beyond this point the ultra-violet rays seem to be completely absorbed by the upper regions of the atmosphere. At the elevation of London Huggins found the photographic spectrum of Vega to terminate at λ2970.

Solar spectroscopes.

Spectroscopes intended for use in connexion with a telescope for observing the spectra of solar phenomena usually consist of a collimator and observing telescope, fixed at an angle of about 25°, with a plane Rowland grating mounted at the point of intersection of their optical axes. Different orders of spectra are brought into the field by rotating the grating. In order to get the best results, the spectroscope should be used with a telescope giving the largest possible image of the Sun, since the spectra of the gases and vapours lying at the base of the chromosphere, and the minute details in the structure of prominences, can be observed only when a large solar image is employed. With the 40-inch Yerkes telescope, which gives a 17·5 cm. image of the Sun, it is possible to observe on any good day the bright bands due to a layer of carbon vapour only

about one second of arc (0·09 mm.) in thickness at the base of the chromosphere (Hale, *Astrophys. Journ.* vol. x. p. 287).

For observations of a total solar eclipse the objective prism, objective grating, or direct concave grating spectroscope may be used with advantage. In all of these instruments the collimator and image-forming lens are dispensed with, the parallel rays from the chromosphere or corona being permitted to fall directly upon the prism or grating. In the two former instruments the objective, before which the prism or grating stands, forms upon the photographic plate a series of monochromatic images of the chromosphere or corona corresponding to the lines in their spectra. The concave grating accomplishes the same result without the aid of an objective, and is thus of special service in the ultra-violet spectrum. Such photographs have the advantage over those made with slit spectroscopes of showing not only the spectrum, but also the distribution of the elements at various elevations above the photosphere. (For the results of solar spectroscopic observations see SUN and ECLIPSE.)

The principle of the spectroheliograph, an instrument devised by Hale for photographing the Sun in monochromatic light, is described under SUN. In the spectroheliograph first used at the Kenwood Observatory in 1892, the only moving parts were the first and second slits, which were mounted at the ends of the collimator and observing telescope of a large grating spectroscope attached to a 12-inch equatorial telescope. Photographs of prominences made with such an instrument are hardly surpassed in delicacy of detail by the best results obtained during total eclipses. In another form of the instrument a spectroscope with two slits is moved as a whole, the solar image and plate being stationary (see *Astron. and Astrophys.* vol. xii. p. 241). A simple modification of the instrument permits photographs to be made simultaneously in any two lines of the spectrum. Thus, if Hβ and K are used, the distribution of hydrogen gas and calcium vapour in a prominence can be learned from a comparison of the resulting photographs.

Spectroheliograph.

Various other forms of spectroheliographs have been devised by Hale (*Astrophys. Journ.* vol. x. p. 287), Deslandres, who obtained good results with a spectroheliograph in 1893 (*L'Astronomie*, June 1894), Wadsworth (*Astrophys. Journ.* vol. i. p. 244), and Evershed. Michelson (*Ibid.* vol. i. p. 1) has shown theoretically that the efficiency of a spectroheliograph increases with the dispersion up to a certain point, beyond which it is not desirable to go.

For the study of stellar spectra two principal types of spectroscopes are used at the present time—the objective prism and the slit spectrograph. The former, employed by Fraunhofer and Secchi for visual observations and adapted for photographic work by Pickering, consists of a large prism mounted in front of the object-glass of an equatorial telescope, with its refracting edge parallel to the diurnal motion. On a photographic plate at the focal plane of the telescope the light from each star in the field is drawn out into a spectrum. In order to give the spectra width the rate of the driving clock is retarded, so as to cause the images to drift slowly in a direction parallel to the lines. The principal advantages of the objective prism are the brightness of the spectrum (no slit being required) and the large number of stellar spectra that can be photographed simultaneously. Unfortunately, however, no satisfactory method of supplying a comparison spectrum has been devised, and consequently the objective prism can be employed for radial velocity determinations only in the case of the few binary stars whose lines are periodically double. Its systematic use at Harvard College Observatory has resulted in the discovery of a large number of stars having remarkable spectra (see *Annals, Harvard College Observatory*). The slit spectrograph generally consists of a spectroscope containing from one to four prisms, provided with arrangements for photographing spectra, and attached to an equatorial telescope. It is used for researches on the spectra of individual stars, and for the measurement of their motions toward or away from the Earth. At present photographic methods are almost invariably employed for the study of stellar spectra.

Stellar spectroscopes.

According to Doppler's principle, the lines in the spectrum of a luminous source will be displaced toward the red if the distance between the source and the observer is increasing, toward the violet if the distance is decreasing. Although the principle has not yet received exhaustive theoretical treatment, its validity may be considered to be firmly established by the results of such investigations as those of Dunér on the rotation period of the Sun, of Keeler on the rotation period of Saturn's rings, and of Vogel on the motion of Algol (see ASTRONOMY). In addition we now have the direct experimental proof of Bélopolsky (*Astrophys. Journ.*, December 1900), who has observed the displacement of lines produced by a system of mirrors moving at high velocity. Keeler's proof (*Ibid.* vol. i. p. 416) that the rings of Saturn are composed of discrete particles is a beautiful application of Doppler's principle. In a photograph of the spectrum of Saturn, taken with the slit placed parallel to the equator, the lines, though straight, are slightly inclined to their normal position, on account of the displacement due to the velocity of axial rotation, which increases uniformly from the centre to the edge of the disc. If the rings were solid, forming a continuous mass with the ball of the planet, the lines on the rings would be direct extensions of those due to the disc. But Keeler found from a study of his photographs that the lines in the spectrum of the rings are not only displaced as a whole, but inclined in the opposite direction. In other words, it appeared that the velocity of rotation of the inner edge of the ring is greater than that of the outer edge, a result evidently incompatible with the existence of a solid ring, but in perfect harmony with Maxwell's mathematical proof that the rings consist of separate particles. Measurements of the inclination of spectral lines have also been employed in determinations of the rotation periods of other planets.

Huggins was the first to apply Doppler's principle to the measurement of stellar motions in the line of sight. But through the inadequacy of the instruments then available, his experiments in 1868 and those of Vogel in 1871 were hardly conclusive, and no accurate results were obtained before the introduction of photographic methods by Vogel in 1887. Keeler's measurements of the velocities of stars and nebulæ in 1890 (*Publ. Lick Observ.* vol. iii.) remain as the only accurate results derived from visual observations. The first systematic use of the photographic method, made at Potsdam during the years 1888–1891, yielded the velocities of 47 stars, and established a procedure which has not been greatly modified by subsequent observers. (*Potsdam Publicationen*, vol. vii. part i.)

The optical principles which govern the efficiency of stellar spectrographs have been stated by Hastings, Keeler (*Sidereal Messenger*, vol. x. p. 433), and Wadsworth (*Astrophys. Journ.* vol. iii. p. 321). Hartmann (*Ibid.* vol. xi. p. 400; vol. xii. p. 30) has described the methods employed in adjusting the new Potsdam spectrographs. The Mills spectrograph, which in the hands of Campbell (*Ibid.* vol. viii. p. 123) has yielded very accurate velocity determinations, consists essentially of a collimator of

$1\frac{1}{2}$ inches aperture and $28\frac{1}{2}$ inches focal length, and a shorter camera, rigidly mounted with their axes parallel. The light of the star, after entering the slit in the focal plane of the telescope, is dispersed by a train of three 60° prisms of dense flint, rigidly clamped at a minimum deviation of 180° corresponding to the Hγ line. Throughout the exposure any irregularities in the motion of the telescope are corrected by the observer, who watches an image of the star within the slit obtained with light reflected from the face of the first prism. Before and after the exposure of the star, which may continue from one minute up to two hours, depending upon its brightness, the light of a spark passing between iron electrodes is admitted to the slit on both sides of the central portion, which is covered during these exposures. The resulting photographs show the narrow spectrum of the star lying between two iron comparison spectra, the lines of which serve as standards of reference in measurements of the displacements of the stellar lines. Provision is made for maintaining the spectrograph at a constant temperature during a prolonged exposure, as changes in the temperature of the prisms would shift the lines and impair the definition of the photographs.

Improvements are constantly being made in spectrographs and auxiliary apparatus. Keeler was the first to use a train of three simple prisms giving 180° deviation, now almost universally employed. Campbell (*loc. cit.*) has devised a method of guiding for use with large visual telescopes. Huggins's reflecting slit-jaws (*Publ. Tulse Hill Observ.* vol. i., 1899) permit the star image to be seen on the slit, and are preferred by many observers to other guiding devices. A correcting lens (Keeler, *Astrophys. Journ.* vol. i. p. 101), placed near the focal plane of a visual telescope for the purpose of uniting the more refrangible rays, has proved to be of great service. The automatic heating apparatus of the new Potsdam spectrograph has been described by Hartmann (*Zeitschrift für Instrumentenkunde*, December 1901). Wright's apparatus (*Astrophys. Journ.* vol. xii., 1900) permits the comparison spectrum to be photographed while the exposure for the star is in progress. The Bruce spectrograph of the Yerkes Observatory embodies many important improvements (Frost, *Ibid.* vol. xv. p. 1, 1902).

In reducing the photographs the following procedure may be employed. The displacements with reference to the comparison lines of from one to thirty known star lines are measured under a microscope. After corrections have been applied for curvature of the lines, wave-lengths are obtained by the aid of the Cornu-Hartmann (*Ibid.* vol. viii. p. 218) interpolation formula

$$\lambda_1 = \lambda_0 + \frac{c}{s - s_0},$$

where λ_0, c, and s_0 are constants and s is the scale-reading of the line whose wave-length is desired. The velocity in kilometres per second corresponding to a displacement $\Delta\lambda$ is given by the expression

$$v_s = \frac{V_L \cdot \Delta\lambda}{\lambda},$$

where v_s is the desired velocity of the star and V_L the velocity of light in kilometres. The velocity thus obtained must finally be "reduced to the Sun" by correcting for the axial and orbital motions of the Earth. To determine the absolute velocity of the star in space an additional correction arising from the motion of the solar system in space would be required. (See Campbell, *loc. cit.*; Frost, *loc. cit.*; Hartmann, *Astronom. Nachr.* Nos. 3702, 3703, 3704; 1901.)

The periodic doubling of lines in the spectrum of ζ Ursæ Majoris led Pickering to the conclusion that the star is binary, the separation occurring when the orbital motions of the components as observed from the Earth are in the line of sight. In another class of spectroscopic binaries the lines move to and fro in the spectrum, but are not doubled, as the spectrum of the fainter component is not visible. At present 52 spectroscopic binaries are known, with periods ranging from a few days to two and one-quarter years. For further details regarding such stars, see ASTRONOMY.

Classification of stellar spectra.

In 1862, only three years after Kirchhoff and Bunsen's application of the spectroscope to the study of the Sun, Huggins measured the position of the lines in the spectra of about forty stars, with a small slit spectroscope attached to an 8-inch telescope. In 1876 he successfully applied photography to a study of the ultra-violet region of stellar spectra, and in 1879 published his paper "On the Photographic Spectra of Stars" (*Phil. Trans.*, 1880, p. 669). The results were arranged and discussed with reference to their bearing on stellar evolution. In the classification adopted Sirius was placed first in the order of development, the Sun at the middle of the series, and Betelgeux last. In *An Atlas of Representative Stellar Spectra*, by Sir William and Lady Huggins (London, 1899), which is superbly illustrated with plates, this classification is retained, but the so-called "Orion" stars, whose spectra are characterized by the helium lines, are made to precede stars like Sirius. This classification is confined to the stars investigated by Huggins, and does not include stars of Vogel's Class III*b*.

Secchi's observations of stellar spectra were contemporaneous with the early work of Huggins. His purely empirical classification, based upon an examination of the spectra of 4000 stars, comprises the following types:—I. White stars, whose spectra contain only a few broad hydrogen lines. II. Yellow stars, whose spectra resemble that of the Sun. III. Red stars, whose spectra contain solar lines and dark bands, sharply bounded on the violet side. IV. Red stars, with spectra characterized by dark bands due to compounds of carbon. V. Stars whose spectra contain bright hydrogen lines. The order is essentially the same as that of Huggins's first classification.

Vogel's classification (1874), which is more generally used than any other, is briefly as follows:—Class I. Spectra strong in more refrangible region, metallic lines faint. I*a*1. Broad hydrogen lines only. I*a*2. Lines of hydrogen and fainter lines of several metals; no helium lines. I*a*3. Metallic lines stronger, K about equal to hydrogen lines. I*b*. Helium lines, with strong hydrogen lines, and a few lines of Ca, Mg, Na, and Fe. I*c*1. Bright hydrogen lines. I*c*2. Bright lines of hydrogen, helium, and a few metals. Class II. More refrangible region fainter, metallic lines strong, hydrogen no longer predominant, H and K very broad. II*a*. Numerous metallic lines, particularly in yellow and green. Hydrogen lines usually intense, but less so than in Class I*a*. II*b*. Bright and dark lines and faint bands (including Wolf-Rayet stars). Class III. More refrangible region very faint, dark bands and lines present. III*a*. Dark lines, and dark bands sharply defined on more refrangible edge. III*b*. Dark lines and dark bands, due to carbon compounds, sharply defined on less refrangible edge. Vogel's classification, like that of Huggins, was intended to represent stages in stellar evolution, following a line of descending temperature. Thus his first class includes white stars like Sirius, whose temperature is so high that the metallic vapours in their atmospheres were supposed to be unable to produce marked absorption. His second class includes yellow stars like the Sun, whose temperature is lower; while his third class contains two divisions corresponding to the two types of red stars, whose

temperature is supposed to be low enough to permit chemical compounds to exist in their atmospheres.

In Lockyer's classification (*Phil. Trans.* vol. clxxxiv. A, pp. 675–726, 1893) the principal groups are as follows:—I. Nebulæ and bright-line stars. Radiation lines and flutings predominant. II. (Vogel's Class IIIa.) Mixed fluting radiation and absorption predominant. III. Stars like α Tauri, γ Cygni, and β Orionis. Line absorption predominant, with increasing temperature. IV. Stars like β Persei, α Andromedæ, and Sirius. Simplest line absorption predominant, hydrogen lines very broad. V. Stars like β Arietis, Procyon, and Capella. Line absorption predominant, with decreasing temperature. VI. (Vogel's Class IIIb.) Carbon absorption predominant. Lockyer's classification is based upon his hypothesis that stars are formed from the condensation of swarms of meteorites. The experimental basis of the hypothesis rests on Lockyer's identification of hydrogen lines, bright carbon bands, and a fluting of magnesium oxide observed in the spectra of meteorites heated in a vacuum, with lines and bands in the spectra of nebulæ. The universally distributed gas hydrogen is present in nebulæ, but most spectroscopists see no indications of carbon bands in nebular spectra, while Keeler has conclusively proved (*Publ. Lick Observatory*, vol. iii. p. 221) that the chief nebular line agrees neither in position nor character with the head of the magnesium oxide fluting. Red stars of Lockyer's Group II. (Vogel's IIIa.) are considered by him to be partially condensed swarms of meteorites; but Hale's recent investigations (*Astrophys. Journ.* vol. ix. p. 273; details in *Publ. Yerkes Observatory*, vol. ii.) indicate their close relationship with stars of Lockyer's Class VI. (Vogel's IIIb.), and confirm the common view that the two classes of red stars are to be regarded as co-ordinate branches, representing a stage of development later than that reached by the Sun.

In the *Draper Catalogue* of the spectra of 10,351 stars photographed at the Harvard Observatory with an objective prism (*Harvard Annals*, vol. xxvii.) Mrs Fleming employs an empirical classification, the relationship of which to the more recent classification of Miss Maury ("Spectra of Bright Stars photographed with the 11-inch Draper Telescope," *Harvard Annals*, vol. xxviii. part i.) will now be indicated. The essential features of Miss Maury's classification are as follows:—Groups I.–V. (*Draper Catalogue*, B and AB; Vogel's Ib.) Stars of Orion type. VI. (*D.C.*, AB.) Stars intermediate between the Orion stars and Secchi's first type. VII.–XI. (*D.C.*, A, AF, F) Stars of Secchi's first type. XII. (*D.C.*, FG) Stars intermediate between Secchi's first and second types. XIII.–XVI. (*D.C.*, G, K) Stars of Secchi's second type. XVII.–XX. (*D.C.*, Ma, Mb, Md) Stars of Secchi's third type. XXI. (*D.C.*, Na) Stars of Secchi's fourth type. XXII. (*D.C.*, O) Stars of Secchi's fifth type. With the exception of Group XXII., which for some reason is placed at the end rather than at the beginning of this series, the classification is considered to represent successive stages in stellar evolution, although this is not insisted upon in the discussion.

McClean's classification, which is amply illustrated by reproductions of a large number of photographs of stellar spectra taken in both hemispheres ("Comparative Photographic Spectra of Stars to 3 1–2 Magnitude," *Phil. Trans.* A, vol. cxci. pp. 127–138, 1898; *Spectra of Southern Stars*, London, 1898), involves a subdivision of Secchi's first type, and makes divisions IV., V., and VI. correspond to Secchi's types II., III., and IV. The numerous photographs in these volumes are very valuable for reference. In the second memoir an account is given of the discovery of the presence of oxygen in the spectrum of β Crucis.

Laplace's nebular hypothesis in its original form is open to serious objections of a dynamical nature, but it is almost universally held that stars are evolved from nebulæ through the long-continued action of gravitation. In any system of classifying spectra we should accordingly expect to find nebulæ rated first in order of development. The following classification of stellar spectra would appear to correspond most closely with current views:—I. Nebulæ. II. Helium stars. III. Stars of Secchi's first type. IV. Stars of Secchi's second type. Va. and Vb. Stars of Secchi's third and fourth types. There is still much uncertainty as to the classification of the bright-line stars, and it is indeed a question whether it will be possible to include all types of spectra in a single unbroken series. Schuster has alluded ("The Evolution of Solar Stars," *Proc. Phil. Soc. Glasgow*, 1901–02) to the doubtful validity of arguments based on the so-called law of uniformity; and the possibility must be admitted that in different regions of space, or through the action of different physical conditions, the path of evolution need not be precisely the same in all cases. The remarkable stars of the Wolf-Rayet type—all of which, with the exception of a few found in the Magellanic clouds, occur in the Milky Way—are probably in an early stage of development.

This is not the place for a discussion of the question of stellar evolution. In the paper just alluded to, Schuster makes many novel and valuable suggestions bearing upon this problem; and in their *Atlas of Representative Stellar Spectra*, Sir William and Lady Huggins interpret the long series of stellar spectra obtained in the course of their investigations. According to them the highest temperatures are attained in stars like the Sun, though Schuster and most other spectroscopists believe that the temperature of stars at the stage of development represented by Sirius is still higher.

Various special investigations of stellar spectra remain to be mentioned. The *Publicationen des Astrophysikalischen Observatoriums zu Potsdam* contain several important memoirs by the Potsdam observers. A visual spectroscopic survey with small dispersion of stars to the 7·5 magnitude in the zone $-1°$ to $+20°$, by Vogel and Müller (vol. iii. part iii.), has been followed by a photographic study with a single prism spectrograph of 528 stars of Vogel's Class I. (Vogel and Wilsing, vol. xii. part i.). In 1883 Vogel observed visually with the Vienna refractor the spectra of certain stars of Classes Ic., IIb., IIIa., and IIIb. (vol. iv. part i.). The spectra of some of the brighter stars photographed by Vogel in his investigations of motion in the line of sight were subsequently studied in detail by Scheiner (vol. vii. part ii.). Many other valuable papers by Vogel, Scheiner, Wilsing, Hartmann, and other Potsdam observers have been published in the *Sitzungsberichte* of the Prussian Academy, the *Astronomische Nachrichten*, and the *Astrophysical Journal*. Some of the extensive investigations made with the objective prism under Pickering's direction have already been alluded to. The preparation and discussion by Mrs Fleming of the *Draper Catalogue* of the spectra of 10,351 stars forms vol. xxvi. part i. of the *Harvard Annals*. In addition to Miss Maury's discussion of the spectra of bright stars (vol. xxviii. part i.), a study of the spectra of bright southern stars by Miss Cannon has appeared (vol. xxviii. part ii.). Numerous papers by Pickering may be found in the *Harvard Circulars* and the various journals. Campbell's important papers, which cover a wide range, including the spectra of Wolf-Rayet stars, temporary stars, planets, &c., are published in *Astronomy and Astrophysics*, the *Astrophysical Journal*, and the *Lick Observatory Bulletins*. Dunér's memoir, "*Sur les Étoiles à Spectres de la Troisième Classe*," contains the results of a visual spectroscopic survey of the

red stars and a discussion of their evolution. Many valuable papers have also been published by Newall, Bélopolsky, Deslandres, Sidgreaves, Espin, and others. The literature of the spectra of temporary stars is too extensive to be given here.

The principal investigations of the spectra of nebulæ are those of Huggins (*loc. cit.*), whose discovery of bright lines in their spectra demonstrated their gaseous nature; Keeler ("On the Spectra of the Orion Nebula and the Orion Stars," *Astron. and Astrophys.* vol. xiii. p. 476, 1894); Lockyer ("On the Photographic Spectrum of the Great Nebula in Orion," *Phil. Trans.* vol. clxxxvi. p. 73, 1895); von Gothard ("Studies on the Photographic Spectra of the Planetary Nebulæ," *Astron. and Astrophys.* vol. xii. p. 51, 1893); Campbell, who discovered differences in the relative intensities of the lines in different parts of the Orion nebula, and mapped the spectra of other nebulæ (*Astron. and Astrophys.* vol. xiii. pp. 384, 494); and Wright (*Lick Observatory Bulletin*, No. 19). Of the nineteen lines measured by Wright, six are due to hydrogen and three to helium. For information regarding the spectra of planets, comets, meteors, lightning, the aurora, &c., reference must be made to the technical journals and the proceedings of societies.

A comprehensive treatise on Spectroscopy, designed to cover the whole subject, is KAYSER'S *Handbuch der Spectroscopie*, two volumes of which have been published. Reference may also be made to SCHEINER'S *Astronomical Spectroscopy* (translated by Frost), and to the journals mentioned in this article. (G. E. H.)

Speculum Perfectionis.—Recent years have seen so great an increase of our knowledge of St Francis of Assisi and his disciples that it amounts practically to a rediscovery. This has been the result of the publication of original documents by various scholars: by the Roman canon Amoni (uncritical as most of his work is), by the Franciscans of Quaracchi (near Florence) and elsewhere, above all by M. Paul Sabatier, to whom belongs the credit not only of having written by far the best life of St Francis of Assisi in existence, but of having shown marvellous insight and skill in the discovery of long-lost documents. M. Sabatier has taken the lead in everything connected with the study of St Francis and his companions, and in 1902 founded a "Société Internationale d'Études Franciscaines" at Assisi, with the object of banding together those who are engaged in these studies. Among the documents which have already been recovered the following may be mentioned: the ancient Rule (*circ.* A.D. 1228) of the Third Order of St Francis, the *Tractatus de Indulgentia S. Mariæ de Portiuncula* (which may perhaps prove, as M. Sabatier holds that it does, the genuineness of the Indulgence), the original Latin basis of the *Fioretti di san Francesco*, a number of fragments of various kinds; above all, the *Speculum Perfectionis*, which is the work, for the most part at any rate, of Brother Leo of Assisi. This is beyond all doubt the oldest of the various accounts of the saint's life, having been finished, according to the colophon, on 11th May, in the year 1228 (according to the Pisan reckoning, *i.e.*, 1227 according to ours); so that it was completely written many months before the first life by Thomas of Celano was begun. Its value is great, not only on account of its extreme vigour and freshness, but as giving us the impression of a disciple who stood nearest to Francis, and who had watched with a somewhat jealous eye the development of a quasi-monastic order out of what had at first been a popular religious movement. It is indeed the work of a man who writes with a definite purpose, namely, to vindicate the intentions of his dead master against tendencies which are all the other way; and this fact must of course be borne in mind in reading it. But the presentment is as essentially true as it is beautiful. St Francis was primarily the simple follower of Christ who desired to lead other simple men in the same way, not the founder of a monastic order; what was subsequently known as the Third Order was not an after-thought but of the very essence of his work. Although the fact was studiously glossed over in the later lives, there can be no question that Francis stood aloof from the formal development of the Minorite Order after 1221, and he appears to have been very little in sympathy with it. This fact is carefully and increasingly ignored in the later lives; and the *Speculum Perfectionis* is the starting-point of a series of *legenda*, ever becoming more formal and more conventional, which ends with the authorized life of the founder of the Order by St Bonaventura. Regarded, then, from the point of view of the light which it throws upon the relations between St Francis and the society which bears its name, the value of the *Speculum* is, and must remain, unequalled.

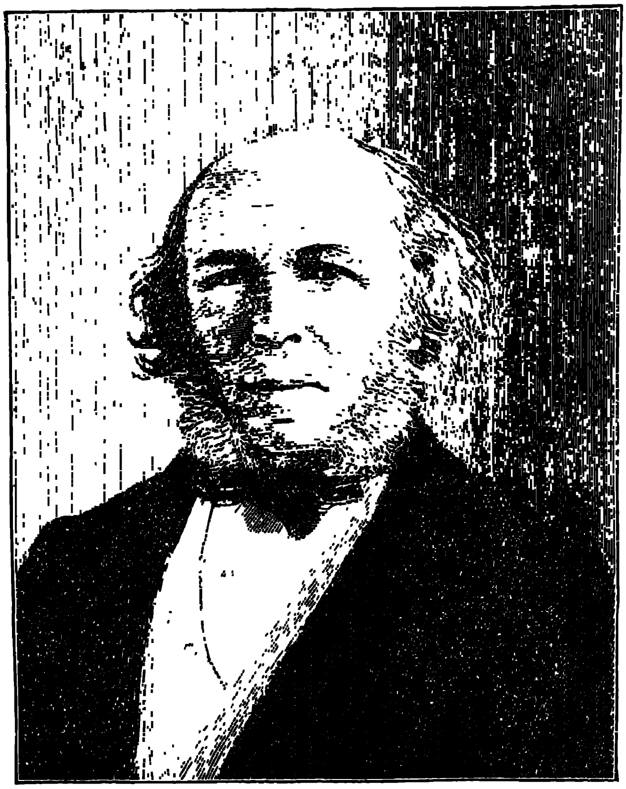
AUTHORITIES.—P. SABATIER. *Collection d'études et de documents pour l'histoire du Moyen Age* (especially vol. i., *Speculum Perfectionis*).—SEBASTIAN EVANS. *The Mirror of Perfection* (Eng. trans.). London, 1898.—P. SABATIER. *Vie de S. François d'Assise.* Paris, 1894 (Eng. trans. by Harwood, London, 1894).—*Analecta Franciscana*, Quaracchi (Ad Claras Aquas), 1885. (W. E. CO.)

Spencer, a town of Worcester county, Massachusetts, U.S.A. It is situated in the central part of the state, a few miles west of Worcester, and contains an area of 34 square miles of hilly country, diversified with lakes and ponds. The principal village, bearing the same name as the town, is on the Boston and Albany Railroad, and has an altitude of 812 feet. Its principal industries are shoe and wire making. Population of the town (1900), 7627, of whom 1614 were foreign-born.

Spencer, Herbert (1820-——), English philosopher, was born at Derby on 27th April 1820. His father, William George Spencer, was a schoolmaster, and his parents' religious convictions familiarized him with the doctrines of the Methodists and Quakers. He declined an offer from his uncle, the Rev. Thomas Spencer, to send him to Cambridge, and so was practically self-taught. During 1837–46 he was employed as a railway engineer; 1848–53 as sub-editor of the *Economist.* From about this time to 1860 he contributed a large number of articles to the *Westminster Review*, which contain the first sketches of his philosophic doctrines. He also published two larger works, *Social Statics* in 1850, and *Principles of Psychology* in 1855. In 1860 he sent out the syllabus of his *Synthetic Philosophy* in ten volumes, and in spite of frequent ill-health had the satisfaction of completing it in 1896 with the third volume of the *Principles of Sociology*. Herbert Spencer's significance in the history of English thought depends on his position as the philosopher of the great scientific movement of the second half of the 19th century, and on the friendship and admiration with which he was regarded by men like Darwin, G. H. Lewes, and Huxley. Spencer tries to express in a sweeping general formula the belief in progress which pervaded his age, and to erect it into the supreme law of the universe as a whole. His labours coincided in time with the great development of biology under the stimulus of the Darwinian theory, and the sympathizers with the new views, feeling the need of a comprehensive survey of the world as a whole, very widely accepted Spencer's philosophy at its own valuation, both in England and, still more, in America. In spite of this, however, his heroic attempt at a synthesis of all scientific knowledge could not but fall short of its aim. Living at the commencement of an epoch of unparalleled scientific activity,

Spencer could not possibly sum up and estimate its total production. To the specialists in sciences which were advancing rapidly and in divergent directions to results which often reacted on and transformed their initial assumptions, Spencer has often appeared too much of a philosopher and defective in specialist knowledge. To the technical philosophers, who strictly confine themselves to the logical collation and criticism of scientific methods, he has contrariwise not seemed philosophic enough. Hence his doctrines were open to damaging attacks from both sides, the more so as he always stood aloof from the academic spirit and its representatives. It seems unlikely therefore that as a system the *Synthetic Philosophy* will prove long-lived; but this hardly detracts from its fruitfulness as a source of suggestion, or from the historic influence of many of its conceptions on the culture of the age.

This estimate of Spencerian philosophy may be substantiated by a brief survey of its origin and leading characteristics. Spencer claims, with some reason, that he was always an evolutionist. But his notions of what "evolution" is developed quite gradually. At first he seems to have meant by the word only the belief that progress is real, and that the existing order of nature is the result of a gradual process and not of a "special creation." In *Social Statics* (1850) he still regards the process teleologically, and argues after the fashion of Paley that "the greatest happiness is the purpose of creation" (chap. iii. § 1), and that to "gag the moral sentiment" is "to balk creative design" (ch. xxxii. § 7). But this phraseology soon disappears, without his considering how, in default of some sort of teleology, it is legitimate to treat the world's history as a process. In *The Development Hypothesis* (1852) he objects strongly to the incredibility of the special creation of the myriad forms of life, without, however, suggesting how development has been effected. In *Progress, its Law and Cause* (1857) he adopted von Baer's law, that the development of the individual proceeds from the homogeneous to the heterogeneous. This is at once connected with the nebular hypothesis, and subsequently "deduced" from the ultimate law of the "persistence of force," and finally supplemented by a counter-process of dissolution, all of which appears to Spencer only as "the addition of von Baer's law to a number of ideas that were in harmony with it." It is clear, however, that Spencer's ideas as to the nature of Evolution were already pretty definite when Darwin's *Origin of Species* (1859) revolutionized the subject of organic evolution by adding natural selection to the direct adaptation by use and disuse, and so suggesting an intelligible method of producing modifications in the forms of life. Spencer welcomed the Darwinian theory, and enriched it with the phrase "survival of the fittest"; but he did not give up the (Lamarckian) belief in the hereditary transmission of the modifications of organisms by the exercise of function. Shortly afterwards (1860) he sent out the prospectus of a systematic exposition of his *Synthetic Philosophy*, of which the first volume, *First Principles*, appeared in 1862. This work is divided into two parts; the first intended to show that while ultimate metaphysical questions are insoluble they compel to a recognition of an inscrutable Power behind phenomena which is called the Unknowable; the second devoted to the formulation and illustration of the Law of Evolution. In the first part Spencer's argument rests on Mansel's *Limits of Religious Thought* and Hamilton's "philosophy of the conditioned" (and so ultimately on Kant), and tries to show that alike in scientific and religious thought the ultimate terms are "inconceivable" (not by him distinguished from "unimaginable"). In science the more we know the more extensive "the contact with surrounding nescience." In religion the really vital and constant element is the sense of mystery. This is illustrated by the difficulties inherent in the conception of Cause, Space, Time, Matter, Motion, the Infinite, and the Absolute, and by the "relativity of knowledge," which precludes knowledge of the Unknowable, since "all thinking is relationing." Yet the Unknowable may exist, and we may even have an "indefinite knowledge" of it, positive, though vague and extralogical. Hence both science and religion must come to recognize as the "most certain of all facts that the Power which the Universe manifests to us is utterly inscrutable." Thus to be buried side by side in the Unknowable constitutes their final reconciliation, as it is the refutation of irreligion, which consists of "a lurking doubt whether the Incomprehensible is really incomprehensible."



Herbert Spencer.
(From a photograph by Elliott and Fry, London.)

Such are the foundations of Spencer's metaphysic of the Unknowable, to which he resorts in all the fundamental difficulties which he subsequently encounters. Whatever its affinities with that version of "faith" which regards it as antagonistic to knowledge, it can hardly be deemed philosophically satisfactory. A failure to solve the problems of metaphysics must always remain a failure, in spite of all protestations that it was inevitable; and it in no wise justifies an advance to so self-contradictory an *asylum ignorantiæ* as the Unknowable. In the edition of his *First Principles* published in 1900, Spencer adds a "postscript" which shows some consciousness of the contradiction involved in his knowledge of the Unknowable, and finally contends that his account of the Knowable in part ii. will stand even if part i. be rejected. Even this, however, understates the case, seeing that a really inscrutable Unknowable would destroy all confidence in the order of nature and render all knowledge entirely precarious.

In part ii. Spencer recognizes successively likenesses and unlikenesses among phenomena (the effects of the Unknowable), which are segregated into manifestations, vivid (object, non-ego) or faint (subject, ego), and then into

space and time, matter and motion and force, of which the last is symbolized for us by the experience of resistance, and is that out of which our ideas of matter and motion are built. Hence the Persistence of Force is the ultimate basis of knowledge. From it Spencer proceeds to deduce the indestructibility of matter and energy, the equivalence and transformation of forces, the necessity of a rhythm, of Evolution (*i.e.*, integration of matter with concomitant dissipation of motion) and Dissolution, and finally reaches the statement of the Law of Evolution as "an integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity, and during which the retained motion undergoes a parallel transformation." This process of Evolution is due to "the instability of the homogeneous," the "multiplication of effects" and their "segregation," continuing until it ceases in complete "equilibration." Sooner or later, however, the reverse process of Dissolution, with its absorption of motion and disintegration of matter, which indeed has always been going on to some extent, must prevail, and these oscillations of the cosmic process will continue without end.

It appears, therefore, that Spencer ultimately describes the Knowable in terms of the mechanical conceptions of matter and motion, and that this must give a materialistic colouring to his philosophy. There are, however, other flaws also in his procedure. The Persistence of Force, *i.e.*, his version of the methodological assumption of constancy in the quantitative aspects of phenomena, seems a very unsuitable basis for a philosophy of progress. To such a philosophy a consideration of the conditions, if any, under which progress can be conceived as ultimately real, seems a necessary preliminary, which Spencer omits. He also assumes that "Evolution" is a real, nay an ultimate, law of nature, but his evidence only goes to show that it is a result, in some cases, of the complex interaction of laws, which like Rhythm, Segregation, &c., are in their turn only tendencies, and may be, and often are, counteracted. By the after-thought of a "dissolution" process (2nd ed. of *First Principles*) Spencer in a way admits this, but introduces fresh difficulties as to its relation to "evolution." If the two processes go on together, both are tendencies, and whether there is on the whole progress or not will depend on their relative strength; neither can be universal, nor the "law" of cosmic existence, unless its co-existing rival is regarded as essentially secondary. But if so, it ceases to be available as evidence of a coming reversal of the dominant process. If, on the other hand, the processes are strictly alternative, a world which *ex hypothesi* exemplifies the one can never justify us in inferring the other. Spencer appeals alternately to the "instability of the homogeneous" and the impossibility of complete equilibration to keep up the cosmic see-saw, but he can do so only by confining himself to a *part* of the universe. A world *wholly* homogeneous or equilibrated could no longer change, while so long as a part only is in process, the process can not be represented as universal. Again, an infinite world cannot be *wholly* engaged either in evolution or in dissolution, so that it is really unmeaning to discuss the universality of the cosmic process until it is settled that we have a universe at all, capable of being considered as a whole. In the last resort, therefore, Spencer fails to deduce philosophically not only the necessity of progress, but also its compatibility with the evolution-dissolution oscillation, and even the general possibility of conceiving the world as a process. In other words, in spite of his intentions he does not succeed in giving a metaphysic of evolutionism.

In the *Principles of Biology* the most notable points are the definition of life as the continuous adjustment of internal to external relations, and the consistent emphasis on the need of adapting the organism to its environment. This exaggerates the passivity of life, and does not sufficiently recognize that the higher organisms largely adjust external to internal relations and adapt their environment to their needs. His universal process of Evolution seems to give Spencer a criterion of "higher" and "lower," "progression" and "degeneration," independent of the accidents of actual history, and unattainable by strictly Darwinian methods. The higher (at least in times of "evolution") is the more complex and differentiated, whether it invariably survives or not. On the other hand, he advances too easily from the maxim that function is prior to, and makes, structure to the conclusion that the results of use and disuse are therefore immediately incarnated in structural adaptations capable of hereditary transmission. This inference has involved him in much controversy with the ultra-Darwinians of Weismann's school, who deny the possibility of the inheritance of acquired characteristics altogether. And though Spencer's general position, that it is absurd to suppose that organisms after being modified by their life should give birth to offspring showing no traces of such modifications, seems the more philosophic, yet it does not dispose of the facts which go to show that most of the evidence for the direct transmission of adaptations is illusory, and that beings are organized to minimize the effects of life on the reproductive tissues so that the transmission of the effects of use and disuse, if it occurs, must be both difficult and rare—far more so than is convenient for Spencer's psychology.

In his *Principles of Psychology* Spencer advocates the genetic explanation of the phenomena of the adult human mind by reference to its infant and animal ancestry. On the fundamental question, however, of the psychophysical connexion and the derivation of mind from matter, his utterances are neither clear nor consistent. On the one hand his whole formulation of Evolution in mechanical terms urges him in the direction of materialism, and he attempts to compose the mind out of homogeneous units of consciousness (or "feeling") "similar in nature to those which we know as nervous shocks; each of which is the correlative of a rhythmical motion of a material unit or group of such units" (§ 62). On the other hand, when pressed by his disciple, Fiske (*Outlines of Cosmic Philosophy*, ii. p. 444), he is ready to amend *nervous* into *psychical* shocks, which is no doubt what he ought to have meant but could not say without ruining the illusory bridge between the psychical and the physiological which is suggested in the phrase "nervous shock." And he admits (§ 63) that if we were compelled to choose between translating mental phenomena into physical and its converse, the latter would be preferable, seeing that the ideas of matter and motion, merely symbolic of unknowable realities, are complex states of consciousness built out of units of feeling. But easiest of all is it to leave the relation of the unknowable "substance of Mind" to the unknowable "substance of Matter" (substance he throughout conceives as the unknowable substrate of phenomena) to the Unknowable, as he finally does. To the theory of knowledge Spencer contributes a "transfigured realism," to mediate between realism and idealism, and the doctrine that "necessary truths," acquired in experience and congenitally transmitted, are *à priori* to the individual, though *à posteriori* to the race, to mediate between empiricism and apriorism. It has already been explained, however, that the biological foundations of the latter doctrine are questionable.

In the *Principles of Sociology* Spencer's most influential ideas have been that of the social organism, of the

origination of religion out of the worship of ancestral ghosts, of the natural antagonism between nutrition and reproduction, industrialism and warfare. Politically, Spencer is an individualist of an extreme *laissez faire* type, and it is in his political attitude that the consequences of his pre-Darwinian conception of Evolution are most manifest. But for this he would hardly have established so absolute an antithesis between industrial and military competition, and have shown himself readier to recognize that the law of the struggle for existence, just because it is universal and equally (though differently) operative in every form of society, cannot be appealed to for guidance in deciding between the respective merits of an industrial or military and of an individualist or socialist organization of society.

In the *Principles of Ethics* Spencer, though relying mainly on the objective order of nature and the intrinsic consequences of actions for the guidance of conduct, conceives the ethical end in a manner intermediate between the hedonist and the evolutionist. The transition from the evolutionist criterion of survival, which in itself it is difficult to regard as anything but non-moral, to the criterion of happiness, is effected by means of the psychological argument that pleasure promotes function and that living beings must, upon pain of extinction, sooner or later take pleasure in actions which are conducive to their survival. Hence pleasure is, on the whole, good, and asceticism reprehensible, although in man's case there has arisen (owing to the rapidity of evolution) a certain derangement and divergence between the pleasant and the salutary (§ 39). Nevertheless pleasure forms an "inexpugnable element" of the moral aim (§ 16). Conduct being the adjustment of acts to ends, and good conduct that which is conducive to the preservation of a pleasurable life in a society so adjusted that each attains his happiness without impeding that of others, life can be considered valuable only if it conduces to happiness. On the other hand, life must in the long run so conduce, whatever its present value may appear to be, because a constant process of adjustment is going on which is bound sooner or later to lead to a complete adjustment which will be perfect happiness. This is the refutation of pessimism, which ultimately agrees with optimism in making pleasure the standard of value. In this reasoning Spencer appears to have overlooked the possibility of an expansion of the ethical environment. If this is as rapid as (or more rapid than) the rate of adaptation, there will be no actual growth of adaptation and so no moral progress. Complete adaptation to an infinitely-receding ideal is impossible, and relative adaptation depends on the distance between the actual and the ideal. Spencer, however, considers that he can not only anticipate such a state of complete adjustment, but even lay down the rules obtaining in it, which will constitute the code of "Absolute Ethics" and the standard for discerning the "least wrong" actions of relative ethics. He conceives it as a state of social harmony so complete that in it even the antagonism between altruism and egoism will have been overcome. Both of these are original and indispensable, but egoism has the priority, since there must be egoistic pleasure somewhere before there can be altruistic sympathy with it. And so in the ideal state every one will derive egoistic pleasure from doing such altruistic acts as may still be needed. In it, too, the sense of duty will have become otiose and have disappeared, being essentially a relic of the history of the moral consciousness. Originally the socially salutary action was in the main that which was enjoined on the individual by his political and religious superiors and by social sentiment; it was also in the main that to which his higher, more complex and re-representative feelings prompted. Hence the fear with which the political, religious, and social controls were regarded came to be associated also with the specifically moral control of lower by higher feelings, and engendered the coercive element in the feeling of obligation. Its authoritativeness depends on the intrinsic salutariness of self-control, and must cease to be felt as the resistance of the lower feelings relaxes. Hence Spencer concludes that the sense of duty is transitory and must diminish as moralization increases. In the preface to the last part of his *Ethics* (1893) Spencer regrets that "the Doctrine of Evolution has not furnished guidance to the extent he had hoped," but his contributions to ethics are not unlikely to be the most permanently valuable part of his philosophy.

After completing his system (1896) Spencer continued to revise it, and brought out new editions of the *Biology* (1898–99) and *First Principles* (1900). The dates of his chief works are as follows:—1842, Letters to the *Nonconformist*, "*The Proper Sphere of Government.*" 1850, *Social Statics*. 1852, *The Theory of Population* (*cf.* part vi. of *Biology*); *The Development Hypothesis* (in *Essays*, vol. i.). 1853, *The Universal Postulate* (cf. *Psychology*, part vii.). 1854, *The Genesis of Science* (in *Essays*, vol. ii.). 1855, *Principles of Psychology* (1 vol.). 1857, *Progress, its Law and Cause* (*Essays*, vol. i.). 1858, *Essays* (containing most of his contributions to the *Westminster Review*; vol. ii., 1863; vol. iii., 1885). 1861, *Education: Intellectual, Moral, Physical.* 1862, *First Principles* (2nd ed. 1867, 6th 1900). 1864–67, *Principles of Biology* (2 vols.). 1872, *Principles of Psychology* (2nd ed., in 2 vols.). 1873, *The Study of Sociology*. 1876, vol. i. of *The Principles of Sociology*; vol. ii., *Ceremonial Institutions*, 1879, *Political Institutions*, 1882; vol. iii., *Ecclesiastical Institutions*, 1885, completed 1896. 1879, *The Data of Ethics* (part i. of *Principles of Ethics* in 2 vols.; part iv., *Justice*, 1891; parts ii. and iii., *Inductions of Ethics* and *Ethics of Individual Life*, 1892; parts v. and vi., *Negative and Positive Beneficence*, 1893). 1884, *Man versus the State*. 1886, *Factors of Organic Evolution*. 1893, *Inadequacy of Natural Selection*. 1894, *A Rejoinder to Professor Weismann* and *Weismannism once more*. 1897, *Fragments*. 1902, *Facts and Comments*. For a full bibliography of his works see W. H. HUDSON'S *Introduction to the Philosophy of Herbert Spencer* (up to 1895); and for a useful summary of his chief doctrines by Spencer himself, his preface to COLLINS'S *Epitome of the Synthetic Philosophy*. He also supervised the compilation of a *Descriptive Sociology*, of which eight parts were published.

Spennymoor, a market town and railway station, Durham, England, in the Bishop Auckland parliamentary division of the county, 6 miles south of Durham. Victoria Park, 10 acres in extent, was opened in 1889. In 1894 the urban district was extended (16,300 acres) to include several neighbouring parishes. Population (1891), 16,353; (1901), 16,661.

Spezia, an Italian city, and the greatest maritime arsenal in the realm, situated in the province of Genoa, at the extremity of the Riviera di Levante, 56 miles south-east of Genoa by rail. The Bay of Spezia is sheltered from all except southerly winds, and on its western shore are numerous openings, which afford perfectly safe anchorage in all weathers. The arsenal consists of three departments, the principal of which is 3937 feet long, with an average width of 2460 feet. The chief basin is 23 acres in extent, and the second—connected with the first by a recently-completed canal 91 feet wide—36 acres. Both basins have an average depth of between 33 and 35 feet. The second basin gives access to the docks, of which there are six; two 390 feet long, two 420 feet long, one 500 feet long, and one 650 feet long. The establishment of San Vito is devoted entirely to the production of artillery; that of San Bartolomeo is now exclusively used for electrical works and the manufacture of submarine weapons. The opening of a railway across the Apennines, placing Spezia in communication with Parma and the most fertile regions of the Po valley, has so stimulated commerce that a new port to the east of the city has had to be built. This harbour consists of a broad quay with 657 feet of wharfage, and of a mole 1639 feet long with 984 feet of

wharfage. The basin of the harbour is about 26 feet deep. A branch railway connects the wharves directly with the main line. Since the opening of the new port the traffic has considerably increased, the figures for 1899 being 753 Italian vessels (574 sailing vessels, 179 steamers), and 232 foreign steamers of an aggregate tonnage of 228,257 tons displacement. Several important industrial establishments lie along the bay, including large lead and silver works at Pertusola, submarine cable works, and a shipyard for the construction of mercantile vessels. Worthy of notice in the neighbourhood are the picturesque Portovenere, with its Grotto Arpaia, also known as Byron's Grotto, from the tradition that Byron drew from it inspiration for his poem "The Corsair"; Lerici and its castle, where Francis I. of France was imprisoned after the battle of Pavia; and San Terenzo, a residence of Shelley and the place of his death. Population (communal) (1890), 44,342; (1900), 63,163.

Spheres of Influence.—"Spheres of influence," "spheres of action," "spheres of interest," "zones of influence," "field of operations," "Machtsphäre," "Interessensphäre," are phrases which have come into use to describe regions as to which nations have agreed that one or more of them shall have exclusive liberty of action. These phrases became common after 1882, when the "scramble for Africa" began, to describe diplomatic arrangements with respect to it. Some definitions may be quoted:—When secretary of state for the Colonies, Lord Knutsford, replying to a deputation in 1890, said: "'Sphere of action' is a term I do not wish to define now; but it amounts to this: we should not allow the Portuguese, Germans, or any foreign nation or republic to settle down and annex the territory" (quoted in Keane's *Compendium of Geography*, i. 21). "The term 'sphere of influence' implies an engagement between two states that one of them will abstain from interfering or exercising influences within certain territories which, as between the contracting parties, are reserved for the operation of the other" (Ilbert, *Government of India*, 431 *n.*). "Unter 'Interessensphäre' oder 'Machtsphäre' versteht man nämlich das auf Grund von Vereinbarungen unter den betheiligten Kolonialstaaten abgegrenzte Gebiet, innerhalb dessen ein Staat ausschliesslich berechtigt ist, seine koloniale Herrschaft durch Besitzergreifung oder Abschluss vor Protectoratsverträgen zu begründen oder doch einen für die in diesem Gebiete vorhandenen Völkerschaften massgebenden politischen Einfluss auszuüben" (Stengel, *Die deutschen Schutzgebiete*, p. 18). "The term 'sphere of influence or sphere of interest' has been given an extended meaning by recent developments. Formerly it was used to signify a region wherein a nation, through its citizens, had acquired commercial or industrial interests without having asserted any political protectorate or suzerainty. To-day, as used in China and elsewhere, the term applies rather to a region pre-empted for further exploitation and possibly for political control" (Dr Reinisch's *Politics*, pp. 60, 61). "A portion of a non-Christian or uncivilized country which is the subject of diplomatic arrangements between European States, but has not yet developed into a protectorate" (Jenkyn's *British Rule and Jurisdiction beyond the Seas*). See also Hall, 4th ed. 134.

Definitions.

The reasons for making these arrangements are to be explained partly by reference to the history of international law as to occupation. The Roman jurists recognized certain "natural modes" of acquiring property, in particular *traditio* and *occupatio.* The doctrines which the Roman jurists had worked out as to acquisition of private property by occupation were applied to the appropriation by states or their subjects of vacant lands (*res nullius*), including lands in the possession of barbarous tribes. "Quod enim nullius est, id ratione naturali occupanti conceditur" (*Institutes*, ii. 1–12). The Roman law required the *animus domini*—there must be seizure for and on behalf of the owner. There must be "*apprehensio.* Apiscimur possessionem corpore et animo, neque per se animo aut per se corpore" (*Dig.* 41, 2–3). Professing to act on these doctrines, and relying also on an assumed right on the part of Christian nations to subdue obdurate non-Christian communities, the navigators and explorers of the 15th and 16th centuries made exorbitant claims. Having occupied certain points on the coast-line, they claimed to have occupied a whole island or continent (De Martens, 1, 462). They made vast claims under Papal bulls; for example, under the bull of Nicholas V. of 1454, and the bull of Alexander VI. of 1494, which assigned to the Portuguese the empire of Guinea just discovered. It was one of Grotius's services to diffuse sounder ideas, and to point out that Roman law gave no support to these pretensions: "Invenire non illud est oculis usurpare, sed apprehendere" (*Mare Liberum*, c. 2). He insisted that "occupatio autem publica eodem modo fit quo privata territoria sunt ex occupationibus populorum ut privata dominia ex occupationibus singulorum." In recent times the old doctrine that discovery without occupation confers an independent right to the land so discovered of any extent is discredited. The tendency is to insist on actual occupation as a condition of legitimate possession or sovereignty (see correspondence between Great Britain and Portugal, State Papers, 79, p. 1062), and to treat the discoverer's right as merely inchoate. Thus, in opening the Conference at Berlin in 1884, Prince Bismarck said: "Pour qu'une occupation soit considérée comme effective, il est, de plus, à désirer que l'acquéreur manifeste, dans délai raisonnable, par des institutions positives, la volonté et le pouvoir d'y exercer ses droits et de remplir les devoirs qui en résultent." This doctrine is recognized in Articles 34 and 35 of the General Act of Berlin, the former of which states that "any Power which henceforth takes possession of a tract of land on the coast of the African continent outside its possessions, or which being hitherto without such possessions shall acquire them, as well as the Power which assumes a protectorate, shall accompany the respective act with a notification thereof, addressed to the other Signatory Powers of the present Act, in order to enable them, if need be, to make good any claim of their own." To a similar effect wrote Lord Salisbury in 1887 with reference to the claims of Portugal in East Africa. "Great Britain considers that it has been admitted in principle by all the parties to the Act of Berlin that a claim of sovereignty in Africa can only be maintained by real occupation of the territory claimed; and that the doctrine has been practically applied in the recent Zambezi delimitation (State Papers, 79, 1063). No paper annexation of territory can pretend to validity as a bar to the enterprise of other nations." At its session at Lausanne, in 1889, the Institut de Droit International adopted the following principles:—

Rights of discoverer and occupation.

"Article 1.—L'occupation d'un territoire à titre de souveraineté ne pourra être reconnue comme effective que si elle réunit les conditions suivantes: 1° La prise de possession d'un territoire enfermé dans certaines limites, faite au nom du gouvernement. 2° La notification officielle de la prise de possession. La prise de possession s'acceptit par l'établissement d'un pouvoir local responsable, pourvu de moyens suffisants pour maintenir l'ordre et pour assurer l'exercice régulier de son autorité dans les limites du territoire occupé. Ces moyens pourront être emprientés à des institutions existantes dans le pays occupé. La notification de la prise de possession de fait, soit pour la publication dans la forme qui, dans chaque état, est en usage pour la notification des actes

officiels soit par la voie diplomatique. Elle contiendra la détermination approximative des limites du territoire occupé" (*Annuaire* 10, 201).

This development of international law naturally led to arrangements as to "spheres of influence." Nations which had not yet settled or occupied, or established protectorates, in regions contiguous to their existing possessions, were desirous to retain a hold over the former, and proceeded to enter into treaties defining the spheres of influence.

The following are some of the chief treaties by which such spheres are defined:—

Great Britain and Portugal as to Africa, 20th August 1890, 14th November 1890, and 11th June 1891. Great Britain and France as to Upper Niger, 20th January 1891; 15th November 1893, as to Lake Chad. Great Britain and France as to Siam, 15th January 1896. The two Governments engage to one another "that neither of them will, without the consent of the other in any case or under any pretext, advance their armed forces into the regions, &c." They also engage not to acquire within this region any special privilege or advantage which shall not be enjoyed in common, or equally open to Great Britain and France or their nationals and dependants. Great Britain and Italy as to Africa, 15th April 1891; 5th May 1894, as to region of the Gulf of Aden. Congo and Portugal, 25th May 1891, as to "sphères de souveraineté et d'influence" in the region of Lunda. Great Britain, Belgium, and Congo, 12th May 1894, as to the sphere of influence of the independent Congo State. Great Britain and Germany, 1st July 1890 and 15th November 1893, as to East and Central Africa. Great Britain and Russia as to the spheres of influence to the east of Lake Victoria in the region of the Pamirs, 11th March 1895.

As an example of the promises or engagements in such treaties may be quoted that between Great Britain and Portugal of the 20th August 1890. Portugal engages that the territory of which the limits are defined in Article 3 shall not, without the consent of Great Britain, be transferred to any other Power. In the treaty between the same Powers of 14th November 1890 it is stipulated that neither Power will make, tender, accept protectorates, or exercise any act of sovereignty, &c. Sometimes a treaty defining spheres of influence declares that such and such territory shall be neutral.

Being the result of treaties, arrangements as to spheres of influence bind only the parties thereto. As Mr Olney, in his correspondence with Lord Salisbury in regard to Venezuela, remarked: "Arrangements as to spheres of influence are new departures, which certain great European Powers have found necessary and convenient in the course of their division among themselves of great tracts of the continent of Africa, and which find their sanction solely in their reciprocal obligations" (United States No. 2, 1896, p. 27).

Some treaties expressly declare that the arrangement shall not affect the rights of other Powers (Stoerck, *Recueil*, 16, p. 932). No doubt, however, the tendency is for spheres of influence to become protectorates. It may be mentioned that Germany and Holland have concluded a treaty (21st December 1897) by which the latter agrees to extradite German criminals in spheres of influence. By an agreement of 12th May 1894 between Great Britain and the Congo State, the former granted to the latter a lease of territories comprised within the sphere of influence laid down in the Anglo-German agreement of 1st July 1890 (19 *Hertslet*, p. 179).

Somewhat akin to the rights of a State in a sphere of influence are those possessed by Germany in the zone surrounding the protectorate of Kiaochow under the treaty of 6th March 1898, and the rights obtained under treaties with China that certain provinces shall not be alienated.

Somewhat similar arrangements as to ports of the sea are not unknown. Grotius in his *Mare Liberum* says: "Illud interim fatemur, potuisse inter gentes aliquas convenire, ut capti in maris hac vel illa parte, hujus aut illius reipublicæ judicium subirent, atque ita ad commoditatem distinguendæ jurisdictionis in mari fines describi, quod ipsos quidem eam sibi legem ferentes obligat, at alios populos non item; neque locum cujus proprium facit, sed in persona contrahentium jus constituit" (c. 5).

The best known example of a claim to a sphere of influence, which is not the result of any treaty, is the Monroe doctrine, first broached by President Monroe in 1823. The Romans had their equivalent to the Monroe doctrine; they forbade any Asiatic king entering Europe and conquering any part of it; the breach of this rule was their chief grievance against Mithradates (Montesquieu, *De la Grandeur et de la Décadence des Romains*, c. 6).

Hinterland. Claims somewhat similar to those relating to spheres of influence have been put forward as against the whole world, in virtue of the right of continuity or the doctrine of the hinterland. Sometimes it is called the "Doctrine of Contiguity," or "Droit de Vicinité, de priorité, de préemption, ou d'enclave." He who occupies a part of a well-defined close or *fundus*, a parcel of land with artificial or natural boundaries, which enables him to control the whole area, may be said to occupy it. He need not be present everywhere, or enter on every part of it: "Sufficit quamlibet partem ejus fundi introire, dum mente et cogitatione hac sit, uti totum fundum usque ad terminum velit possidere" (*Dig.* 41, 2, 3). In virtue of a supposed analogy to such occupation, it has been said that the occupation of the mouth of a river is constructive occupation of all its basin and tributaries, and that the occupation of part of a territory extends to all the country of which it forms physically a part. A State, having actually occupied the coast, may claim to reserve to itself the right of occupying from time to time territory lying inland (hinterland). In the discussions as to the western boundary of Louisiana between the Commissions of the United States and Spain, as to Oregon, as to the claims of the Portuguese in East Africa, and as to the boundaries of Venezuela, the question of the extent of the rights of the discoverer and occupier came up. Portugal actually claimed all territory lying between her African possessions. It has been urged that the subsequent settlement within a reasonable time of the mouth of a river, "particularly if none of its branches had been explored prior to such discovery, gave the right of occupation, and ultimately of sovereignty, to the whole country drained by such river and its several branches." Another form of the same doctrine is, that the occupier of a part of the sea-coast thereby acquires rights "extending into the interior of the country to the sources of the rivers emptying within that coast, to all their branches, and the country they cover" (Twiss, *Laws of Nations in Time of Peace*, 170; Twiss, *Oregon Question*, 245; Bluntschli, s. 282; Phillimore, *Commentaries*, 236; Westlake, *International Law*, 166).

Lord Salisbury has referred to "the modern doctrine of hinterland with its inevitable contradictions" (United States, No. 2, 1896, p. 12). Certainly it is inconsistent with the doctrine, more and more received in recent times, that effective possession is necessary to found a title to sovereignty or control. It is akin to the extravagant claims of the early Portuguese and Spanish navigators to territory on which they had never set foot or eyes. The doctrine of the hinterland is likely to become less important, now that Africa has been parcelled out.

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Correspondence as to Delagoa Bay (Portugal, No. 1, 1875, p. 191). *British Counter Case, Venezuela*, No. 2, 1899, p. 135. *Annuaire de l'Institut de Droit International*, 9, 243; 10, 173. *Revue de Droit International*, 17, 113; 18, 433; 19, 371. *Venezuelan Papers*, No. 4, 1896. (J. M†.)

Spherical Harmonics are certain functions of fundamental importance in the mathematical theories of Gravitation, Electricity, Hydrodynamics, and in other branches of Physics. The term "spherical harmonic" is due to Lord Kelvin, and is primarily employed to denote either a rational integral homogeneous function of three variables x, y, z, which satisfies the differential equation

$$\Delta^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0,$$

known as Laplace's equation, or a function which satisfies the differential equation, and becomes a rational integral homogeneous function when multiplied by a power of $(x^2+y^2+z^2)^{\frac{1}{2}}$. Of all particular integrals of Laplace's equation, these are of the greatest importance in respect of their applications, and were the only ones considered by the earlier investigators; the solutions of potential problems in which the bounding surfaces are exactly or approximately spherical, are usually expressed as series in which the terms are these spherical harmonics. In the wider sense of the term, a spherical harmonic is any homogeneous function of the variables which satisfies Laplace's equation, the degree of the function being not necessarily integral or real, and the functions are not necessarily rational in x, y, z, or single-valued; when the term spherical harmonic is used in the narrower sense, the functions may, when necessary, be termed ordinary spherical harmonics. For the treatment of potential problems which relate to spaces bounded by special kinds of surfaces, solutions of Laplace's equation are required which are adapted to the particular boundaries, and various classes of such solutions have thus been introduced into analysis. Such functions are usually of a more complicated structure than ordinary spherical harmonics, although they possess analogous properties. As examples we may cite Bessel's functions in connexion with circular cylinders, Lamé's functions in connexion with ellipsoids, and toroidal functions for anchor rings. The theory of such functions may be regarded as embraced under the general term Harmonic analysis. The present article contains an account of the principal properties of ordinary spherical harmonics, and some indications of the nature and properties of the more important of the other classes of functions which occur in harmonic analysis. Spherical and other harmonic functions are of additional importance in view of the fact that they are largely employed in the treatment of the partial differential equations of physics, other than Laplace's equation; as examples of this, we may refer to the equation $\frac{\partial u}{\partial t} = k\Delta^2 u$, which is fundamental in the theory of conduction of heat and electricity, also to the equation $\frac{\partial^2 u}{\partial t^2} = k\Delta^2 u$, which occurs in the theory of the propagation of aërial and electromagnetic waves. The integration under given conditions of more complicated equations which occur in the theories of hydrodynamics and elasticity, can in certain cases be effected by the use of the functions employed in harmonic analysis.

Relation between Spherical Harmonics of Positive and Negative Degrees.—A function which is homogeneous in x, y, z, of degree n in those variables, and which satisfies Laplace's equation

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0, \text{ or } \Delta^2 V = 0, \quad . \quad . \quad (1)$$

is termed a solid spherical harmonic, or simply a spherical harmonic of degree n. The degree n may be fractional or imaginary, but we are at present concerned with the case in which n is a positive or negative integer. If x, y, z be replaced by their values $r\sin\theta\cos\phi$, $r\sin\theta\sin\phi$, $r\cos\theta$ in polar co-ordinates, a solid spherical harmonic takes the form $r^n f_n(\theta, \phi)$; the factor $f_n(\theta, \phi)$ is called a surface harmonic of degree n. If V_n denote a spherical harmonic of degree n, it may be shown by differentiation that $\Delta^2(r^m V_n) = m(2n+m+1)r^{m-2}V_n$, and thus as a particular case that $\Delta^2(r^{-2n-1}V_n) = 0$; we have thus the fundamental theorem that from any spherical harmonic V_n of degree n, another of degree $-n-1$ may be derived by dividing V_n by r^{2n+1}. All spherical harmonics of negative integral degree are obtainable in this way from those of positive integral degree. This theorem is a particular case of the more general inversion theorem that if $F(x, y, z)$ is any function which satisfies the equation (1), the function

$$\frac{1}{r}F\left(\frac{x}{r^2}, \frac{y}{r^2}, \frac{z}{r^2}\right)$$

also satisfies the equation.

The ordinary spherical harmonics of positive integral degree n are those which are rational integral functions of x, y, z. The most general rational integral function of degree n in three letters contains $\frac{1}{2}(n+1)(n+2)$ coefficients; if the expression be substituted in (1), we have on equating the coefficients separately to zero $\frac{1}{2}n(n-1)$ relations to be satisfied; the most general spherical harmonic of the prescribed type therefore contains $\frac{1}{2}(n+1)(n+2) - \frac{1}{2}n(n-1)$, or $2n+1$ independent constants. There exists, therefore, $2n+1$ independent ordinary harmonics of degree n, and corresponding to each of these there is a negative harmonic of degree $-n-1$ obtained by dividing by r^{2n+1}. The three independent harmonics of degree 1 are x, y, z; the five of degree 2 are y^2-z^2, z^2-x^2, yz, zx, xy. Every harmonic of degree n is a linear function of $2n+1$ independent harmonics of the degree; we proceed, therefore, to find the latter.

Determination of Harmonics of given Degree.—It is clear that a function $f(ax+by+cz)$ satisfies the equation (1), if a, b, c are constants which satisfy the condition $a^2+b^2+c^2=0$; in particular the equation is satisfied by $(z+\iota x\cos\alpha+\iota y\sin\alpha)^n$. Taking n to be a positive integer, we proceed to expand this expression in a series of cosines and sines of multiples of α; each term will then satisfy (1) separately. Denoting $e^{\iota\alpha}$ by k, and $y+\iota x$ by t, we have

$$+\iota x\cos\alpha+\iota y\sin\alpha)^n = \left(z+\frac{1}{2}kt+\frac{z^2}{2kt}-\frac{r^2}{2kt}\right)^n$$

which may be written as $(2kt)^{-n}\{(z+kt)^2-r^2\}^n$; on expansion by Taylor's theorem this becomes

$$(2kt)^{-n}\sum_0^{2n}\frac{k^s t^s}{s!}\frac{\partial^s}{\partial z^s}(z^2-r^2)^n,$$

the differentiation applying to z only as it occurs explicitly; the terms involving $\cos m\alpha$, $\sin m\alpha$ in this expansion are

$$\frac{1}{2^n}\cos m\alpha\left\{\frac{(y+\iota x)^m}{(n+m)!}\frac{\partial^{n+m}}{\partial z^{n+m}}(z^2-r^2)^n + \frac{(y+\iota x)^{-m}}{(n+m)!}\frac{\partial^{n-m}}{\partial z^{n-m}}(z^2-r^2)^m\right\}$$
$$\frac{1}{2^n}\sin m\alpha\left\{\frac{(y+\iota x)^m}{(n+m)!}\frac{\partial^{n+m}}{\partial z^{n+m}}(z^2-r^2)^n - \frac{(y+\iota x)^{-m}}{(n-m)!}\frac{\partial^{n-m}}{\partial z^{n-m}}(z^2-r^2)^m\right\}$$

where $m=1, 2, \ldots n$, and the term independent of α is

$$\frac{1}{2^n n!}\frac{\partial^n}{\partial z^n}(z^2-r^2)^n.$$

On writing

$$(y+\iota x)^m = \iota^m r^m(\cos m\phi - \iota\sin m\phi)\sin^m\theta, \quad (y+\iota x)^{-m} = -\iota^m r^m(\cos m\phi + \iota\sin m\phi)\sin^{-m}\theta$$

and observing that in the expansion of $(z+\iota x\cos\alpha+\iota y\sin\alpha)^m$, the expressions $\cos m\alpha$, $\sin m\alpha$ can only occur in the combination $\cos m(\phi-\alpha)$, we see that the relation

$$\frac{\sin^m\theta}{(n+m)!}\frac{\partial^{n+m}}{\partial z^{n+m}}(z^2-r^2)^n + \frac{\sin^{-m}\theta}{(n-m)!}\frac{\partial^{n-m}}{\partial z^{n-m}}(z^2-r^2)^m = 0$$

must hold identically, and thus that the terms in the expansion reduce to

$$\frac{1}{(n+m)!}\frac{\iota^m}{2^{n-1}}r^m\cos m\alpha\cos m\phi\sin^m\theta\frac{\partial^{n+m}}{\partial z^{n+m}}(z^2-r^2)^n$$
$$\frac{1}{(n+m)!}\frac{\iota^m}{2^{n-1}}r^m\sin m\alpha\sin m\phi\sin^m\theta\frac{\partial^{n+m}}{\partial z^{n+m}}(z^2-r^2)^n.$$

We thus see that the spherical harmonics of degree n are of the form

$$r^n \begin{matrix}\cos\\ \sin\end{matrix} m\phi\sin^m\theta\frac{d^{n+m}}{d\mu^{n+m}}(\mu^2-1)^n$$

where μ denotes $\cos\theta$; by giving m the values $0, 1, 2 \ldots n$ we thus have the $2n+1$ functions required. On carrying out the differentiations we see that the required functions are of the form

$$A[(x+\iota y)^m \pm (x-\iota y)^m]\left\{z^{n-m} - \frac{(n-m)(n-m-1)}{2.\,2n-1}z^{n-m-2}(x^2+y^2+z^2)\right.$$
$$\left. + \frac{(n-m)(n-m-1)(n-m-2)(n-m-3)}{2.\,4.\,2n-1.\,2n-3}z^{n-m-4}(x^2+y^2+z^2)^2 \quad \ldots \right\} \quad (2)$$

where $m=0, 1, 2, 3, \ldots n$.

Zonal, Tesseral, and Sectorial Harmonics.—Of the system of $2n+1$ harmonics of degree n, only one is symmetrical about the z axis; this is

$$r^n \frac{1}{2^n n!}\frac{d^n}{d\mu^n}(\mu^2-1)^n;$$

writing

$$P_n(\mu) = \frac{1}{2^n n!}\frac{d^n}{d\mu^n}(\mu^2-1)^n,$$

we observe that $P_n(\mu)$ has n zeroes all lying between ± 1, consequently the locus of points on a sphere $r=a$, for which $P_n(\mu)$ vanishes is n circles all parallel to the meridian plane: these circles divide the sphere into zones, thus $P_n(\mu)$ is called the zonal surface harmonic of degree n, and $r^n P_n(\mu)$, $r^{-n-1}P_n(\mu)$ are the solid zonal harmonics of degrees n and $-n-1$. The locus of points on a sphere for which $\begin{smallmatrix}\cos\\ \sin\end{smallmatrix} m\phi.\ \sin^m\theta\frac{d^{n+m}}{d\mu^{n+m}}(\mu^2-1)^n$ vanishes consists of $n-m$ circles parallel to the meridian plane, and m great circles through the poles; these circles divide the spherical surface into quadrilaterals or τεσσερα, except when $n=m$, in which case the surface is divided into sectors, and the harmonics are therefore called tesseral, except those for which $m=n$, which are called sectorial. Denoting $(1-\mu^2)^{\frac{1}{2}m}\frac{d^m P_n(\mu)}{d\mu^m}$ by $P_n^m(\mu)$, the tesseral surface harmonics are $\begin{smallmatrix}\cos\\ \sin\end{smallmatrix} m\phi.\ P_n^m(\cos\theta)$, where $m=1, 2, \ldots n-1$, and the sectorial harmonics are $\begin{smallmatrix}\cos\\ \sin\end{smallmatrix} n\phi.\ P_n^n(\cos\theta)$. The functions $P_n(\mu)$, $P_n^m(\mu)$ denote the expressions

$$P_n(\mu) = \frac{(2n)!}{2^n n!\, n!}\left\{\mu^n - \frac{n(n-1)}{2.2n-1}\mu^{n-2} + \frac{n(n-1)(n-2)(n-3)}{2.4.2n-1.2n-3}\mu^{n-4}\ldots\right\} \quad (3)$$

$$P_n^m(\mu) = \frac{(2n)!}{2^n n!(n-m)!}(1-\mu^2)^{\frac{1}{2}m}\left\{\mu^{n-m} - \frac{(n-m)(n-m-1)}{2.2n-1}\mu^{n-m-2} + \ldots\right\} \quad . \quad (4)$$

$$P_n^n(\mu) = \frac{(2n)!}{2^n n!\, n!}(1-\mu^2)^{\frac{1}{2}n}$$

Every ordinary harmonic of degree n is expressible as a linear function of the system of $2n+1$ zonal, tesseral, and sectorial harmonics of degree n, thus the general form of the surface harmonic is

$$a_0 P_n(\mu) + \sum_{m=1}^{n}(a_m \cos m\phi + b_m \sin m\phi)P_n^m(\mu) \quad . \quad . \quad (5).$$

In the present notation we have

$$(z + \iota x\cos\alpha + \iota y\sin\alpha)^n = r^n\left\{P_n(\mu) + 2\sum_1^n \iota^m \frac{n!}{(n+m)!}P_n^m(\mu)\cos m(\phi-\alpha)\right\}$$

if we put $\alpha=0$, we thus have

$$(\cos\theta + \iota\sin\theta\cos\phi)^n = P_n(\cos\theta) + 2\sum_1^n \iota^m\frac{n!}{(n+m)!}P_n^m(\cos\theta)\cos m\phi,$$

from this we obtain expressions for $P_n(\cos\theta)$, $P_n^m(\cos\theta)$ as definite integrals

$$\left.\begin{aligned} P_n(\cos\theta) &= \frac{1}{\pi}\int_0^\pi(\cos\theta+\iota\sin\theta\cos\phi)^n d\phi \\ \iota^m\frac{n!}{(n+m)!}P_n^m(\cos\theta) &= \frac{1}{\pi}\int_0^\pi(\cos\theta+\iota\sin\theta\cos\phi)^n\cos m\phi d\phi\end{aligned}\right\}(6).$$

Derivation of Spherical Harmonics by Differentiation.—The linear character of Laplace's equation shows that, from any solution, others may be derived by differentiation with respect to the variables x, y, z, or, more generally, if

$$f\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$$

denote any rational integral operator,

$$f\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)V$$

is a solution of the equation if V satisfies it. This principle has been applied by Thomson and Tait to the derivation of the system of any integral degree, by operating upon $1/r$, which satisfies Laplace's equation. The operations may be conveniently carried out by means of the following differentiation theorem. (See papers by Hobson, in the *Messenger of Mathematics*, vol. xxiii. p. 115, and *Proc. Lond. Math. Soc.* vol. xxiv.)

$$f_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)\frac{1}{r} = (-1)^n\frac{(2n)!}{2^n n!}\frac{1}{r^{2n+1}}\left\{1 - \frac{r^2\Delta^2}{2.2n-1} + \frac{r^4\Delta^4}{2.4.2n-1.2n-3} - \ldots\right\}f_n(x, y, z) \quad (7),$$

which is a particular case of the more general theorem

$$f_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)F(r) = \left\{2^n\frac{d^n F}{d(r^2)^n} + \frac{2^{n-2}}{1!}\frac{d^{n-1}F}{d(r^2)^{n-1}}\Delta^2 + \ldots + \frac{2^{n-2s}}{s!}\frac{d^{n-s}F}{d(r^2)^{n-s}}\Delta^{2s} + \ldots\right\}f_n(x, y, z) \quad (7^1),$$

where $f_n(x, y, z)$ is a rational integral homogeneous function of degree n. The harmonic of positive degree n corresponding to that of degree $-n-1$ in the expression (7) is

$$\left\{1 - \frac{r^2\Delta^2}{2.2n-1} + \frac{r^4\Delta^4}{2.4.2n-1.2n-3} - \ldots\right\}f_n(x, y, z).$$

It can be verified that even when n is unrestricted, this expression satisfies Laplace's equation, the sole restriction being that of the convergence of the series.

Maxwell's Theory of Poles.—Before proceeding to obtain by means of (7), the expressions for the zonal, tesseral, and sectorial harmonics, it is convenient to introduce the conception, due to Maxwell (see *Electricity and Magnetism*, vol. i. chap. ix.), of the poles of a spherical harmonic. Suppose a sphere of any radius drawn with its centre at the origin; any line whose direction-cosines are l, m, n drawn from the origin, is called an axis, and the point where this axis cuts the sphere is called the pole of the axis. Different axes will be denoted by suffixes attached to the direction-cosines; the cosine $\frac{l_\iota x + m_\iota y + n_\iota z}{r}$ of the angle between the radius vector r to a point (x, y, z) and the axis $(l_\iota, m_\iota, n_\iota)$, will be denoted by λ_r.; the cosine of the angle between two axes is $l_\iota l_\gamma + m_\iota m_\gamma + n_\iota n_\gamma$, which will be denoted by $\mu_{\iota\gamma}$. The operation

$$l_\iota\frac{\partial}{\partial x} + m_\iota\frac{\partial}{\partial y} + n_\iota\frac{\partial}{\partial z}$$

performed upon any function of x, y, z is spoken of as differentiation with respect to the axis $(l_\iota, m_\iota, n_\iota)$, and is denoted by $\frac{\partial}{\partial h_\iota}$.

The potential function $V_0 = \frac{e_0}{r}$ is defined to be the potential due to a singular point of degree zero at the origin; e_0 is called the strength of the singular point. Let a singular point of degree zero, and strength e_0, be on an axis h_1, at a distance a_0 from the origin, and also suppose that the origin is a singular point of strength $-e_0$; let e_0 be indefinitely increased, and a_0 indefinitely diminished, but so that the product $e_0 a_0$ is finite and equal to e_1; the origin is then said to be a singular point of the first degree, of strength e_1, the axis being h_1. Such a singular point is frequently called a doublet. In a similar manner, by placing two singular points of degree, unity, and strength, e_1, $-e_1$, at a distance a_1 along an axis h_2, and at the origin respectively, when e_1 is indefinitely increased, and a_1 diminished so that $e_1 a_1$ is finite and $=e_2$, we obtain a singular point of degree 2, strength e_2 at the origin, the axes being h_1, h_2. Proceeding in this manner we arrive at the conception of a singular point of any degree n, of strength e_n at the origin, the singular point having any n given axes $h_1, h_2, \ldots h_n$. If $e_{n-1}\,\phi_{n-1}(x, y, z)$ is the potential due to a singular point at the origin, of degree $n-1$, and strength e_{n-1}, with axes $h_1, h_2, \ldots h_{n-1}$, the potential of a singular point of degree n, the new axis of which is h_n, is the limit of

$$e_{n-1}\,\phi_{n-1}(x - l_n a,\ y - m_n a,\ z - n_n a) - e_{n-1}\,\phi_{n-1}(x, y, z)$$

when

$$La = 0,\ Le_{n-1} = \infty,\ Lae_{n-1} = e_n;$$

this limit is

$$-e_n\left(l_n\frac{\partial\phi_{n-1}}{\partial x} + m_n\frac{\partial\phi_{n-1}}{\partial y} + n_n\frac{\partial\phi_{n-1}}{\partial z}\right) \text{ or } -e_n\frac{\partial}{\partial h_n}\phi_{n-1}.$$

Since $\phi_0 = \frac{1}{r}$, we see that the potential V_n due to a singular point at the origin of strength e_n, and axes $h_1, h_2, \ldots h_n$ is given by

$$V_n = (-1)^n e_n\frac{\partial^n}{\partial h_1\partial h_2\ldots\partial h_n}\frac{1}{r}. \quad . \quad . \quad (8).$$

Expression for a Harmonic with given Poles.—The result of performing the operations in (8) is that V_n is of the form

$$n!\,e_n\frac{Y_n}{r^{n+1}},$$

where Y_n is a surface harmonic of degree n, and will appear as a function of the angles which r makes with the n axes, and of the angles these axes make with one another. The poles of the n axes are defined to be the poles of the surface harmonics, and are also frequently spoken of as the poles of the solid harmonics $Y_n r^n$, $Y_n r^{-n-1}$. Any spherical harmonic is completely specified by means of its poles.

In order to express Y_n in terms of the positions of its poles, we apply the theorem (7) to the evaluation of V_n in (8). On putting

$$f_n(x, y, z) = \prod_{r=1}^{r=n}(l_r x + m_r y + n_r z), \text{ we have}$$

$$Y_n = \frac{(2n!)}{2^n n!\, n!} \cdot \frac{1}{r^n}\left(1 - \frac{r^2\Delta^2}{2.2n-1} + \frac{r^4\Delta^4}{2.4.2n-1.2n-3}\cdots\right)\prod_1^n(l_r x + m_r y + n_r z).$$

By $\Sigma(\mu^s\lambda^{n-2s})$ we shall denote the sum of the products of s of the quantities μ, and $n-2s$ of the quantities λ; in any term each suffix is to occur once and once only, every possible order being taken. We find

$$\Pi(lx+my+nz) = \Sigma(\lambda^n)r^n,\ \Delta^2\Pi(lx+my+nz) = 2\Sigma(\mu^1\lambda^{n-2})r^{n-2},$$

and generally

$$\Delta^{2m}\Pi(lx+my+nz) = 2^m m!\,\Sigma(\mu^m\lambda^{n-2m})r^{n-2m};$$

thus we obtain the following expression for Y_n, the surface harmonic which has given poles $h_1, h_2, \ldots h_n$;

$$\begin{aligned} Y_n &= r^{n+1}\frac{(-1)^n}{n!}\frac{\partial^n}{\partial h_1 \partial h_2 \ldots \partial h_n} \cdot \frac{1}{r} \\ &= \mathop{S}_{m=0}\left\{(-1)^m \frac{(2n-2m)!}{2^{n-m} n!(n-m)!}\Sigma(\lambda^{n-2m}\mu^m)\right\} \qquad (9), \end{aligned}$$

where S denotes a summation with respect to m from $m=0$ to $m=\frac{1}{2}n$, or $\frac{1}{2}(n-1)$, according as n is even or odd. This is Maxwell's general expression (*loc. cit.*) for a surface harmonic with given poles.

If the poles on a sphere of radius r are denoted by A, B, C..., we obtain from (9) the following expressions for the harmonics of the first four degrees:—

$$Y_1 = \cos PA,\ Y_2 = \frac{1}{2}(3\cos PA\cos PB - \cos AB),$$

$$Y_3 = \frac{1}{2}(15\cos PA\cos PB\cos PC - \cos PA\cos BC - \cos PB\cos CA - \cos PC\cos AB)$$

$$Y_4 = \frac{1}{8}(35\cos PA\cos PB\cos PC\cos PD - 5\Sigma\cos PA\cos PB\cos CD + \Sigma\cos AB\cos CD).$$

Poles of Zonal, Tesseral, and Sectorial Harmonics.—Let the n axes of the harmonic coincide with the axis of z, we have then by (8) the harmonic

$$\frac{(-1)^n r^{n+1}}{n!}\frac{\partial^n}{\partial z^n}\frac{1}{r};$$

applying the theorem (7) to evaluate this expression, we have

$$\begin{aligned} \frac{(-1)^n r^{n+1}}{n!}\frac{\partial^n}{\partial z^n}\frac{1}{r} &= \frac{(2n)!}{2^n n!\, n!}\frac{1}{r^n}\left\{1 - \frac{r^2\Delta^2}{2.2n-1} + \frac{r^4\Delta^4}{2.4.2n-1.2n-3} - \right\}z^n \\ &= \frac{(2n)!}{2^n n!\, n!}\left\{\mu^n - \frac{n(n-1)}{2.2n-1}\mu^{n-2} + \ldots\right\}, \end{aligned}$$

the expression on the right side is $P_n(\mu)$, the zonal surface harmonic; we have therefore

$$P_n(\mu) = \frac{(-1)^n r^{n+1}}{n!}\frac{\partial^n}{\partial z^n}\frac{1}{r}.$$

The zonal harmonic has therefore all its poles coincident with the z axis. Next, suppose $n-m$ axes coincide with the z axis, and that the remaining m axes are distributed symmetrically in the plane of x, y at intervals π/m, the direction cosines of one of them being $\cos a$, $\sin a$, 0. We have

$$\prod_0^{m-1}\left\{\cos\left(a+\frac{r\pi}{m}\right)\frac{\partial}{\partial x} + \sin\left(a+\frac{r\pi}{m}\right)\frac{\partial}{\partial y}\right\} = \frac{1}{2^m}\Pi\left\{e^{\iota\left(a+\frac{r\pi}{m}\right)}\left(\frac{\partial}{\partial x} - \iota\frac{\partial}{\partial y}\right) + e^{-\iota\left(a+\frac{r\pi}{m}\right)}\left(\frac{\partial}{\partial x} + \iota\frac{\partial}{\partial y}\right)\right\}.$$

Let $\xi = x + \iota y$, $\eta = x - \iota y$, the above product becomes

$$\prod_0^{m-1}\left\{e^{\iota\left(a+\frac{r\pi}{m}\right)}\frac{\partial}{\partial\xi} + e^{-\iota\left(a+\frac{r\pi}{m}\right)}\frac{\partial}{\partial\eta}\right\},$$

which is equal to

$$e^{(m-1)\frac{\iota\pi}{2}}\Pi\left\{e^{m\iota a}\left(\frac{\partial}{\partial\xi}\right)^m - e^{-m\iota a}\left(-\frac{\partial}{\partial\eta}\right)^m\right\}; \text{ when } a = 0, \frac{\pi}{2m},$$

this becomes

$$e^{(m-1)\frac{\iota\pi}{2}}\left\{\left(\frac{\partial}{\partial\xi}\right)^m - (-1)^m\left(\frac{\partial}{\partial\eta}\right)^m\right\} \text{ and}$$

$$e^{(m-1)\frac{\iota\pi}{2}}\left[\left(\frac{\partial}{\partial\xi}\right)^m + (-1)^m\left(\frac{\partial}{\partial\eta}\right)^m\right].$$

From (7), we find

$$\begin{aligned} \frac{\partial^{n-m}}{\partial z^{n-m}}\left(\frac{\partial}{\partial x} \pm \iota\frac{\partial}{\partial y}\right)^m\frac{1}{r} &= \frac{(2n)!}{2^n n!}\frac{1}{r^{2n+1}}\left[1 - \frac{r^2\Delta^2}{2.2n-1} + \ldots\right]z^{n-m}(x \pm \iota y)^m \\ &= (-1)^n\frac{(2n)!}{2^n n!}\frac{1}{r^{n+1}}(\cos m\phi \pm \iota\sin m\phi)\sin^m\theta\left\{\cos^{n-m}\theta - \frac{(n-m)(n-m-1)}{2.2n-1}\cos^{n-m-2}\theta + \ldots\right\}, \end{aligned}$$

hence

$$\frac{\partial^{n-m}}{\partial z^{n-m}}\left(\frac{\partial}{\partial x} \pm \iota\frac{\partial}{\partial y}\right)^m\frac{1}{r} = (-1)^n\frac{(n-m)!}{r^{n+1}}(\cos m\phi \pm \iota\sin m\phi)P_n^m(\cos\theta),$$

as we see on referring to (4); we thus obtain the formulæ

$$\left.\begin{aligned} \frac{\partial^{n-m}}{\partial z^{n-m}}\left\{\left(\frac{\partial}{\partial\xi}\right)^m + \left(\frac{\partial}{\partial\eta}\right)^m\right\}\frac{1}{r} &= (-1)^n\frac{(n-m)!}{2^{m-1}r^{n+1}}\cos m\phi \,.\, P_n^m(\cos\theta) \\ \iota\frac{\partial^{n-m}}{\partial z^{n-m}}\left\{\left(\frac{\partial}{\partial\xi}\right)^m - \left(\frac{\partial}{\partial\eta}\right)^m\right\}\frac{1}{r} &= (-1)^n\frac{(n-m)!}{2^{m-1}r^{n+1}}\sin m\phi \,.\, P_n^m(\cos\theta) \end{aligned}\right\}(10).$$

It is thus seen that the tesseral harmonics of degree n and order m are those which have $n-m$ axes coincident with the z axis, and the other m axis distributed in the equatorial plane, at angular intervals π/m. The sectorial harmonics have all their axes in the equatorial plane.

Determination of the Poles.—It has been shown that a spherical harmonic $Y_n(x, y, z)$ can be generated by means of an operator

$$f_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right) \text{ acting upon } \frac{1}{r},$$

the function f_n being so chosen that

$$Y_n(x, y, z) = (-1)^n\frac{(2n)!}{2^n n!}\left\{1 - \frac{r^2\Delta^2}{2.2n-1} + \ldots\right\}f_n(x, y, z);$$

this relation shows that if an expression of the form

$$(x^2+y^2+z^2)f_{n-2}(x, y, z)$$

is added to $f_n(x, y, z)$, the harmonic $Y_n(x, y, z)$ is unaltered; thus if Y_n be regarded as given, $f_n(x, y, z) = 0$, is not uniquely determined, but has an indefinite number of values differing by multiples of $x^2+y^2+z^2$. In order to determine the poles of a given harmonic, f_n must be so chosen that it is resolvable into linear factors; it will be shown that this can be done in one and only one way, so that the poles are all real.

If x, y, z are such as to satisfy the two equations $Y_n(x, y, z) = 0$, $x^2+y^2+z^2 = 0$, the equation $f_n(x, y, z)$ is also satisfied; the problem of determining the poles is therefore equivalent to the algebraical one of reducing Y_n to the product of linear factors by means of the relation $x^2+y^2+z^2 = 0$, between the variables. Suppose

$$Y_n(x, y, z) = A\prod_{s=1}^m(l_s x + m_s y + n_s z) + (x^2+y^2+z^2)V_{n-2}(x, y, z),$$

we see that the plane $l_s x + m_s y + n_s z = 0$ passes through two of the $2n$ generating lines of the imaginary cone $x^2+y^2+z^2 = 0$, in which that cone is intersected by the cone $Y_n(x, y, z) = 0$. Thus a pole (l_s, m_s, n_s) is the pole with respect to the cone $x^2+y^2+z^2 = 0$, of a plane passing through two of the generating lines; the number of systems of poles is therefore $n(2n-1)$, the number of ways of taking the $2n$ generating lines in pairs; of these systems of poles, however, only one is real, viz. that in which the lines in each pair correspond to conjugate complex roots of the equations $Y_n = 0$, $x^2+y^2+z^2 = 0$. Suppose

$$\frac{x}{a_1+\iota\beta_1} = \frac{y}{a_2+\iota\beta_2} = \frac{z}{a_3+\iota\beta_3}$$

gives one generating line, then the conjugate one is given by

$$\frac{x}{a_1-\iota\beta_1} = \frac{y}{a_2-\iota\beta_2} = \frac{z}{a_3-\iota\beta_3},$$

and the corresponding factor $lx+my+nz$ is

$$\begin{vmatrix} x & y & z \\ a_1+\iota\beta_1 & a_2+\iota\beta_2 & a_3+\iota\beta_3 \\ a_1-\iota\beta_1 & a_2-\iota\beta_2 & a_3-\iota\beta_3 \end{vmatrix},$$

which is real. It is obvious that if any non-conjugate pair of roots is taken, the corresponding factor, and therefore the pole, is imaginary. There is therefore only one system of real poles of a given harmonic, and its determination requires the solution of an

equation of degree $2n$. This theorem is due to Sylvester (*Phil. Mag.* vol. ii. series 5, 1876, "A Note on Spherical Harmonics").

Expression for the Zonal Harmonic with any Axis.—The zonal surface harmonic, whose axis is in the direction

$$\frac{x'}{r'}, \frac{y'}{r'}, \frac{z'}{r'}, \text{ is } \mathrm{P}_n\left(\frac{xx'+yy'+zz'}{rr'}\right)$$

or $\mathrm{P}_n(\cos\theta\cos\theta'+\sin\theta\sin\theta'\cos\overline{\phi-\phi'})$, this is expressible as a linear function of the system of zonal, tesseral, and sectorial harmonics already found; it will be observed that it is symmetrical with respect to (x, y, z) and (x', y', z'), and must thus be capable of being expressed in the form

$$a_0\mathrm{P}_n(\cos\theta)\mathrm{P}_n(\cos\theta')+\sum_1^n a_m\mathrm{P}_n^m(\cos\theta)\mathrm{P}_n^m(\cos\theta')\cos m(\phi-\phi'),$$

and it only remains to determine the coefficients $a_0, a_1, \ldots a_m \ldots a_n$. To find this expression, we transform $(x'x+y'y+z'z)^n$, where x, y, z satisfy the condition $x^2+y^2+z^2=0$; writing $\xi=x+\iota y$, $\eta=x-\iota y$, $\xi'=x'+\iota y'$, $\eta'=x'-\iota y'$, we have

$$(xx'+yy'+zz')^n=\left(\frac{1}{2}\eta'\xi+\frac{1}{2}\xi'\eta+zz'\right)^n$$

which equals

$$(zz')^n+\Sigma\Sigma\frac{n!}{a!\,b!\,(n-a-b)!}\left\{\frac{\eta'^a\xi'^b\xi^a\eta^b+\eta'^b\xi'^a\xi^b\eta^a}{2^{a+b}}\right\}(zz')^{n-a-b},$$

the summation being taken for all values of a and b, such that $a+b\leqq n$, $a>b$; the values $a=0$, $b=0$ corresponding to the term $(zz')^n$. Using the relation $\xi\eta=-z^2$, this becomes

$$(xx'+yy+zz')^n=(zz')^n+\Sigma\Sigma\frac{(-1)^b}{2^{a+b}}\frac{n!}{a!\,b!\,(n-a-b)!}(\xi'\eta')^b z'^{n-a-b}$$
$$\left\{(\eta'\xi)^{a-b}+(\xi'\eta)^{a-b}\right\}z^{n-a+b},$$

putting $a-b=m$, the coefficient of $\xi^m z^{n-m}$, on the right side is

$$\sum\frac{(-1)^b}{2^{m+2b}}\frac{n!}{b!\,(m+b)!\,(n-m-2b)!}(\xi'\eta')^b\eta'^m z'^{n-m-2b},$$

from $b=0$ to $b=\frac{1}{2}(n-m)$, or $\frac{1}{2}(n-m-1)$, according as $n-m$ is even or odd. This coefficient is equal to

$$\frac{n!}{2^m m!\,(n-m)!}(x'-\iota y')^m\left\{z'^{n-m}-\frac{(n-m)(n-m-1)}{2.\,2m+2}z'^{n-m-2}(x'^2+y'^2)\right.$$
$$\left.+\frac{(n-m)(n-m-1)(n-m-2)(n-m-3)}{2.\,4.\,2m+2.\,2m+3}z'^{n-m-4}(x'^2+y'^2)^2-\right\};$$

in order to evaluate this coefficient, put $z=1$, $x'=\iota\cos a$, $y'=\iota\sin a$, then this coefficient is that of $(\iota\cos a+\sin a)^m$, or of $\iota^m e^{-m\iota a}$ in the expansion of $(z'+\iota x'\cos a+\iota y'\sin a)^n$ in powers of $e^{-\iota a}$ and $e^{\iota a}$, this has been already found, thus the coefficient is

$$\frac{n!}{(n+m)!}e^{-\iota m\phi'}\mathrm{P}_n^m(\cos\theta').\,r'^n.$$

Similarly the coefficient of $\eta^m z^{n-m}$ is

$$\frac{n!}{(n+m)!}e^{+\iota m\phi'}\mathrm{P}_n^m(\cos\theta')r'^n;$$

hence we have

$$\frac{1}{r'^n}(xx'+yy'+zz')^n=z^n\mathrm{P}_n(\cos\theta')+n!\sum_1^n\mathrm{P}_n^m(\cos\theta')\{\cos m\phi'(\xi^m+\eta^m)$$
$$+\iota\sin m\phi'(\eta^m-\xi^m)\}\frac{z^{n-m}}{(n+m)!}$$

in this result, change x, y, z into

$$\frac{\partial}{\partial x'}, \frac{\partial}{\partial y'}, \frac{\partial}{\partial z'}$$

and let each side operate on $\frac{1}{r}$, then in virtue of (10), we have

$$(rr')^n\mathrm{P}_n\left(\frac{xx'+yy'+zz'}{rr'}\right)=\mathrm{P}_n(\cos\theta\cos\theta'+\sin\theta\sin\theta'\cos\overline{\phi-\phi'})$$
$$=\mathrm{P}_n(\cos\theta)\mathrm{P}_n(\cos\theta')+2\Sigma\frac{(n-m)!}{(n+m)!}\mathrm{P}_n^m(\cos\theta)\mathrm{P}_n^m(\cos\theta')$$
$$\cos m(\phi-\phi') \qquad (11)$$

which is known as the addition and theorem for the function P_n.

It has incidentally been proved that

$$\mathrm{P}_n^m(\cos\theta)=\frac{(n+m)!}{2^m(n-m)!}\sin^m\theta\left\{\cos^{n-m}\theta\right.$$
$$\left.-\frac{(n-m)(n-m-1)}{2.2m+2}\cos^{n-m-2}\theta\sin^2\theta+\right\} \text{(12)},$$

which is an expression for $\mathrm{P}_n^m(\cos\theta)$ alternative to (4).

Legendre's Coefficients.—The reciprocal of the distance of a point (r, θ, ϕ) from a point on the z axis distant r' from the origin is

$$(r^2-2rr'\mu+r'^2)^{-\frac{1}{2}}$$

which satisfies Laplace's equation, μ denoting $\cos\theta$. Writing this expression in the forms

$$\frac{1}{r'}\left\{1-2\frac{r}{r'}\mu+\frac{r^2}{r'^2}\right\}^{-\frac{1}{2}}, \frac{1}{r}\left\{1-2\frac{r'}{r}\mu+\frac{r'^2}{r^2}\right\}^{-\frac{1}{2}},$$

it is seen that when $r<r'$, the expression can be expanded in a convergent series of powers of r/r', and when $r'<r$ in a convergent series of powers of r'/r. We have, when $h^2(2\mu-h)^2<1$

$$(1-2h\mu+h^2)^{-\frac{1}{2}}=1+h(2\mu-h)+\frac{1.3}{2.4}h^2(2\mu-h)^2+\ldots$$
$$+\frac{1.3.5\ldots2n-1}{2.4\ldots2n}h^n(2\mu-h)^n+\ldots$$

and since the series is absolutely convergent, it may be re-arranged as a series of powers of h, the coefficient of h^n is then found to be

$$\frac{1.3.5\ldots2n-1}{1.2.3\ldots n}\left\{\mu^n-\frac{n(n-1)}{2.2n-1}\mu^{n-2}+\frac{n(n-1)(n-2)(n-3)}{2.4.2n-1.2n-3}\mu^{n-4}\ldots\right\}$$

this is the expression we have already denoted by $\mathrm{P}_n(\mu)$; thus

$$(1-2h\mu+h^2)^{-\frac{1}{2}}=\mathrm{P}_0(\mu)+h\mathrm{P}_1(\mu)+\ldots+h^n\mathrm{P}_n(\mu)+\ldots \quad \text{(13)},$$

the function $\mathrm{P}_n(\mu)$ may thus be defined as the coefficient of h^n in this expansion, and from this point of view is called the Legendre's coefficient or Legendre's function of degree n, and is identical with the zonal harmonic. It may be shown that the expansion is valid for all real and complex values of h and μ, such that mod. h is less than the smaller of the two numbers mod. $(\mu\pm\sqrt{\mu^2-1})$. We now see that

$$(r^2-2rr'\mu+r'^2)^{-\frac{1}{2}}$$

is expressible in the form

$$\sum_0^\infty\frac{r^n}{r'^{n+1}}\mathrm{P}_n(\mu)$$

when $r<r'$, or

$$\sum_0^\infty\frac{r'^n}{r^{n+1}}\mathrm{P}_n(\mu)$$

when $r'<r$; it follows that the two expressions $r^n\mathrm{P}_n(\mu)$, $r^{-n-1}\mathrm{P}_n(\mu)$ are solutions of Laplace's equation.

The values of the first few Legendre's coefficients are

$$\mathrm{P}_0(\mu)=1,\ \mathrm{P}_1(\mu)=\mu,\ \mathrm{P}_2(\mu)=\frac{1}{2}(3\mu^2-1),\ \mathrm{P}_3(\mu)=\frac{1}{2}(5\mu^3-3\mu)$$
$$\mathrm{P}_4(\mu)=\frac{1}{8}(35\mu^4-30\mu^2+3),\ \mathrm{P}_5(\mu)=\frac{1}{8}(63\mu^5-70\mu^3+15\mu)$$
$$\mathrm{P}_6(\mu)=\frac{1}{16}(231\mu^6-315\mu^4+105\mu^2-5),\ \mathrm{P}_7(\mu)=\frac{1}{16}(429\mu^7-693\mu^5$$
$$+315\mu^3-35\mu).$$

We find also

$$\mathrm{P}_n(1)=1,\ \mathrm{P}_n(-1)=(-1)^n$$
$$\mathrm{P}_n(0)=0, \text{ or } (-1)^{\frac{1}{2}n}\frac{1.3.5\ldots n-1}{2.4\ldots n}$$

according as n is odd or even; these values may be at once obtained from the expansion (13), by putting $\mu=1, 0, -1$.

Additional Expressions for Legendre's Coefficients.—The expression (3) for $\mathrm{P}_n(\mu)$ may be written in the form

$$\mathrm{P}_n(\mu)=\frac{(2n)!}{2^n n!\,n!}\mu^n\mathrm{F}\left(-\frac{n}{2}, \frac{1-n}{2}, \frac{1}{2}-n, \frac{1}{\mu^2}\right)$$

with the usual notation for hypergeometric series.

On writing this series in the reverse order

$$\mathrm{P}_n(\mu)=(-1)^{\frac{1}{2}n}\frac{n!}{2^n\left(\frac{1}{2}n\right)!\left(\frac{1}{2}n\right)!}\mathrm{F}\left(-\frac{n}{2}, \frac{n+1}{2}, \frac{1}{2}, \mu^2\right)$$

or

$$(-1)^{\frac{n-1}{2}}\frac{n!}{2^{n-1}\frac{n-1}{2}!\frac{n-1}{2}!}\mu\mathrm{F}\left(-\frac{n-1}{2}, \frac{n}{2}+1, \frac{3}{2}, \mu^2\right)$$

according as n is even or odd.

From the identity

$$(1-2h\cos\theta+h^2)^{-\frac{1}{2}}=(1-he^{\iota\theta})^{-\frac{1}{2}}(1-he^{-\iota\theta})^{-\frac{1}{2}},$$

it can be shown that

$$\mathrm{P}_n(\cos\theta)=\frac{1.3.5\ldots2n-1}{2.4.6\ldots2n}\left\{\cos n\theta+\frac{1.n}{1.2n-1}\cos(n-2)\theta\right.$$
$$\left.+\frac{1.3.n(n-1)}{1.2.(2n-1)(2n-3)}\cos(n-4)\theta+\right\} \quad \text{(14)}.$$

By (13), or by the formula

$$P_n(\mu)=\frac{1}{2^n n!}\frac{d^n}{d\mu^n}(\mu^2-1)^n$$

which is known as Rodrigue's formula, we may prove that

$$P_n(\cos\theta)=1-\frac{(n+1)n}{1^2}\sin^2\frac{\theta}{2}+\frac{(n+2)(n+1)n(n-1)}{1^2.2^2}\sin^4\frac{\theta}{2}\ldots$$
$$=F\left(n+1,\ -n,\ 1,\ \sin^2\frac{1}{2}\theta\right)\quad .\quad .\quad (15).$$

Also that

$$P_n(\cos\theta)=\cos^{2n}\frac{1}{2}\theta\left\{1-\frac{n^2}{1^2}\tan^2\frac{1}{2}\theta+\frac{n^2(n-1)^2}{1^2.2^2}\tan^4\frac{1}{2}\theta-\ldots\right\}$$
$$=\cos^{2n}\frac{1}{2}\theta F\left(-n,\ -n,\ 1,\ -\tan^2\frac{1}{2}\theta\right).\quad .\quad (16).$$

By means of the identity

$$\left(1-2h\mu+h^2\right)^{-\frac{1}{2}}=\left(1-h\mu\right)^{-1}\left\{1+\frac{h^2(1-\mu^2)}{(1-h\mu)^2}\right\}^{-\frac{1}{2}},$$

it may be shown that

$$P_n(\cos\theta)=\cos^n\theta\left\{1-\frac{n(n-1)}{2^2}\tan^2\theta+\frac{n(n-1)(n-2)(n-3)}{2^2.4^2}\tan^4\theta-\ldots\right\}$$
$$=\cos^n\theta F\left(-\frac{1}{2}n,\ \frac{1}{2}-\frac{1}{2}n,\ 1,-\tan^2\theta\right).\quad .\quad (17).$$

Laplace's definite integral expression (6) may be transformed into the expression

$$\frac{1}{\pi}\int_0^\pi\frac{d\phi}{(\mu-\sqrt{\mu^2-1}\cos\psi)^{n+1}},$$

by means of the relation

$$(\mu+\sqrt{\mu^2-1}\cos\phi)(\mu-\sqrt{\mu^2-1}\cos\psi)=1.$$

Two definite integral expressions for $P_n(\mu)$ given by Dirichlet, have been put by Mehler into the forms

$$P_n(\cos\theta)=\frac{2}{\pi}\int_0^\theta\frac{\cos\left(n+\frac{1}{2}\right)\phi}{\sqrt{2\cos\phi-2\cos\theta}}d\phi=\frac{2}{\pi}\int_\theta^\pi\frac{\sin\left(n+\frac{1}{2}\right)\phi}{\sqrt{2\cos\theta-2\cos\phi}}d\phi.$$

Relations between successive Legendre's Coefficients and their Derivatives.—If $(1-2h\mu+h^2)^{-\frac{1}{2}}$ we denoted by u, we find

$$(1-2h\mu+h^2)\frac{\partial u}{\partial h}+(h-\mu)u=0\ ;$$

on substituting Σh^nP_n for u, and equating to zero the coefficient of h^n, we obtain the relation

$$nP_n-(2n-1)\mu P_{n-1}+(n-1)P_{n-2}=0.$$

From Laplace's definite integral, or otherwise, we find

$$(\mu^2-1)\frac{dP_n}{d\mu}=n(\mu P_n-P_{n-1})=-(n+1)(\mu P_n-P_{n+1}).$$

We may also show that

$$\mu\frac{dP_n}{d\mu}-\frac{dP_{n-1}}{d\mu}=nP_n$$
$$(n+1)P_n=-\mu\frac{dP_n}{d\mu}+\frac{dP_{n+1}}{d\mu}$$
$$(2n+1)P_n=\frac{dP_{n+1}}{d\mu}-\frac{dP_{n-1}}{d\mu}$$
$$(2n+1)\mu\frac{dP_n}{d\mu}=(n+1)\frac{dP_{n-1}}{d\mu}+n\frac{dP_{n+1}}{d\mu}$$
$$(2n+1)(\mu^2-1)\frac{dP_n}{d\mu}=n(n+1)(P_{n+1}-P_{n-1})$$
$$\frac{dP_n}{d\mu}=(2n-1)P_{n-1}+(2n-5)P_{n-3}+(2n-9)P_{n-5}+\ldots$$

the last term being $3P_1$ or P_0 according as n is even or odd.

Integral Properties of Legendre's Coefficients.—It may be shown that if $P_n(\mu)$ be multiplied by any one of the numbers $1,\ \mu,\ \mu^2,\ldots\mu^{n-1}$, and the product be integrated between the limits $1,\ -1$ with respect to μ, the result is zero, thus

$$\int_{-1}^{1}\mu^kP_n(\mu)d\mu=0,\ k=0,\ 1,\ 2,\ldots n-1\quad .\quad (18).$$

To prove this theorem, we have

$$\int_{-1}^{1}\mu^kP_n(\mu)d\mu=\frac{1}{2^nn!}\int_{-1}^{1}\mu^k\frac{d^n}{d\mu^n}(\mu^2-1)^nd\mu,$$

on integrating the expression k times by parts, and remembering that $(\mu^2-1)^n$ and its first $n-1$ derivatives all vanish when $\mu=\pm1$, the theorem is established. This theorem derives additional importance from the fact that it may be shown that $AP_n(\mu)$ is the only rational integral function of degree n which has this property; from this arises the importance of the functions P_n in the theory of quadratures.

The theorem which lies at the root of the applicability of the functions P_n to potential problems is that if n and n' are unequal integers

$$\int_{-1}^{1}P_{n'}(\mu)P_n(\mu)d\mu=0\quad .\quad .\quad .\quad (19),$$

which may be stated by saying that the integral of the product of two Legendre's coefficients of different degree taken over the whole of a spherical surface with its centre at the origin is zero; this is the fundamental harmonic property of the functions. It is immediately deducible from (18), for if $n'<n$, $P_{n'}(\mu)$ is a linear function of powers of μ, whose indices are all less than n.

When $n'=n$, the integral in (19) becomes $\int_{-1}^{1}\{P_n(\mu)\}^2d\mu$; to evaluate this we write it in the form

$$\frac{1}{2^{2n}n!n!}\int_{-1}^{1}\frac{d^n}{d\mu^n}(\mu^2-1)^n\frac{d^n}{d\mu^n}(\mu^2-1)^nd\mu\ ;$$

on integrating n times by parts, this becomes

$$\frac{(-1)^n}{2^{2n}n!n!}\int_{-1}^{1}(\mu^2-1)^n\frac{d^{2n}}{d\mu^{2n}}(\mu^2-1)^nd\mu,\ \text{or}\ \frac{(2n)!}{2^{2n}n!n!}\int_{-1}^{1}(1-\mu^2)^n\mu,$$

which on putting

$$u=\frac{1}{2}(1-\mu),\ \text{becomes}\ 2\frac{(2n)!}{n!n!}\int_{-1}^{1}u^n(1-u)^ndu,$$

hence

$$\int_{-1}^{1}\{P_n(\mu)\}^2d\mu=\frac{2}{2n+1}\quad .\quad .\quad .\quad (20).$$

Expansion of Functions in Series of Legendre's Coefficients.—If it be assumed that a function $f(\mu)$ given arbitrarily in the interval $\mu=-1$ to $+1$, can be represented by a series of Legendre's coefficients $a_0+a_1P_1(\mu)+a_2P_2(\mu)+\ldots+a_nP_n(\mu)+\ldots$ and it be assumed that the series converges in general uniformly within the interval, the coefficient a can be determined by using (19) and (20); we see that the theorem (19) plays the same part as the property $\int_0^\pi{}^{\sin}_{\cos}n\theta\,{}^{\sin}_{\cos}n'\theta d\theta=0,(n\neq n')$ does in the theory of the expansion of functions in series of circular functions. On multiplying the series by $P_n(\mu)$, we have

$$a_n\int_{-1}^{1}\{P_n(\mu)\}^2d\mu=\int_{-1}^{1}f(\mu)P_n(\mu)d\mu$$

hence

$$a_n=\frac{2n+1}{2}\int_{-1}^{1}f(\mu)P_n(\mu)d\mu,$$

hence the series by which $f(\mu)$ is in general represented in the interval is

$$\sum\frac{2n+1}{2}P_n(\mu)\int_{-1}^{1}f(\mu')P_n(\mu')d\mu'\quad .\quad .\quad (21)$$

The proof of the possibility of this representation, including the investigation of sufficient conditions as to the nature of the function $f(\mu)$, that the series may in general converge to the value of the function requires an investigation, for which we have not space, similar in character to the corresponding investigations for series of circular functions (see FOURIER'S SERIES).

The expansion may be applied to the determination at an external and an internal point, of the potential due to a distribution of matter of surface density $f(\mu)$ placed on a spherical surface $r=a$. If

$$V_i=\Sigma A_n'\frac{r^n}{a^{n+1}}P_n(\mu),\ V_0=\Sigma A_n\frac{a^n}{r^{n+1}}P_n(\mu),$$

we see that V_i, V_0 have the characteristic properties of potential functions for the spaces internal to, and external to the spherical surface respectively: moreover, the condition that V_i is continuous with V_0 at the surface $r=a$, is satisfied. The density of a surface distribution which produces these potentials is in accordance with a known theorem in the potential theory, given by

$$\sigma=\frac{1}{4\pi}\left(\frac{\partial V_i}{\partial r}-\frac{\partial V_0}{\partial r}\right)_{r=a},$$

hence

$\sigma=\frac{1}{4\pi a^2}\Sigma(2n+1)A_nP_n(\mu)$; on comparing this with the series (21),

we have $A_n=2\pi a^2\int_{-1}^{1}f(\mu')P_n(\mu')d\mu'$,

hence

$$\begin{cases}V_i=2\pi a\Sigma\frac{r^n}{a^n}P_n(\mu)\int_{-1}^{1}f(\mu')P_n(\mu')d\mu'\\ V_0=2\pi a\Sigma\frac{a^{n+1}}{r^{n+1}}P_n(\mu)\int_{-1}^{1}f(\mu')P_n(\mu')d\mu'\end{cases}$$

are the required expressions for the internal and external potentials due to the distribution of surface density $f(\mu)$.

Integral Properties of Spherical Harmonics.—The fundamental

harmonic property of spherical harmonics, of which property (19) is a particular case, is that if $Y_n(x, y, z)$, $Z_{n'}(x, y, z)$ be two (ordinary) spherical harmonics, then

$$\iint Y_n(x, y, z) Z_{n'}(x, y, z) dS = 0 \quad . \quad . \quad (22),$$

where n and n' are unequal, the integration being taken for every element dS of a spherical surface, of which the origin is the centre.

Since $\Delta^2 Y_n = 0$, $\Delta^2 Z_{n'} = 0$, we have

$$\iiint (Y_n \Delta^2 Z_{n'} - Z_n \Delta^2 Y_n) dx dy dz = 0,$$

the integration being taken through the volume of the sphere of radius r; this volume integral may be written

$$\iiint \left\{ \frac{\partial}{\partial x}\left(Y_n \frac{\partial Z_{n'}}{\partial x} - Z_{n'} \frac{\partial Y_n}{\partial x}\right) + \frac{\partial}{\partial y}\left(Y_n \frac{\partial Z_{n'}}{\partial y} - Z_{n'} \frac{\partial Y_n}{\partial y}\right) + \frac{\partial}{\partial z}\left(Y_n \frac{\partial Z_{n'}}{\partial z} - Z_{n'} \frac{\partial Y_n}{\partial z}\right) \right\} dx dy dz = 0;$$

by a well-known theorem in the Integral Calculus, the volume integral may be replaced by a surface integral over the spherical surface; we thus obtain

$$\iint \left\{ \frac{x}{r}\left(Y_n \frac{\partial Z_{n'}}{\partial x} - Z_{n'} \frac{\partial Y_n}{\partial x}\right) + \frac{y}{r}\left(Y_n \frac{\partial Z_{n'}}{\partial y} - Z_{n'} \frac{\partial Y_n}{\partial y}\right) + \frac{z}{r}\left(Y_n \frac{\partial Z_{n'}}{\partial z} - Z_{n'} \frac{\partial Y_n}{\partial y}\right) \right\} dS = 0;$$

on using Euler's theorem for homogeneous functions, this becomes

$$\frac{n' - n}{r} \iint Y_n Z_{n'} dS = 0,$$

whence the theorem (22), which is due to Laplace, is proved.

The integral over a spherical surface of the product of a spherical harmonic of degree n, and a zonal surface harmonic P_n of the same degree, the pole of which is at (x', y', z') is given by

$$\iint Y_n(x, y, z) P_n dS = \frac{4\pi}{2n+1} a^{n+2} Y_n(x', y', z') \quad . \quad (23),$$

thus the value of the integral depends on the value of the spherical harmonic at the pole of the zonal harmonic.

This theorem may also be written

$$\int_0^{2\pi}\int_{-1}^{1} V_n(\theta, \phi) P_n(\cos\theta\cos\theta' + \sin\theta\sin\theta'\cos\overline{\phi - \phi'}) d\mu d\phi = \frac{4\pi}{2n+1} V_n(\theta', \phi');$$

to prove the theorem, we observe that V_n is of the form

$$a_0 P_n(\mu) + \sum_1^n (a_m \cos m\phi + b_m \sin m\phi) P_n^m(\mu);$$

to determine a_0 we observe that when $\mu = 1$,

$$P_n(\mu) = 1, \ P_n^m(\mu) = 0,$$

hence a_0 is equal to the value $V_n(0)$ of $V_n(\theta, \phi)$ at the pole $\theta = 0$ of $P_n(\mu)$. Multiply by $P_n(\mu)$ and integrate over the surface of the sphere of radius unity, we then have

$$\int_0^{2\pi}\int_{-1}^{1} V_n(\theta, \phi) P_n(\mu) d\mu d\phi = a_0 \int_0^{2\pi}\int_{-1}^{1} \{P_n(\mu)\}^2 d\mu d\phi = \frac{4\pi}{2n+1} a_0 = \frac{4\pi}{2n+1} V_n(0)$$

if instead of taking $\mu = 1$ as the pole of $P_n(\mu)$ we take any other point (μ', ϕ'), we obtain the theorem (23).

If $f(x, y, z)$ is a function which is finite and continuous throughout the interior of a sphere of radius R, it may be shown that

$$\iint Y_n(x, y, z) f(x, y, z) dS = 4\pi R^{2n+2} \frac{2^n n!}{(2n+1)!} \left\{ 1 + \frac{R^2 \Delta^2}{2 \cdot \overline{2n+3}} + \frac{R^4 \Delta^4}{2 \cdot 4 \cdot \overline{2n+3} \cdot \overline{2n+5}} + \dots \right\} Y_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right) f(x, y, z)$$

where x, y, z are put equal to zero after the operations have been performed, the integral being taken over the surface of the sphere of radius R (see Hobson, "On the Evaluation of a certain Surface Integral," *Proc. Lond. Math. Soc.* vol. xxv.)

The following case of this theorem should be remarked:— If $f_n(x, y, z)$ is homogeneous and of degree n

$$\iint Y_n(x, y, z) f_n(x, y, z) dS = 4\pi R^{2n+2} \frac{2^n n!}{(2n+1)!} Y_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right) f_n(x, y, z)$$

if $f_n(x, y, z)$ is a spherical harmonic, we obtain from this a theorem, due to Maxwell (*Electricity*, vol. i. chap. ix.),

$$\iint Y_n(x, y, z) f_n(x, y, z) dS = \frac{4\pi R^{2n+2}}{2n+1} \frac{1}{n!} \frac{\partial^n}{\partial h_1 \partial h_2 \dots \partial h_n} f_n(x, y, z)$$

where $h_1 h_2 \dots h_n$ are the axes of Y_n. Two harmonics of the same degree are said to be conjugate, when the surface integral of their product vanishes; if Y_n, Z_n are two such harmonics, the addition of conjugacy is

$$Y_n\left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right) Z_n(x, y, z) = 0.$$

Lord Kelvin has shown how to express the conditions that $2n+1$ harmonics of degree n form a conjugate system (see *B. A. Report*, 1871).

Expansion of a Function in a Series of Spherical Harmonics.—It can be shown that under certain restrictions as to the nature of a function $F(\mu, \phi)$ given arbitrarily over the surface of a sphere, the function can be represented by a series of spherical harmonics which converges in general uniformly. On this assumption we see that the terms of the series can be found by the use of the theorems (22), (23). Let $F(\mu, \phi)$ be represented by

$$V_0(\mu, \phi) + V_1(\mu, \phi) + \dots + V_n(\mu, \phi) + \dots;$$

change μ, ϕ into μ', ϕ' and multiply by

$$P_n(\cos\theta\cos\theta' + \sin\theta\sin\theta'\cos\overline{\phi - \phi'}),$$

we have then

$$\int_0^{2\pi}\int_{-1}^{1} F(\mu', \phi') P_n(\cos\theta\cos\theta' + \sin\theta\sin\theta'\cos\overline{\phi - \phi'}) d\mu' d\phi'$$
$$= \int_0^{2\pi}\int_0^{1} V_n(\mu', \phi') P_n(\cos\theta\cos\theta' + \sin\theta\sin\theta'\cos\overline{\phi - \phi'}) d\mu' d\phi'$$
$$= \frac{4\pi}{2n+1} V_n(\theta, \phi),$$

hence the series which represents $F(\mu, \phi)$ is

$$\frac{1}{4\pi}\sum_0^\infty (2n+1) \int_0^{2\pi}\int_{-1}^{1} F(\mu', \phi') P_n(\cos\theta\cos\theta' + \sin\theta\sin\theta'\cos\overline{\phi - \phi'}) d\mu' d\phi' \qquad (24).$$

A rational integral function of $\sin\theta\cos\phi$, $\sin\theta\cos\phi$, $\cos\theta$ of degree n may be expressed as the sum of a series of spherical harmonics, by assuming

$$f_n(x, y, z) = Y_n + r^2 Y_{n-2} + r^4 Y_{n-4} + \dots$$

and determining the solid harmonics Y_n, Y_{n-2}, ... and then letting $r = 1$, in the result.

Since $\Delta^2(r^{2s} Y_{n-2s}) = 2s(2n - 2s + 1) r^{2s-2} Y_{n-2s}$, we have

$$\Delta^2 f_n = 2(2n-1) Y_{n-2} + 4(2n-3) r^2 Y_{n-4} + 6(2n-5) r^4 Y_{n-6} + \dots$$
$$\Delta^4 f_n = 2 \cdot 4(2n-3)(2n-5) Y_{n-4} + 4 \cdot 6(2n-5)(2n-7) r^2 Y_{n-6} + \dots$$

the last equation being

$$\Delta^n f_n = n(n+1)(n-2)(n-1) \dots Y_0, \text{ if } n \text{ is even},$$

or

$$\Delta^{n-1} f_n = (n-1)(n+2)(n-3) n \dots Y_1, \text{ if } n \text{ is odd}$$

from the last equation Y_0 or Y_1 is determined, then from the preceding one Y_2 or Y_3, and so on. This method is due to Gauss (see *Collected Works*, vol. v. p. 630).

As an example of the use of spherical harmonics in the potential theory, suppose it required to calculate at an external point, the potential of a nearly spherical body bounded by $r = a(1 + \epsilon u)$, the body being made of homogeneous material of density unity, and u being a given function of θ, ϕ, the quantity ϵ being so small that its square may be neglected. The potential is given by

$$\int_0^{2\pi}\int_{-1}^{1}\int_0^{a(1+\epsilon u')} \{r^2 + r'^2 - 2rr'\cos\gamma\}^{-\frac{1}{2}} dr' d\mu' d\phi',$$

where γ is the angle between r and r'; now let u' be expanded in a series

$$Y_0(\mu', \phi') + Y_1(\mu', \phi') + \dots + Y_n(\mu', \phi') + \dots$$

of surface harmonics; we may write the expression for the potential

$$\int_0^{2\pi}\int_{-1}^{1}\int_0^{a(1+\epsilon u')} \left\{ \frac{1}{r} + \frac{r'}{r^2} P_1(\cos\gamma) + \dots + \frac{r'^n}{r^{n+1}} P_n(\cos\gamma) + \dots \right\} r'^2 dr' d\mu' d\phi'$$

which is

$$\int_0^{2\pi}\int_{-1}^{1} \left\{ \frac{a^3}{3r}(1 + 3\epsilon u') + \frac{1}{4}\frac{a^4}{r^2}(1 + 4\epsilon u') P_1 + \dots + \frac{1}{n+3}\frac{a^{n-3}}{r^{n+1}}(1 + n + 3\epsilon u') P_n(\cos\gamma) \right\} d\mu' d\phi'$$

on substituting for u' the series of harmonics, and using (22), (23), this becomes

$$4\pi a^2 \left[\frac{1}{3}\frac{a}{r} + \epsilon\left\{ \frac{a^3}{3r^2} Y_1(\mu, \phi) + \frac{a^3}{5r^3} Y_2(\mu, \phi) + \dots + \frac{a^{n+1}}{(2n+1) r^{n-1}} Y_n(\mu, \phi) + \dots \right\} \right]$$

which is the required potential at the external point (r, θ, ϕ).

The Normal Solutions of Laplace's Equation in Polars.—If

h_1, h_2, h_3 be the parameters of three orthogonal sets of surfaces, the length of an elementary arc ds may be expressed by an equation of the form $ds^2=\frac{1}{H_1^2}dh_1^2+\frac{1}{H_2^2}dh_2^2\frac{1}{H_3^2}dh_3^2$, where H_1, H_2, H_3 are functions of h_1, h_1, h_3, which depend on the form of these parameters; it is known that Laplace's equation when expressed with h_1, h_2, h_3 as independent variables, takes the form

$$\frac{\partial}{\partial h_1}\left(\frac{H_1}{H_2H_3}\frac{\partial V}{\partial h_1}\right)+\frac{\partial}{\partial h_2}\left(\frac{H_2}{H_3H_1}\frac{\partial V}{\partial h_2}\right)+\frac{\partial}{\partial h_3}\left(\frac{H_3}{H_1H_2}\frac{\partial V}{\partial h_3}\right)=0 \quad (25).$$

In case the orthogonal surfaces are concentric spheres, co-axial circular cones, and planes through the axes of the cones, the parameters are the usual polar co-ordinates r, θ, ϕ, and in this case $H_1=1$, $H_2=\frac{1}{r}$, $H_3=\frac{1}{r\sin\theta}$, thus Laplace's equation becomes

$$\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right)+\frac{1}{\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right)+\frac{1}{\sin^2\theta}\frac{\partial^2 V}{\partial\phi^2}=0.$$

Assume that $V=R\Theta\Phi$ is a solution, R being a function of r only, Θ of θ only, Φ of ϕ only; we then have

$$\frac{1}{R}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right)+\frac{1}{\Theta\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)+\frac{1}{\sin^2\theta.\Phi}\frac{d^2\Phi}{d\phi^2}=0.$$

This can only be satisfied if $\frac{1}{R}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right)$ is a constant, say $n(n+1)$, $\frac{1}{\Phi}\frac{d^2\Phi}{d\phi^2}$ is a constant, say $-m^2$, and Θ satisfies the equation

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)+\left\{n(n+1)-\frac{m^2}{\sin^2\theta}\right\}\Theta=0,$$

if we write u for Θ, and μ for $\sin\theta$, this equation becomes

$$\frac{d}{d\mu}\left\{(1-\mu^2)\frac{du}{d\mu}\right\}+\left\{n(n+1)-\frac{m^2}{1-\mu^2}\right\}u=0 \quad . \quad (26).$$

From the equations which determine R, Θ, u, it appears that Laplace's equation is satisfied by

$$\begin{matrix} r^n \\ r^{-n-1}\end{matrix}\ \begin{matrix}\cos \\ \sin\end{matrix} m\phi.\ u_n^m$$

where u is any solution of (26); this product we may speak of as the normal solution of Laplace's equation in polar co-ordinates; it will be observed that the constants n, m may have any real or complex values.

Legendre's Equation.—If in the above normal solution we consider the case $m=0$, we see that

$$\begin{matrix} r_n \\ r^{-n-1}\end{matrix} u_n$$

is the normal form where u_n satisfies the equation

$$\frac{d}{d\mu}\left\{(1-\mu^2)\frac{du}{d\mu}\right\}+n(n+1)u=0 \quad . \quad . \quad (27),$$

known as Legendre's equation; we shall here consider the special case in which n is a positive integer. One solution of (27) will be the Legendre's coefficient $P_n(\mu)$, and to find the complete primitive we must find another particular integral; in considering the forms of solution, we shall consider μ to be not necessarily real and between ±1. If we assume

$$u=\mu^m+a_2\mu^{m-2}+a_4\mu^{m-4}+\dots$$

as a solution, and substitute in the equation (27), we find that $m=n$, or $-n-1$, and thus we have as solutions, on determining the ratios of the coefficients in the two cases,

$$a\left\{\mu^n-\frac{n(n-1)}{2.2n-1}\mu^{n+2}+\dots\right\}$$

and

$$\beta\left\{\frac{1}{\mu^{n+1}}+\frac{(n+1)(n+2)}{2.2n+3}\frac{1}{\mu^{n+3}}+\frac{(n+1)(n+2)(n+3)(n+4)}{2.4.2n+3.2n+5}\frac{1}{\mu^{n+5}}+\dots\right\}$$

the first of these series is (n integral) finite, and represents $P_n(\mu)$, the second is an infinite series which is convergent when mod $\mu>1$. If we choose the constant β to be $\frac{1.2.3\dots n}{3.5\dots 2n+1}$, the second solution may be denoted by $Q_n(\mu)$, and is called the Legendre's function of the second kind, thus

$$Q_n(\mu)=\frac{1.2.3\dots n}{3.5\dots 2n+1}\left\{\frac{1}{\mu^{n+1}}+\frac{(n+1)(n+2)}{2.2n+3}\frac{1}{\mu^{n+3}}+\dots\right\}$$
$$=\frac{1.2.3\dots n}{3.5\dots 2n+1}\frac{1}{\mu^{n+1}}F\left(\frac{n+1}{2},\frac{n+2}{2},\frac{2n+3}{2},\frac{1}{\mu^2}\right) \quad (28).$$

This function $Q_n(\mu)$, thus defined for mod $\mu>1$, is of considerable importance in the potential theory. When mod $\mu<1$, we may in a similar manner obtain two series in ascending powers of μ, one of which represents $P_n(\mu)$, and a certain linear function of the two series represents the analytical continuation of $Q_n(\mu)$ as defined above. The complete primitive of Legendre's equation is

$$u=AP_n(\mu)+BQ_n(\mu).$$

By the usual rule for obtaining the complete primitive of an ordinary differential equation of the second order when a particular integral is known, it can be shown that (27) is satisfied by

$$P_n(\mu)\int^\mu\frac{d\mu}{(\mu^2-1)\{P_n(\mu)\}^2},$$

the lower limit being arbitrary.

From this form it can be shown that

$$Q_n(\mu)=\frac{1}{2}P_n(\mu)\log\frac{\mu+1}{\mu-1}-W_{n-1}(\mu),$$

where $W_{n-1}(\mu)$ is a rational integral function of degree $n-1$ in μ; it can be shown that this form is in agreement with the definition of $Q_n(\mu)$ by series, for the case mod $\mu>1$. In case mod $\mu<1$ it is convenient to use the symbol $Q_n(\mu)$ for

$$\frac{1}{2}P_n(\mu)\log\frac{1+\mu}{1-\mu}-W_{n-1}(\mu),$$

which is real when μ is real and between ±1, the function $Q_n(\mu)$ in this case is not the analytical continuation of the function $Q_n(\mu)$ for mod $\mu>1$, but differs from it by an imaginary multiple of $P_n(\mu)$. It will be observed that $Q_n(1)$, $Q_n(-1)$ are infinite, and $Q_n(\infty)=0$. The function $W_{n-1}(\mu)$ has been expressed by Christoffel in the form

$$\frac{2n-1}{1.n}P_{n-1}(\mu)+\frac{2n-5}{3.n-1}P_{n-3}(\mu)+\frac{2n-9}{5.n-2}P_{n-5}(\mu)+\dots,$$

and it can also be expressed in the form

$$\frac{1}{n}P_0(\mu)P_{n-1}(\mu)+\frac{1}{n-1}P_1(\mu)P_{n-2}(\mu)+\dots+P_{n-1}(\mu)P_0(\mu).$$

It can easily be shown that the formula (28) is equivalent to

$$Q_n(\mu)=2^n n!\int_\mu^\infty\int_\mu^\infty\dots\int_\mu^\infty\frac{(d\mu)^{n+1}}{(\mu^2-1)^{n+1}}$$

which is analogous to Rodrigue's expression for $P_n(\mu)$.

Another expression of a similar character is

$$Q_n(\mu)=(-1)^n\frac{2^n n!}{(2n)!}\frac{d^n}{d\mu^n}\left\{(\mu^2-1)^n\int_\mu^\infty\frac{d\mu}{(\mu^2-1)^{n+1}}\right\}.$$

It can be shown that under the condition mod $(u-\sqrt{u^2-1})$ $>$mod $(\mu-\sqrt{\mu^2-1})$, the function $\frac{1}{\mu-u}$ can be expanded in the form $\Sigma(2n+1)P_n(u)Q_n(u)$; this expansion is connected with the definite integral formula for $Q_n(\mu)$ which was used by F. Neumann as a definition of the function $Q_n(\mu)$, this is

$$Q_n(\mu)=\frac{1}{2}\int_{-1}^1\frac{P_n(u)}{\mu-u}du,$$

which holds for all values of μ which are not real and between ±1.

From Neumann's integral can be deduced the formula

$$Q_n(\mu)=\int_1^\infty\frac{d\psi}{(\mu+\sqrt{\mu^2-1}\cosh\psi)^{n+1}},$$

which holds for all values of μ which are not real and between ±1, provided the sign of $\sqrt{\mu^2-1}$ is properly chosen; when μ is real and greater than 1, $\sqrt{\mu^2-1}$ has its positive value.

By means of the substitution

$$(\mu+\sqrt{\mu^2-1}\cosh\psi)(\mu-\sqrt{\mu^2-1}\cosh\chi)=1,$$

the above integral becomes

$$Q_n(\mu)=\int_0^{\chi_0}(\mu-\sqrt{\mu^2-1}\cosh\chi)^n d\chi,\ \text{where}\ \chi_0=\frac{1}{2}\log_e\frac{\mu+1}{\mu-1}.$$

This formula gives a simple means of calculating $Q_n(\mu)$ for small values of n; thus

$$Q_0(\mu)=\int_0^{\chi_0}d\chi=\frac{1}{2}\log_e\frac{\mu+1}{\mu-1}.$$

$$Q_1(\mu)=\mu\chi_0-\sqrt{\mu^2-1}\sinh\chi_0=\mu.\frac{1}{2}\log\frac{\mu+1}{\mu-1}-1.$$

Neumann's integral affords a means of establishing a relation between successive Q functions, thus

$$nQ_n-(2n-1)\mu Q_{n-1}+(n-1)Q_{n-2}$$
$$=\frac{1}{2}\int_{-1}^1\frac{nP_n(u)+(n-1)P_{n-2}(u)-(2n-1)\mu P_{n-1}(u)}{\mu-u}du$$
$$=-\frac{1}{2}\int_{-1}^1(2n-1)P_{n-1}(u)=0.$$

Again, it may similarly be proved that

$$\frac{dQ_{n+1}}{d\mu}-\frac{dQ_{n-1}}{d\mu}=(2n+1)Q_n.$$

Legendre Associated Functions.—Returning to the equation (26) satisfied by u_n^m the factor in the normal forms $\frac{r^n}{r^{-n-1}}\frac{\cos}{\sin}m\phi . u_n^m$, we shall consider the case in which n, m are positive integers, and $n \geqq m$. Let $u=(\mu^2-1)^{\frac{1}{2}m}v$, then it will be found that v satisfies the equation

$$(1-\mu^2)\frac{d^2v}{d\mu^2}-2(m+1)\mu\frac{dv}{d\mu}+(n-m)(n+m+1)v=0.$$

If in Legendre's equation, we differentiate m times, we find

$$(1-\mu^2)\frac{d^{m+2}u}{d\mu^{m+2}}-2(m+1)\mu\frac{d^{m+1}u}{d\mu^{m+1}}+(n-m)(n+m+1)\frac{d^m u}{d\mu^m}=0\ ;$$

it follows that $v=\frac{d^m u}{d\mu^m}$, hence $u_n^m=(\mu^2-1)^{\frac{1}{2}m}\frac{d^m u}{d\mu^m}$.

The complete solution of (26) is therefore

$$u=(\mu^2-1)^{\frac{1}{2}m}\left\{A\frac{d^m P_n(\mu)}{d\mu^m}+B\frac{d^m Q_n(\mu)}{d\mu^m}\right\};$$

when μ is real and lies between ± 1, the two functions

$$(1-\mu^2)^{\frac{1}{2}m}\frac{d^m P_n(\mu)}{d\mu^m},\ (1-\mu^2)^{\frac{1}{2}m}\frac{d^m Q_n(\mu)}{d\mu^m}$$

are called the Legendre's associated functions of degree n, and order m, of the first and second kinds respectively. When μ is not real and between ± 1, the same names are given to the two functions

$$(\mu^2-1)^{\frac{1}{2}m}\frac{d^m P_n(\mu)}{d\mu^m},\ (\mu^2-1)^{\frac{1}{2}m}\frac{d^m Q_n(\mu)}{d\mu^m}\ ;$$

in either case the functions may be denoted by $P_n^m(\mu)$, $Q_n^m(\mu)$.

It can be shown that, when μ is real and between ± 1

$$P_n^m(\mu)=\frac{(-1)^m}{2^n(n-m)!}\left(\frac{1+\mu}{1-\mu}\right)^{\frac{1}{2}m}\frac{d^n}{d\mu^n}\{(\mu-1)^{n+m}(\mu+1)^{n-m}\}$$

$$=\frac{1}{2^n(n-m)!}\left(\frac{1-\mu}{1+\mu}\right)^{\frac{1}{2}m}\frac{d^n}{d\mu^n}\{(\mu-1)^{n-m}(\mu+1)^{n+m}\}.$$

In the same case, we find

$$P_n^{m+2}(\cos\theta)-2(m+1)\cot\theta\, P_n^{m+1}(\cos\theta)+(n-m)(n+m+1)P_n^m(\cos\theta)=0$$

$$(n-m+2)P_{n+2}^m(\cos\theta)-(2n+3)\mu P_{n+1}^m(\cos\theta)+(n+m+1)P_n^m(\cos\theta)=0.$$

Bessel's Functions.—If we take for three orthogonal systems of surfaces a system of parallel planes, a system of co-axial circular cylinders perpendicular to the planes, and a system of planes through the axis of the cylinders, the parameters are z, ρ, ϕ, the cylindrical co-ordinates; in that case $H_1=1$, $H_2=1$, $H_3=\frac{1}{\rho}$, and the equation (25) becomes

$$\frac{\partial^2 V}{\partial z^2}+\frac{\partial^2 V}{\partial\rho^2}+\frac{1}{\rho}\frac{\partial V}{\partial\rho}+\frac{1}{\rho^2}\frac{\partial^2 V}{\partial\phi^2}=0.$$

To find the normal functions which satisfy this equation, we put $V=ZR\Phi$, when Z is a function of z only, R of ρ only, and Φ of ϕ, the equation then becomes

$$\frac{1}{Z}\frac{d^2Z}{dz^2}+\frac{1}{R}\left(\frac{d^2R}{d\rho^2}+\frac{1}{\rho}\frac{dR}{d\rho}\right)+\frac{1}{\rho^2}\frac{1}{\Phi}\frac{d^2\Phi}{d\phi^2}=0.$$

That this may be satisfied we must have $\frac{1}{Z}\frac{d^2Z}{dz^2}$ constant, say $=k^2$, $\frac{1}{Z}\frac{d^2Z}{dz^2}$ constant, say $=-m^2$, and R for which we write u, must satisfy the differential equation

$$\frac{d^2u}{d\rho^2}+\frac{1}{\rho}\frac{du}{d\rho}+\left(k^2-\frac{m^2}{\rho^2}\right)u=0,$$

it follows that the normal forms are $e^{\pm kz}\frac{\cos}{\sin}m\phi . u(k\rho)$, where $u(\rho)$ satisfies the equation

$$\frac{d^2u}{d\rho^2}+\frac{1}{\rho}\frac{du}{d\rho}+\left(1-\frac{m^2}{\rho^2}\right)u=0 \quad . \quad . \quad . \quad (29).$$

This is known as Bessel's equation of order m; the particular case

$$\frac{d^2u}{d\rho^2}+\frac{1}{\rho}\frac{du}{d\rho}+u=0 \quad . \quad . \quad . \quad . \quad (30),$$

corresponding to $m=0$, is known as Bessel's equation.

If we solve the equation (29) in series, we find by the usual process that it is satisfied by the series

$$\rho^m\left\{1-\frac{\rho^2}{2.2m+2}+\frac{\rho^4}{2.4.2m+2.2m+4}-\dots\right\};$$

the expression

$$\frac{\rho^m}{2^m\Pi(m)}\left\{1-\frac{\rho^2}{2.2m+2}+\frac{\rho^4}{2.4.2m+2.2m+4}-\dots\right\}$$

or

$$\sum_{n=0}^{\infty}\frac{(-1)^n\rho^{m+2n}}{2^{m+2n}\Pi(m+n)\Pi(n)}$$

is denoted by $J_m(\rho)$.

When $m=0$, the solution

$$1-\frac{\rho^2}{2^2}+\frac{\rho^4}{2^2.4^2}-\dots$$

of the equation (30) is denoted by $J_0(\rho)$ or by $J(\rho)$.

The function $J_m(\rho)$ is called Bessel's function of order m, and $J_0(\rho)$ simply Bessel's function; the series are convergent for all finite values of ρ.

The equation (29) is unaltered by changing m into $-m$, it follows that $J_{-m}(\rho)$ is a second solution of (29), thus in general

$$u=AJ_m(\rho)+BJ_{-m}(\rho)$$

is the complete primitive of (29). However, in the most important case, that in which m is an integer, the solutions $J_{-m}(\rho)$, $J_m(\rho)$ are not distinct, for $J_{-m}(\rho)$ may be written in the form

$$\left(\frac{\rho}{2}\right)^{-m}\sum_{n=0}^{m-1}\frac{(-1)^n}{\Pi(n-m)\Pi(n)}\left(\frac{\rho}{2}\right)^{2n}+(-1)^m\left(\frac{\rho}{2}\right)^m\sum_{p=0}^{\infty}\frac{(-1)^p}{\Pi(m+p)\Pi(p)}\left(\frac{\rho}{2}\right)^{2p}$$

now $\Pi(n-m)$ is infinite when m is an integer, and $n<m$; thus the first part of the expression vanishes, and the second part is $(-1)^m J_m(\rho)$, hence when m is an integer $J_{-m}(\rho)=(-1)^m J_m(\rho)$, and the second solution remains to be found.

Bessel's Functions of the Second Kind.—When m is not a real integer, we have seen that any linear function of $J_m(\rho)$, $J_{-m}(\rho)$ satisfies the equation of order m. The Bessel's function of the second kind of order m is defined as the particular linear function

$$\pi e^{m\pi\iota}\frac{J_{-m}(\rho)-\cos m\pi . J_m(\rho)}{\sin 2m\pi},$$

and may be denoted by $Y_m(\rho)$. This definition has the advantage of giving a meaning to $Y_m(\rho)$ in the case in which m is an integer, for it may be evaluated as a limiting form 0/0, and the limit will satisfy the equation (29). The only failing case is when m is half an odd integer; in that case we take $\cos m\pi . Y_m(\rho)$ as a second finite solution of the differential equation.

When m is an integer, we have

$$Y_m(\rho)=(-1)^m\frac{\pi}{2}\left\{\frac{dJ_{-m-\epsilon}}{d\epsilon}-(-1)^m\frac{dJ_{m+\epsilon}}{d\epsilon}\right\}_{\epsilon=0};$$

on carrying out the differentiations, and proceeding to the limit, we find

$$Y_m(\rho)=J_m(\rho)\log\frac{2}{\rho}+\frac{1}{2}\left(\frac{\rho}{2}\right)^m\sum_{n=0}^{\infty}[\dagger(n)+\dagger(m+n)]\frac{(-1)^n}{\Pi(m+n)\Pi(n)}\left(\frac{\rho}{2}\right)^{2n}+\frac{1}{2}\left(\frac{\rho}{2}\right)^{-m}\sum_{n=0}^{m-1}\frac{\Pi(m-n-1)}{\Pi(n)}\left(\frac{\rho}{2}\right)^{2n}$$

where $\dagger(n)$ denotes $\Pi'(n)/\Pi(n)$.

When $m=0$ we have the second solution of (30) given by

$$Y_0(\rho)=J_0(\rho)\log\frac{2}{\rho}+\sum_0^{\infty}\frac{(-1)^n\dagger(n)}{\Pi(n)\Pi(n)}\left(\frac{\rho}{2}\right)^{2n}.$$

Relations between Bessel's Functions of Different Orders.—Since $e^z\frac{\cos}{\sin}m\phi . u_m(\rho)$ satisfies Laplace's equation, it follows that $\frac{\cos}{\sin}m\phi . u_m(\rho)$ satisfies the differential equation

$$\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+u=0 \quad . \quad . \quad . \quad . \quad (31).$$

The linear character of this equation shows that if u is any solution

$$f\left(\frac{\partial}{\partial x},\frac{\partial}{\partial y}\right)u$$

is also one, f denoting a rational integral function of the operators. Let ξ, η denote $x+\iota y$, $x-\iota y$, then since $\rho^{-m}\xi^m u_m(\sqrt{\xi\eta})$ satisfies the differential equation, so also does

$$\xi^m\frac{\partial^p}{\partial\eta^p}\{\rho^{-m}u_m(\sqrt{\xi\eta})\},$$

or

$$\xi^{m+p}\frac{d^p}{d(\rho^2)^p}\{\rho^{-m}u_m(\rho)\},$$

thus we have

$$u_{m+p} = C\rho^{m+p}\frac{d^p}{d(\rho^2)^p}\left\{\frac{u_m(\rho)}{\rho_m}\right\}$$

where C is a constant. If $u_m(\rho)=J_m(\rho)$, we have $u_{m+p}=J_{m+p}(\rho)$, and by comparing the coefficients of ρ^{m+p}, we find $C=(-2)^p$, hence

$$J_{m+p}(\rho)=(-2)^p\rho^{m+p}\frac{d^p}{d(\rho^2)^p}\{\rho^{-m}J_m(\rho)\},$$

and changing m into $-m$, we find

$$J_{p-m}(\rho)=(-2)^p\rho^{p-m}\frac{d^p}{d(\rho^2)^p}\{\rho^m J_{-m}(\rho)\}.$$

In a similar manner it can be proved that

$$J_{m-p}(\rho)=2^p\rho^{p-m}\frac{d^p}{d(\rho^2)^p}\{\rho^m J_m(\rho)\}.$$

From the definition of $Y_m(\rho)$, and applying the above analysis, we prove that

$$Y_{m+p}(\rho)=(-2)^p\rho^{m+p}\frac{d^p}{d(\rho^2)^p}\{\rho^{-m}Y_m(\rho)\}$$

and

$$Y_{m-p}(\rho)=2^p\rho^{p-m}\frac{d^p}{d(\rho^2)^p}\{\rho^m Y_m(\rho)\}.$$

As particular cases of the above formulæ, we find

$$J_p(\rho)=(-2\rho)^p\frac{d^p}{d(\rho^2)^p}J_0(\rho),\ Y_p(\rho)=(-2\rho)^p\frac{d^p}{d(\rho^2)^p}Y_0(\rho)$$
$$J_1(\rho)=-\frac{dJ_0(\rho)}{d\rho},\ Y_1(\rho)=-\frac{dY_0(\rho)}{d\rho}.$$

Bessel's Functions as Coefficients in an Expansion.—It is clear that $e^{\iota\rho\cos\phi}=e^{\iota x}$, or $e^{\iota\rho\sin\phi}=e^{\iota y}$ satisfy the differential equation (31), hence if these exponentials be expanded in series of cosines and sines of multiples of ϕ, the coefficients must be Bessel's functions, which it is easy to see are of the first kind. To expand $e^{\iota\rho\sin\phi}$, put $e^{\iota\phi}=t$, we have then to expand $e^{\frac{1}{2}\rho(t-t^{-1})}$ in powers of t. Multiplying together the two absolutely convergent series

$$e^{\frac{1}{2}\rho t}=\sum\frac{1}{m!}\left(\frac{\rho}{2}\right)^m t^m,\ e^{-\frac{1}{2}\rho t^{-1}}=\sum\frac{(-1)^m}{m!}\left(\frac{1}{2\rho}\right)^m t^m,$$

we obtain for the coefficient of t^m in the product

$$\frac{\rho^m}{2^m m!}\left\{1-\frac{\rho^2}{2.2m+2}+\frac{\rho^4}{2.4.2m+2.2m+4}-\dots\right\}\text{ or }J_m(\rho),$$

hence

$$\left.\begin{aligned}e^{\frac{1}{2}\rho(t-t^{-1})}=J_0(\rho)+tJ_1(\rho)+\dots+t^mJ_m(\rho)+\dots\\ -t^{-1}J_1(\rho)+\dots+(-1)^m t^{-m}J_m(\rho)\end{aligned}\right\}\tag{32}$$
$$=\sum_{-\infty}^{\infty}t^mJ_m(\rho)$$

the Bessel's functions were defined by Schlömilch as the coefficients of the powers of t in the expansion of $e^{\frac{1}{2}\rho(t-t^{-1})}$, and many of the properties of the functions can be deduced from this expansion. By differentiating both sides of (32) with respect to t, and equating the coefficients of t^{m-1} on both sides, we find the relation

$$J_{m-1}(\rho)+J_{m+1}(\rho)=\frac{2m}{\rho}J_m(\rho),$$

which connects three consecutive functions. Again, by differentiating both sides of (32) with respect to ρ, and equating the coefficients of corresponding terms, we find

$$2\frac{dJ_m(\rho)}{d\rho}=J_{m-1}(\rho)-J_{m+1}(\rho).$$

In (32), let $t=e^{\iota\phi}$, and equate the real and imaginary parts, we have then

$$\cos(\rho\sin\phi)=J_0(\rho)+2J_2(\rho)\cos 2\phi+2J_3(\rho)\cos 3\phi+\dots$$
$$\sin(\rho\sin\phi)=2J_1(\rho)\sin\phi+2J_3(\rho)\sin 3\phi+\dots$$

we obtain expansions of $\cos(\rho\cos\phi)$, $\sin(\rho\cos\phi)$, by changing ϕ into $\frac{\pi}{2}-\phi$. On comparing these expansions with Fourier's series, we find expressions for $J_m(\rho)$ as definite integrals, thus

$$J_0(\rho)=\frac{1}{\pi}\int_0^\pi\cos(\rho\sin\phi)d\phi,\ J_m(\rho)=\frac{1}{\pi}\int_0^\pi\cos(\rho\sin\phi)\cos m\phi d\phi\ (m\text{ even})$$
$$J_m(\rho)=\frac{1}{\pi}\int_0^\pi\sin(\rho\sin\phi)\sin m\phi d\phi\ (m\text{ odd}).$$

It can easily be deduced that when m is any positive integer

$$J_m(\rho)=\frac{1}{\pi}\int_0^\pi\cos(m\phi-\rho\sin\phi)d\phi.$$

Bessel's Functions as Limits of Legendre's Functions.—The system of orthogonal surfaces whose parameters are cylindrical co-ordinates may be obtained as a limiting case of those whose parameters are polar co-ordinates, when the centre of the spheres moves off to an indefinite distance from the portion of space which is contemplated. It would therefore be expected that the normal forms $e^{\pm\lambda z}J_m(\lambda\rho)\frac{\cos}{\sin}m\phi$ would be derivable as limits of $\frac{r^n}{r^{-n-1}}P_n^m(\cos\theta)\frac{\cos}{\sin}m\phi$, and we shall show that this is actually the case. If O be the centre of the spheres, take as new origin a point C on the axis of z, such that $OC=a$; let P be a point whose polar co-ordinates are r, θ, ϕ referred to O as origin, and cylindrical co-ordinates ρ, z, ϕ referred to C as origin; we have $\rho=r\sin\theta, z=r\cos\theta-a$, hence $\left(\frac{r}{a}\right)^nP_n(\cos\theta)=\sec^n\theta\left(1+\frac{z}{a}\right)^nP_n(\cos\theta)$. Now let O move off to an infinite distance from C, so that a becomes infinite, and at the same time let n become infinite in such a way that n/a has a finite value λ. Then

$$L\sec^n\theta=L\left(\sec\frac{\rho}{a}\right)^{\lambda a}=1,\ L\left(1+\frac{z}{a}\right)^n=e^{\lambda z},$$

and it remains to find the limiting value of $P_n(\cos\theta)$. From the series (15), it may be at once proved that

$$P_n(\cos\theta)=1-\frac{(n+1)n}{1^2}\left(\sin\frac{\theta}{2}\right)^2+\dots$$
$$+(-1)^m\delta\frac{(n+m)\dots(n-m+1)}{1^2.2^2.m^2}\left(\sin\frac{\theta}{2}\right)^{2m}$$

where δ is some proper fraction, and m is a fixed finite quantity sufficiently large; on proceeding to the limit, we have

$$LP_n\left(\cos\frac{\lambda\rho}{n}\right)=1-\frac{\lambda^2\rho^2}{2^2}+\frac{\lambda^4\rho^4}{2^2.4^2}-\dots+(-1)^m\delta_1\frac{\lambda^{2m}\rho^{2m}}{2^2.4^2.(2m)^2}$$

where δ_1 is some proper fraction.

Hence

$$\underset{n=\infty}{L}\ P_n\left(\cos\frac{\lambda\rho}{n}\right)=J_0(\lambda\rho).$$

Again, since

$$P_n^m(\cos\rho)=\sin^m\theta\frac{d^mP_n(\cos\theta)}{d(\cos\theta)^m},$$

we have

$$Ln^{-m}P_n^m\left(\cos\frac{\rho}{n}\right)=L\frac{\rho^m}{n^{2m}}\frac{d^mP_n\left(\cos\frac{\rho}{n}\right)}{d\left(-\frac{\rho^2}{2n^2}\right)^m}$$
$$=(-2)^m\rho^m\frac{d^mJ_0(\rho)}{d(\rho^2)^m}$$

hence

$$\underset{n=\infty}{L}\ n^{-m}P_n^m\left(\cos\frac{\rho}{n}\right)=J_m(\rho).$$

It may be shown that $Y_0(\rho)$ is obtainable as the limit of $Q_n\left(\cos\frac{\rho}{n}\right)$ the zonal harmonic of the second kind; and that $Y_m(\rho)=Ln^{-m}Q_n^m\left(\cos\frac{\rho}{n}\right)$.

Definite Integral Solutions of Bessel's Equation.—Bessel's equation of order m, where m is unrestricted, is satisfied by the expression $\rho^m\int e^{\iota\rho t}(t^2-1)^{m-\frac{1}{2}}dt$, where the path of integration is either a curve which is closed on the Riemann's surface on which the integrand is represented, or is taken between limits, at each of which $e^{\iota\rho t}(t^2-1)^{m+\frac{1}{2}}$ is zero. The equation is also satisfied by the expression $\int e^{\frac{1}{2}\rho\left(t-\frac{1}{t}\right)}t^{-m-1}dt$ where the integral is taken along a closed path as before, or between limits at each of which $e^{\frac{1}{2}\rho\left(t-\frac{1}{t}\right)}t^{-m-1}$ vanishes.

The following definite integral expressions for Bessel's functions are derivable from these fundamental forms.

$$J_m(\rho)=\frac{1}{\Pi\left(-\frac{1}{2}\right)\Pi\left(m-\frac{1}{2}\right)}\left(\frac{\rho}{2}\right)^m\int_0^\pi e^{\iota\rho\cos\phi}\sin^{2m}\phi d\phi$$

where the real part of $m+\frac{1}{2}$ is positive.

$$Y_m(\rho)+\frac{1}{2}\pi\iota.e^{m\pi\iota}\sec m\pi.J_m(\rho)$$
$$=\frac{\Pi\left(-\frac{1}{2}-m\right)}{\Pi\left(-\frac{1}{2}\right)}\left(\frac{\rho}{2}\right)^m\int_0^{\infty+\frac{1}{2}\pi\iota}e^{\iota\rho\cosh\phi}\sinh^{2m}\phi d\phi$$

where the real parts of $m+\frac{1}{2}$, ρ are positive; if ρ is purely

imaginary and positive the upper limit may be replaced by ∞.

$$Y_m(\rho)-\frac{1}{2}\pi\iota\,.\,e^{m\pi\iota}\sec m\pi\,.\,J_m(\rho)$$

$$=e^{2m\pi\iota}\frac{\Pi\left(-\frac{1}{2}-m\right)}{\Pi\left(-\frac{1}{2}\right)}\left(\frac{\rho}{2}\right)^m\int_0^{\infty-\frac{1}{2}\pi\iota}e^{-\iota\rho\cosh h\phi}\sinh^{2m}\phi d\phi$$

under the same restrictions as in the last case; if ρ is a negative imaginary number, we may put ∞ for the upper limit.

If ρ is real and positive

$$J_0(\rho)=\frac{2}{\pi}\int_0^\infty\sin(\rho\cosh\phi)d\phi$$

$$Y_0(\rho)=\int_0^\infty\cos(\rho\cosh\phi)d\phi.$$

Bessel's Functions with Imaginary Argument.—The functions with purely imaginary argument are of such importance in connexion with certain differential equations of physics, that a special notation has been introduced for them. We denote the two solutions of the equation

$$\frac{d^2u}{dr^2}+\frac{1}{r}\frac{du}{dr}-u=0,$$

by $I_0(r)$, $K_0(r)$ when

$$I_0(r)=J_0(\iota r)=1+\frac{r^2}{2^2}+\frac{r^4}{2^2.4^2}+\cdots$$

$$=\frac{1}{\pi}\int_0^\pi\cosh(r\cos\phi)d\phi,$$

and

$$K_0(r)=Y_0(\iota r)+\frac{1}{2}\iota\pi J_0(\iota r)=\int_0^\infty e^{-r\cosh h\phi}d\phi=\int_0^\infty\cos(r\sinh\psi)d\psi$$

The particular integral $K_0(r)$ is so chosen that it vanishes when r is real and infinite; it is also represented by

$$\int_0^\infty\frac{\cos v}{\sqrt{v^2+r^2}}dv,$$

and by

$$\int_1^\infty\frac{e^{-ru}}{\sqrt{u^2-1}}du.$$

The solutions of the equation

$$\frac{d^2u}{dr^2}+\frac{1}{r}\frac{du}{dr}-\left(1+\frac{m^2}{r^2}\right)u=0,$$

are denoted by $I_m(r)$, $K_m(r)$, where

$$I_m(r)=\frac{r^m}{2^m\Pi(m)}\left\{1+\frac{\rho^2}{2.\overline{2m+2}}+\frac{\rho^4}{2.4.\overline{2m+2}.\overline{2m+4}}+\ldots\right\}$$

$$=(2r)^m\frac{d^m}{d(r^2)^m}I_0(r),$$

when m is an integer, and

$$K_m(r)=(2r)^m\frac{d^m}{d(r^2)^m}K_0(r)=e^{-\frac{1}{2}m\pi\iota}\left\{Y_m(\iota r)+\frac{1}{2}\iota\pi J_m(\iota r)\right\}.$$

We find also

$$I_m(r)=\frac{r^m}{1.3.5\ldots(2m-1}\frac{1}{\pi}\int_0^\pi\cosh(r\cos\phi)\sin^{2m}\phi d\phi$$

$$K_m(r)=\frac{(-1)^m r^m}{1.3.5\ldots(2m-1)}\int_0^\infty e^{-r\cosh\phi}\sinh^{2m}\phi d\phi$$

$$=(-1)^m 3.5\ldots\overline{2m-1}r^m\int_0^\infty\frac{\cos u}{(\overline{u^2+r^2})^{m+\frac{1}{2}}}du.$$

The Semi-convergent Series for Bessel's Functions.—It may be shown, by means of definite integral expressions for the Bessel's functions, that

$$J_m(\rho)=\sqrt{\frac{2}{\pi\rho}}\left\{P\cos\left(\frac{m\pi}{2}+\frac{\pi}{4}-\rho\right)+Q\sin\left(\frac{m\pi}{2}+\frac{\pi}{4}-\rho\right)\right\}$$

$$Y_m(\rho)=\sqrt{\frac{\pi}{2\rho}}e^{m\pi\iota}\sec m\pi\left\{P\sin\left(\frac{m\pi}{2}+\frac{\pi}{4}-\rho\right)-Q\cos\left(\frac{m\pi}{2}+\frac{\pi}{4}-\rho\right)\right\}$$

where P and Q denote the series

$$P=1-\frac{(4m^2-1^2)(4m^2-3^2)}{1.2.(8\rho)^2}+\frac{(4m^2-1^2)(4m^2-3^2)(4m^2-5^2)(4m^2-7^2)}{1.2.3.4(8\rho)^4}-\ldots$$

$$Q=\frac{4m^2}{1.8\rho}-\frac{(4m^2-1^2)(4m^2-3^2)(4m^2-5^2)}{1.2.3.(8\rho)^3}+\ldots$$

These series for P, Q are divergent unless m is half an odd integer, but it can be shown that they may be used for calculating the values of the functions, as they have the property that if in the calculation we stop at any term, the error in the value of the function is less than the next term; thus in using the series for calculation, we must stop at a term which is small. In such series the remainder after n terms has a minimum for some value of n and for greater values of n increases beyond all limits; such series are called semi-convergent or asymptotic.

We have as particular cases of such series:—

$$J_0(\rho)=\sqrt{\frac{2}{\pi\rho}}\cos\left(\frac{\pi}{4}-\rho\right)\left\{1-\frac{1^2.3^2}{1.2(8\rho)^2}+\frac{1^2.3^2.5^2.7^2}{1.2.3.4(8\rho)^4}-\cdots\right\}$$

$$-\sqrt{\frac{2}{\pi\rho}}\sin\left(\frac{\pi}{4}-\rho\right)\left\{\frac{1^2}{1.8\rho}-\frac{1^2.3^2.5^2}{1.2.3(8\rho)^3}+\cdots\right\}$$

when m is an integer,

$$K_m(r)=(-1)^m\sqrt{\frac{\pi}{2r}}e^{-r}\left\{1+\frac{4m^2-1^2}{1.8r}+\frac{(4m^2-1^2)(4m^2-3^2)}{1.2(8r)^2}+\ldots\right\}$$

$$I_m(r)=\frac{1}{\sqrt{2\pi r}}e^r\left\{1-\frac{4m^2-1^2}{1.8r}+\frac{(4m^2-1^2)(4m^2-3^2)}{1.2(8r)^2}-\ldots\right\}$$

The Bessel's functions of degree half an odd integer are of special importance in connexion with the differential equations of physics. The two equations

$$\frac{\partial u}{\partial t}=k\Delta^2 u,\ \frac{\partial^2 u}{\partial t^2}=k^2\Delta^2 u,$$

are reducible by means of the substitutions $u=e^{-kt}v$, $u=e^{\iota kt}v$ to the form $\Delta^2 v+v=0$. If we suppose v to be a function of r only, this last differential equation takes the form

$$\frac{d^2(vr)}{dr^2}+vr=0,$$

so that v has the values

$$\frac{\sin r}{r},\ \frac{\cos r}{r};$$

in order to obtain more general solutions of the equation $\Delta^2 v+v=0$, we may operate on

$$\frac{\sin r}{r},\ \frac{\cos r}{r}$$

with the operator

$$Y_n\left(\frac{\partial}{\partial x},\frac{\partial}{\partial y},\frac{\partial}{\partial z}\right),$$

where $Y_n(x, y, z)$ is any spherical solid harmonic of degree n. The result of the operation may be at once obtained by taking $Y_n(x, y, z)$ for $f_n(x, y, z)$ in the theorem (7′), we thus find as solutions of $\Delta^2 v+v=0$, the expressions

$$Y_n(x,y,z)\frac{d^n}{d(r^2)^n}\frac{\sin r}{r},\ Y_n(x,y,z)\frac{d^n}{d(r^2)^n}\frac{\cos r}{r}.$$

By recurring to the definition of the function $J_m(r)$, we see that

$$J_{\frac{1}{2}}(r)=\sqrt{\frac{2\rho}{\pi}}\left\{1-\frac{r^2}{2.3}+\frac{r^4}{2.3.4.5}-\ldots\right\}=\sqrt{\frac{2}{\pi}}\frac{\sin r}{\sqrt{r}};$$

thus

$$r^{-\frac{1}{2}}J_{\frac{1}{2}}(r)=\sqrt{\frac{2}{\pi}}\frac{\sin\rho}{\rho}.$$

Using the relation between Bessel's functions whose orders differ by an integer, we have

$$J_{n+\frac{1}{2}}(r)=(-2)^n r^{n+\frac{1}{2}}\frac{d^n}{d(r^2)^n}\frac{J_{\frac{1}{2}}(r)}{\sqrt{r}}=(-2)^n\sqrt{\frac{2}{\pi}}r^{n+\frac{1}{2}}\frac{d^n}{d(r^2)^n}\frac{\sin r}{r}.$$

It may be shown at once that

$$r^{n+\frac{1}{2}}\frac{d^n}{d(r^2)^n}\frac{\cos r}{r}$$

is a second solution of Bessel's equation of order $n+\frac{1}{2}$; thus the differential equation $\Delta^2 v+v=0$ is satisfied by the expressions

$$Y_n(x,y,z)\frac{J_{n+\frac{1}{2}}(r)}{r^{n+\frac{1}{2}}},$$

and by the corresponding expression with a second solution of Bessel's equation instead of $J_{n+\frac{1}{2}}(r)$; if $S_n(\mu, \phi)$ denotes a surface harmonic of degree n, the expression

$$S_n(\mu,\phi)\frac{1}{\sqrt{r}}J_{n+\frac{1}{2}}(r)$$

is a solution of the equation $\Delta^2 v+v=0$.

The Bessel's function of degree half an odd integer are the only ones which are expressible in a closed form involving no transcendental functions other than circular functions. It will be observed that in this case the semi-convergent series for J_m becomes a finite one as the expressions P, Q then break off after a finite number of terms.

The Zeroes of Bessel's Functions.—The determination of the position of the zeroes of the Bessel's functions, and the values of the argument at which they occur have been investigated by Hurwitz

(*Math. Ann.* vol. xxxiii.), and more completely by H. M. Macdonald (*Proc. Lond. Math. Soc.* vols. xxix. xxx.) It has been shown that the zeroes of $J_n(z)/z^n$ are all real and associated with the singular point at infinity when n is real and >-1, and that all the real zeroes of $J_n(z)/z^n$ when n is real and <-1, and not an integer, are associated with the essential singularity at infinity. When n is a negative integer $-m$, $J_n(z)/z^n$ has, in addition, $2m$ real zeroes coincident at the origin. When $n=-m-v$, m being a positive integer, and $1>v>0$, $J_n(z)/z^n$ has a finite number $2m$ of zeroes which are not associated with the essential singularity. If n is real, and starts with any positive value, the zeroes nearest the origin approach it as n diminishes, two of them reaching it when $n=-1$, and two more reach it whenever n passes through a negative integral value; these zeroes then become complex for values of n not integral. The zeroes of $J_n(z)/z^n$ are separated by those of $J_{n+1}(z)/z^n$, one zero of the latter, and one only, lies between two consecutive zeroes of $J_n(z)/z^n$. When n is real and >-1, all the zeroes of $J_n(z)/z^n$ are given by a formula due to Stokes; the m^{th} positive zero in order of magnitude is given by

$$a=\frac{4n^2-1}{8a}-\frac{4(4n^2-1)(28n^2-31)}{3.(8a)^3}-\text{etc.},$$

where

$$a=\frac{\pi}{4}(2n+4m-1).$$

It has been shown by Macdonald that the function $K_n(z)$ has no real zeroes unless $n=2k+\frac{3}{2}$, where k is an integer, when it has one real negative zero; and that $K_n(z)$ has no purely imaginary zeroes, and no zero whose real part is positive, other than those at infinity. When $1>n>0$, $K_n(z)$ has no zeroes other than those at infinity, when $2>n>1$, it has one zero whose real part is negative, and when $m+1>n>m$, where m is an integer, there are m zeros whose real parts are negative. When n is an integer, $K_n(z)$ has n zeroes with negative real parts.

Spheroidal Harmonics.—For potential problems in which the boundary is an ellipsoid of revolution, the co-ordinates to be used are r, θ, ϕ where in the case of a prolate spheroid

$$x=c\sqrt{r^2-1}\sin\theta\cos\phi,\ y=c\sqrt{r^2-1}\sin\theta\sin\phi,\ z=cr\cos\theta,$$

the surfaces $r=r_0$, $\theta=\theta_0$, $\phi=\phi_0$ are confocal prolate spheroids, confocal hyperboloids of revolution, and planes passing through the axis of revolution. We may suppose r to range from 1 to ∞, θ from 0 to π, and ϕ from 0 to 2π, every point in space has then unique co-ordinates r, θ, ϕ.

For oblate spheroids, the corresponding co-ordinates are r, θ, ϕ given by

$$x=c\sqrt{r^2+1}\sin\theta\cos\phi,\ y=c\sqrt{r^2+1}\sin\theta\sin\phi,\ z=cr\cos\theta,$$

where

$$0\leqq r\leqq\infty,\ 0\leqq\theta\leqq\pi,\ 0\leqq\phi\leqq 2\pi;$$

these may be obtained from those for the prolate spheroid by changing c into $-\iota c$, and r into ιr.

Taking the case of the prolate spheroid, Laplace's equation becomes

$$\frac{\partial}{\partial r}\left\{(r^2-1)\frac{\partial V}{\partial r}\right\}+\frac{1}{\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right)+\frac{r^2-\cos^2\theta}{(r^2-1)\sin^2\theta}\frac{\partial^2 V}{\partial\phi^2}=0,$$

and it will be found that the normal solutions are

$$\left.\begin{matrix}P_n(r)\\ Q_n^m(r)\end{matrix}\right\}\left.\begin{matrix}P_n^m(\cos\theta)\\ Q_n^m(\cos\theta)\end{matrix}\right\}\begin{matrix}\cos\\ \sin\end{matrix}m\phi.$$

For the space inside a bounding spheroid the appropriate normal forms are $P_n^m(r)P_n^m(\cos\theta)\begin{smallmatrix}\cos\\ \sin\end{smallmatrix}m\phi$, where n, m are positive integers, and for the external space

$$Q_n^m(r)P_n^m(\cos\theta)\begin{matrix}\cos\\ \sin\end{matrix}m\phi.$$

For the case of an oblate spheroid, $P_n^m(\iota r)$, $Q_n^m(\iota r)$, take the place of $P_n^m(r)$, $Q_n^m(r)$.

Toroidal Functions.—For potential problems connected with the anchor-ring, the following co-ordinates are appropriate: If A, B are points at the extremities of a diameter of a fixed circle, and P is any point in the plane PAB which is perpendicular to the plane of the fixed circle, let $P=\log\frac{AP}{BP}$, $\theta=\angle APB$, and let ϕ be the angle the plane APB makes with a fixed plane through the axis of the circle. Let θ be restricted to lie between $-\pi$ and π, a discontinuity in its value arising as we pass through the circle, so that within the circumference θ is π on the upper side of the circle, and $-\pi$ on the lower side; θ is zero in the plane of the circle outside the circumference; ρ may have any value between $-\infty$ and ∞, and ϕ any value between 0 and 2π. The position of a point is then uniquely represented by the co-ordinates ρ, θ, ϕ, which are the parameters of a system of tores with the fixed circle as limiting circle, a system of bowls with the fixed circle as common rim, and a system of planes through the axis of the tores. If x, y, z are the co-ordinates of a point referred to axes, two of which x, y are in the plane of the circle and the third along its axis, we find that

$$x=\frac{a\sinh\rho}{\cosh\rho-\cos\theta}\cos\phi,\ y=\frac{a\sinh\rho}{\cosh\rho-\cos\theta}\sin\phi,\ z=\frac{a\sin\theta}{\cosh\rho-\cos\theta},$$

where a is the radius of the fixed circle.

Laplace's equation reduces to

$$\frac{\partial}{\partial\rho}\left\{\frac{\sinh\rho}{P^2}\frac{\partial V}{\partial\rho}\right\}+\frac{\partial}{\partial\theta}\left\{\frac{\sinh\rho}{P^2}\frac{\partial V}{\partial\theta}\right\}+\frac{1}{P^2\sinh\rho}\frac{\partial^2 V}{\partial\phi^2}=0,$$

when P denotes $\sqrt{\cosh\rho-\cos\theta}$. It can be shown that this equation is satisfied by

$$\sqrt{\cosh\rho-\cos\theta}\,\begin{matrix}P_{n-\frac{1}{2}}^m(\cosh\rho)\\ Q_{n-\frac{1}{2}}^m(\cosh\rho)\end{matrix}\begin{matrix}\cos\\ \sin\end{matrix}n\theta\begin{matrix}\cos\\ \sin\end{matrix}m\phi,$$

the functions $P_{n-\frac{1}{2}}^m(\cosh\rho)$, $Q_{n-\frac{1}{2}}^m(\cosh\rho)$ required for the potential problems, are associated Legendre's functions of degree $n-\frac{1}{2}$, half an odd integer, of integral order m, and of argument real and greater than unity; these are known as toroidal functions. For the space external to a boundary tore, the function $Q_{n-\frac{1}{2}}^m(\cosh\rho)$ must be used, and for the internal space $P_{n-\frac{1}{2}}^m(\cosh\rho)$.

The following expressions may be given for the toroidal functions:—

$$P_{n-\frac{1}{2}}^m(\cosh\rho)=\frac{(-1)^m}{\pi}\frac{\Pi\left(n-\frac{1}{2}\right)}{\Pi\left(n-m-\frac{1}{2}\right)}\int_0^\pi\frac{\cos m\phi}{(\cosh\rho+\sinh\rho\cos\phi)^{n+\frac{1}{2}}}d\phi$$

$$=\frac{1}{\pi}\frac{\Pi\left(n+m-\frac{1}{2}\right)}{\Pi\left(n-\frac{1}{2}\right)}\int_0^\pi(\cosh\rho+\sinh\rho\cos\phi)^{n-\frac{1}{2}}\cos m\phi\,d\phi.$$

$$P_{n-\frac{1}{2}}(\cosh\rho)=\frac{2}{\pi}\int_0^\rho\frac{\cosh n\phi}{\sqrt{2\cosh\rho-2\cosh\phi}}d\phi.$$

$$Q_{n-\frac{1}{2}}(\cosh\rho)=(-1)^m\frac{\Pi\left(n+m-\frac{1}{2}\right)}{\Pi\left(n-\frac{1}{2}\right)}\int_0^{\log\coth\frac{1}{2}\rho}(\cosh\rho$$

$$-\sinh\rho\cosh w)^{n-\frac{1}{2}}\cosh mw\,dw$$

$$=(-1)^m\frac{1}{\pi}2^m\Pi\left(m-\frac{1}{2}\right)\Pi\left(-\frac{1}{2}\right)\sinh^m\rho\int_0^\pi\frac{\cos n\phi}{(2\cosh\rho-2\cos\phi)^{m+\frac{1}{2}}}d\phi.$$

The relations between functions for three consecutive values of the degree or the order are

$$2n\cosh\rho P_{n-\frac{1}{2}}^m(\cosh\rho)-\left(n-m+\frac{1}{2}\right)P_{n+\frac{1}{2}}^m(\cosh\rho)$$

$$-\left(n+m-\frac{1}{2}\right)P_{n-\frac{1}{2}}^m(\cosh\rho)=0.$$

$$P_{n-\frac{1}{2}}^{m+2}(\cosh\rho)+2(m+1)\coth\rho P_{n-\frac{1}{2}}^{m+1}(\cosh\rho)$$

$$-\left(n-m-\frac{1}{2}\right)\left((n+m+\frac{1}{2}\right)P_{n-\frac{1}{2}}^m(\cosh\rho)=0,$$

with relations identical in form for the functions $Q_{n-\frac{1}{2}}^m(\cosh\rho)$.

The function $Q_{n-\frac{1}{2}}(\cosh\rho)$ is expansible in the form

$$\frac{\Pi\left(n-\frac{1}{2}\right)\Pi\left(-\frac{1}{2}\right)}{\Pi(n)}e^{-(n+\frac{1}{2})\rho}F\left(\frac{1}{2},n+\frac{1}{2},n+1,e^{-2\rho}\right),$$

which is useful for calculation of the function, when ρ is not small. $P_{n-\frac{1}{2}}(\cosh\rho)$ can also be expressed in terms of $e^{-\rho}$, by a somewhat complicated formula.

Ellipsoidal Harmonics.—In order to treat potential problems in which the boundary surface is an ellipsoid, Lamé took as co-ordinates the parameters ρ, μ, ν of systems of confocal ellipsoids, hyperboloids of one sheet, and of two sheets; these co-ordinates are three roots of the equation

$$\frac{x^2}{t^2}+\frac{y^2}{t^2-h^2}+\frac{z^2}{t^2-k^2}=1,\ (k>h);$$

we thence find that

$$x=\frac{\rho\mu\nu}{hk},\ y=\frac{\sqrt{\rho^2-h^2}\sqrt{\mu^2-h^2}\sqrt{h^2-\nu^2}}{h\sqrt{k^2-h^2}},\ z=\frac{\sqrt{\rho^2-k^2}\sqrt{k^2-\mu^2}\sqrt{k^2-\nu^2}}{k\sqrt{k^2-h^2}}$$

where

$$\infty\geqq\rho^2\geqq h^2,\ k^2\leqq\mu^2\leqq h^2,\text{ and }k^2\geqq\nu^2\geqq0.$$

We find from these values of x, y, z

$$(dx)^2+(dy)^2+(dz)^2=\frac{(\rho^2-\mu^2)(\rho^2-\nu^2)}{(\rho^2-h^2)(\rho^2-k^2)}(d\rho)^2+\frac{(\rho^2-\mu^2)(\mu^2-\nu^2)}{(\mu^2-h^2)(k^2-\mu^2)}(d\mu)^2$$
$$+\frac{(\rho^2-\nu^2)(\mu^2-\nu^2)}{(h^2-\nu^2)(k^2-\nu^2)}(d\nu)^2,$$

and on applying the general transformation of Laplace's equation that equation becomes

$$(\mu^2-\nu^2)\frac{\partial^2V}{\partial\xi^2}+(\rho^2-\nu^2)\frac{\partial^2V}{\partial\eta^2}+(\rho^2-\mu^2)\frac{\partial^2V}{\partial\zeta^2}=0,$$

where ξ, η, ζ are defined by the formulæ

$$\xi=\int_h^\rho\frac{d\rho}{\sqrt{\rho^2-h^2}\sqrt{\rho^2-k^2}},\quad \eta=\int_h\frac{d\mu}{\sqrt{\mu^2-h^2}\sqrt{k^2-\mu^2}},$$
$$\zeta=\int_0^\nu\frac{d\nu}{\sqrt{h^2-\nu^2}\sqrt{k^2-\nu^2}},$$

which are equivalent to

$$\rho=kdn(k\xi, k_1),\ \mu=kdn(\mathrm{K}-k\eta, k_1),\ \nu=ksn(k\xi, k_1'),$$

where k_1^2, $k_1'^2$ denote the quantities $1-\frac{h^2}{k^2}$, $\frac{h^2}{k^2}$, and K denotes the complete elliptic integral

$$\int_0^{\frac{\pi}{2}}\frac{d\psi}{\sqrt{1-k_1^2\sin^2\psi}}.$$

It can now be shown that Laplace's equation is satisfied by the product $\mathrm{E}(\rho)\mathrm{E}(\mu)\mathrm{E}(\nu)$, where $\mathrm{E}(\rho)$ satisfies the differential equation

$$\frac{d^2\mathrm{E}(\rho)}{d\xi^2}-\{n(n+1)\rho^2-(h^2+k^2)p\}\,\mathrm{E}(\rho)=0\,;$$

and $\mathrm{E}(\mu)$, $\mathrm{E}(\nu)$ satisfy the equations

$$\frac{d^2\mathrm{E}(\mu)}{d\eta^2}+[n(n+1)\mu^2-p(h^2+k^2)]\mathrm{E}(\mu)=0,$$
$$\frac{d^2\mathrm{E}(\nu)}{d\zeta^2}-[n(n+1)\nu^2-p(h^2+k^2)]\mathrm{E}(\nu)=0,$$

where n and p are arbitrary constants. On substituting the values of the parameters ξ, η, ζ in terms of ρ, μ, ν, we find that the equation satisfied by $\mathrm{E}(\rho)$ becomes

$$(\rho^2-h^2)(\rho^2-k^2)\frac{d^2\mathrm{E}(\rho)}{d\rho^2}+\rho(2\rho^2-h^2-k^2)\frac{d\mathrm{E}(\rho)}{d\rho}$$
$$+\{(h^2+k^2)p-n(n+1)\rho^2\}\,\mathrm{E}(\rho)=0,$$

and $\mathrm{E}(\mu)$, $\mathrm{E}(\nu)$ satisfy equations in μ, ν respectively of identically the same form; this equation is known as Lamé's equation.

If n be taken to be a positive integer, it can be shown that it is possible in $2n+1$ ways so to determine p that the equation in $\mathrm{E}(\rho)$ is satisfied by an algebraical function of degree n, rational in ρ, $\sqrt{\rho^2-h^2}$, $\sqrt{\rho^2-k^2}$. The functions so determined are called Lamé's functions, and the $2n+1$ functions of degree n are of one of the four forms

$$\mathrm{K}(\rho)=a_0\rho^n+a_1\rho^{n-2}+\ldots,$$
$$\mathrm{L}(\rho)=\sqrt{\rho^2-h^2}(a_0'\rho^{n-1}+a_1'\rho^{n-3}+\ldots),$$
$$\mathrm{M}(\rho)=\sqrt{\rho^2-k^2}(a_0''\rho^{n-1}+a_1''\rho^{n-3}+\ldots),$$
$$\mathrm{N}(\rho)=\sqrt{\rho^2-k^2}\sqrt{\rho^2-h^2}(a_0'''\rho^{n-2}+a_1'''\rho^{n-4}+\ldots).$$

These are the four classes of Lamé's functions of degree n; of the functions K there are $1+\frac{1}{2}n$, or $\frac{1}{2}(n+1)$, according as n is even or odd; of each of the functions L, M, there are $\frac{1}{2}n$, or $\frac{1}{2}(n-1)$, and of the functions N, there are $\frac{1}{2}n$, or $\frac{1}{2}(n+1)$.

The normal forms of solution of Laplace's equation, applicable to the space inside the ellipsoid, are the $2n+1$ products $\mathrm{E}(\rho)$, $\mathrm{E}(\mu)$, $\mathrm{E}(\nu)$. It can be shown that the $2n+1$ values of p are real and unequal.

It can be shown that, subject to certain restrictions, a function of μ and ν arbitrarily given over the surface of the ellipsoid $\rho=\rho_1$, can be expressed as the sum of products of Lamé's functions of μ and ν, in the form

$$\sum_1^\infty\sum_{s=1}^{2n+1}c_n^s\mathrm{E}_n^s(\mu)\mathrm{E}_n^s(\nu)\,;$$

the potential function for the space inside the ellipsoid, which has the arbitrarily given value over the surface of the ellipsoid, is consequently

$$\sum\sum c_n^s\frac{\mathrm{E}_n^s(\rho)\mathrm{E}_n^s(\mu)\mathrm{E}_n^s(\nu)}{\mathrm{E}_n^s(\rho_1)}.$$

It can be shown that a second solution of Lamé's equation is $\mathrm{F}_n(\rho)$ where

$$\mathrm{F}_n(\rho)=(2n+1)\mathrm{E}_n(\rho)\int_\rho^\infty\frac{d\rho}{\{\mathrm{E}_n(\rho)\}^2\sqrt{\rho^2-h^2}\sqrt{\rho^2-k^2}}\,;$$

this function $\mathrm{F}_n(\rho)$ vanishes at infinity as ρ^{-n-1}, and is therefore adapted to the space outside the bounding ellipsoid. The external potential which has at the surface $\rho=\rho_1$ the value

$$\sum\sum c_n^s\mathrm{E}_n^s(\mu)\mathrm{E}_n^s(\nu)\text{ is }\sum\sum c_n^s\frac{\mathrm{F}_n^s(\rho)}{\mathrm{F}_n^s(\rho_1)}\mathrm{E}_n^s(\mu)\mathrm{E}_n^s(\nu).$$

History and Literature.—The first investigator in the subject was Legendre, who introduced the functions known by his name, and at present also called zonal surface harmonics; he applied them to the determination of the attractions of solids of revolution. Legendre's investigations are contained in a memoir of the Paris Academy, *Sur l'attraction des sphéroides*, published in 1785, and in a memoir published by the Academy in 1787, *Recherches sur la figure des planètes*; his investigations are collected in his *Exercises*, and in his *Traité des functions elliptiques*. The potential function was introduced by Laplace, who also first obtained the equation which bears his name; he applied spherical surface harmonics to the determination of the potential of a nearly spherical solid, in his memoir, *Théorie des attractions des sphéroides et de la figure des planètes*, published by the Paris Academy in 1785. Laplace was the first to consider the functions of two angles, which functions have consequently been known as Laplace's functions; his investigations on these functions are given in the *Mécanique Céleste*, tome ii. livre iii., tome v. livre xi., and in the supplement to vol. v. The notation $\mathrm{P}^{(n)}$ was introduced by Dirichlet (see Crelle's *Journal*, vol. xvii., "sur les séries dont le terme général dépend de deux angles," &c.; see also his memoir, "Ueber einen neuen Ausdruck zur Bestimmung der Dichtigkeit einer unendlich dünnen Kugelschale" in the *Abhandlungen* of the Berlin Academy, 1850). The name "Kugelfunctionen" was introduced by Gauss (see *Collected Works*, vol. vi. p. 648). A direct investigation of the expression for the reciprocal of the distance between two points in spherical surface harmonics was given by Jacobi (Crelle's *Journal*, vol. xxvi., see also vol. xxxii.). The functions of the second kind were first introduced by Heine (see his "Theorie der Anziehung einer Ellipsoides," Crelle's *Journal*, vol. xlii. 1851). The above-mentioned investigators employed almost entirely polar co-ordinates; the use of Cartesian co-ordinates for the expression of spherical harmonics was introduced by Kelvin in his theory of the equilibrium of an elastic spherical shell (see *Phil. Trans. Roy. Soc.* 1862), and also independently by Clebsch (see his paper, "Ueber die Reflexion an einer Kugelfläche," Crelle's *Journal*, vol. lxi. 1863). The functions which bear the name of Bessel were first introduced by Fourier in his investigations on the conduction of heat (see his *Théorie analytique de la chaleur*, 1822; they were employed by Bessel in the theory of planetary motion (see the *Abhandlungen* of the Berlin Academy, 1824). The functions which are now known as Bessel's functions of degree, half an odd integer, were employed by Poisson in the theory of the conduction of heat in a solid spherical body (see the *Journal de l'École polyt.* Cah. 19 (1823). The toroidal functions were introduced by C. Neumann (*Theorie der Elektricitäts- und- Wärme- Vertheilung in einem Ringe*, Halle, 1864), and independently by Hicks (*Phil. Trans. Roy. Soc.* 1881). The ellipsoidal harmonics were first investigated by Lamé in connexion with the stationary motion of heat in an ellipsoidal body (see Liouville's *Journal*, part iv. 1839). The external ellipsoidal harmonics were introduced by Liouville and Heine (see Liouville's *Journal*, vol. x., and Crelle's *Journal*, vol. xxix.) The ellipsoidal harmonics have been considered as expressed in Cartesian co-ordinates by Green (see *Collected Works*), by Ferrers (see his Treatise), and by W. D. Niven (*Phil. Trans. Roy. Soc.* 1892). A vast number of memoirs and papers on Spherical Harmonics and the allied functions are scattered through the various mathematical journals and the Transactions of scientific societies.

The following treatises may be consulted:—HEINE. *Theorie der Kugelfunctionen*, second edition, vol. i. 1878, vol. ii. 1881; this treatise gives much information as to the history and literature of the subject.—FERRERS. *Spherical Harmonics*. Cambridge, 1881.—TODHUNTER. *The Functions of Laplace, Lamé, and Bessel*. Cambridge, 1875.—THOMSON and TAIT. *Natural Philosophy*, 1879 (Appendix B).—HAENTZSCHEL. *Reduction der Potentialgleichung auf gewöhnliche Differentialgleichungen*. Berlin, 1893.—F. NEUMANN. *Beiträge zur Theorie der Kugelfunctionen*. Leipzig, 1878.—C. NEUMANN. *Theorie der Bessel'schen Functionen*. Leipzig, 1867; *Ueber die nach Kreis- Kugel- und Cylinder-Functionen fortschreitenden Entwickelungen*. Leipzig, 1881.—LOMMEL. *Studien über die Bessel'schen Functionen*. Leipzig, 1868.—MATHIEU. *Cours de physique mathématique*

Paris, 1873. — POCKELS. *Ueber die partielle Differentialgleichung* $\Delta u + k^2 u = 0$, Berlin, 1891. — BÔCHER. *Ueber die Reihenentwickelungen der Potentialtheorie*, Leipzig, 1894.—GRAY and MATHEWS. *Treatise on Bessel's Functions.* (E. W. H.)

Spielhagen, Friedrich von (1829-——), German novelist, was born at Magdeburg, 24th February 1829. Forsaking law for philology, he became a teacher in a gymnasium at Leipzig, but upon his father's death in 1854 devoted himself entirely to authorship. After writing *Clara Ver* (1857) and *Auf der Düne* (1858), he obtained a striking success with *Problematische Naturen*, and long maintained a position at the head of contemporary German fiction with *In Reih und Glied* (1866), *Hammer und Amboss* (1869), *Sturmfluth* (1876), and *Quisisana* (1880). Since this latter period Spielhagen's works were less important until, in 1897, he recovered the lost ground with *Faustulus*, a modernized prose version of the Gretchen episode in *Faust*, which Tieck and Charles Lamb thought so much below the dignity of the subject. Spielhagen's novels combine two elements of especial power, the masculine assertion of liberty which renders him the favourite of the intelligent and progressive citizen, and the love of the sea, derived from an early residence at Stralsund, which introduces an element of poetry into his otherwise rather matter-of-fact fiction, and is especially conspicuous in *Sturmfluth* and *Faustulus.*

Spires (German *Speyer*), a town and episcopal see of Bavaria, Germany, chief town of the Palatinate, on the left bank of the Rhine, 16 miles south of Mannheim by rail. A Protestant church has been built on the site of the Retscher to commemorate the Protest of 1529. In the upper storey of the classical school is the Museum of Palatine Antiquities, containing archæological, natural history, and numismatic collections. There is also a botanical garden. Cloth, sugar, tobacco, and wax-cloth are manufactured; and tobacco, hops, fruit, madder, and corn are grown. Population (1885), 16,238; (1900), 20,911.

Spirits.—The original meaning of the word Spirit was wind in motion, breath, the soul, and hence it came to denote that which gives life or vigour to the human body and other objects, and is therefore synonymous with everything eminently pure, ethereal, refined, or distilled. In popular chemical nomenclature the term spirit in its former sense is still occasionally encountered, for instance *spirits of salt* for hydrochloric acid. The spirits of the British Pharmacopœia (e.g., *sp. ætheris nitrosi*; *sp. chloroformi*; *sp. camphoræ*) are solutions of various substances obtained either by distilling these with, or dissolving them in, the rectified spirit of the Pharmacopœia, which latter is pure alcohol with 16 per cent. by weight of water. In the modern sense, spirits may be broadly defined as the products resulting from the distillation of saccharine liquids which have undergone alcoholic fermentation. Spirits of wine means rectified spirit of a strength of 43 degrees over proof and upwards. By rectified spirit is meant spirit rectified at a licensed rectifier's premises. Legally, the word spirits implies spirit of any description, and all liquors, mixtures, and compounds made with the same. In the same way plain spirit is any British spirit which has not been artificially flavoured, and to which no ingredient has been added subsequent to distillation.

The principal Act now governing and regulating the manufacture of spirits and the working of distilleries is the Spirits Act of 1880. The provisions of this and the other Acts bearing on the subject are exceedingly numerous and complicated, and therefore only a few of the chief points can be set forth here, so that an adequate appreciation may be gained of the somewhat arduous and rigid conditions under which the spirit manufacturer is, in order to ensure the safeguarding of the revenue, constrained to carry out his operations. A distillery must not, without permission, be carried on at a greater distance than half a mile from a market town, nor may it be situated within a quarter of a mile from a rectifying establishment. A distiller must give notice of the erection of new plant or apparatus, of the time of brewing, of the removing of sugar from store or of yeast from wort or wash, of the making of "bub," of the locking of the spirit receiver supply pipe, &c. He may use any materials he pleases, provided that the gravity of the wort can be ascertained by the saccharometer, but he may not brew beer nor make cider, wine, nor sweet wines. When the worts are collected in the wash-back (fermenting vessel) a declaration must be made at once, specifying the original gravity and number of dry inches remaining in the back. At the end of every distilling period a return must be delivered showing (*a*) the quantity of brewing materials used, (*b*) the quantity of wort and wash attenuated and distilled, (*c*) the quantity of spirits produced at proof-strength and, (*d*) the quantity of "feints" remaining. Regulations also exist with regard to the amount of "bub" (see below) that may be added to the worts, or the quantity of yeast that may be removed from the wash, concerning the time permissible for drawing over spirit at the various stages, as to placing in and taking spirit out of store, the number and size of vessels, the locking of the latter, and the painting of the pipes carrying various liquids in certain colours. The methods of assessing the duty are threefold, and whichever of these methods gives the highest return is the one adopted. The first is the *attenuation charge.* This consists in levying the charge due on one gallon of proof spirit for every 100 gallons of worts collected and for every five degrees of attenuation observed, the latter being calculated by taking the difference between the highest specific gravity of the worts and the lowest gravity of the wash after complete fermentation. Secondly, there is the *low-wines charge*, calculated upon the bulk-quantity at proof strength of the low wines produced by the distillation of the wash; and lastly, the *feints and spirits* charge. This is the method usually adopted, as it generally gives the highest results: it is assessed on the number of bulk-gallons at proof of the feints and spirits produced by the final distilling operations. The duty which was fixed at 10s. per proof gallon in 1860 remained at that rate until 1890, when an addition of 6d. was made, but a further increase to the like amount made in 1894 was, owing to the unsatisfactory results obtained, remitted in the next year. The rate remained at 10s. 6d. until 1900, when it was raised to 11s.

Conditions of manufacture.

In the decade 1880–90 the quantity of spirits distilled in the United Kingdom remained practically stationary, and the consumption per head of population steadily declined, so much so that the spirit duty began to be looked upon as one of the failing sources of the public revenue. During the ten years, 1890–1900, however, there was a rapid increase, not only in the spirit produced, but also in the consumption per head. A point was then reached at which the production had considerably outstripped the consumption, due in part to the desire of the spirit trade to meet the increased demand for "matured" spirits, and in part to the fact that a large amount of capital had been attracted to the distilling industry.

Commercial development.

The following figures regarding the gallonage, excise duty, exports, &c., need no explanation:—

United Kingdom.

Year.	Quantity Distilled (Proof Gallons).	Duty Paid (Excise).	Exports (Proof Gallons).	Imports (Proof Gallons).	Remaining in Warehouse (Proof Gallons).
1880 . .	37,412,170	£13,631,785	1,704,204	10,050,467	46,001,437
1885 . .	41,006,486	13,987,472	2,588,078	11,755,518	64,405,817
1890 . .	40,970,295	13,860,002	3,371,396	12,714,040	85,376,037
1895 . .	44,870,357	16,195,664	3,854,102	10,211,068	108,195,402
1900 . .	59,246,277	20,303,147	5,284,611	10,739,106	157,169,968

The importation of foreign potable spirit has fallen off materially since 1870–75, during which period it stood at sixteen to seventeen millions of gallons. This is chiefly due to the decreased consumption of brandy and, to a smaller extent, to the diminishing importance of rum and other foreign spirits. The most remarkable change in this connexion is in the case of foreign methylated spirit. At one time (1891) the quantity of this article imported was

almost equal to the amount manufactured in the United Kingdom, the figures being 1,994,782 gallons for the home product and 1,456,108 for the foreign. For various reasons—chiefly, perhaps, owing to the surtax of 4d. per gallon on all foreign spirit—the quantity imported has gradually dwindled away, and in 1900 the figures were 4,978,027 gallons for the United Kingdom, against 6245 gallons imported.

The Russian Empire is now the greatest spirit-producing nation, the German Empire coming next, and then Austria-Hungary, France, the United States, and the United Kingdom in succession. The following are the comparable figures for 1898:—

Production of Spirits (1898).

	Gallons.		Gallons.
Russian Empire	159,192,000	France	106,128,000
German Empire	144,672,000	United States	71,572,000
Austro-Hungarian Empire	106,788,000	United Kingdom	62,731,000

With regard to the consumption in gallons per head, Denmark stands first with 3·2, then follow the Austro-Hungarian Empire with 2·2, Rumania with 2·11, France with 2·07, Belgium with 1·89, the German Empire with 1·85, Holland with 1·83, the United Kingdom with 1·04, and last (of the more important nations) the United States with 0·97 gallons. In the British colonies, South Australia (Northern Territory) comes first with a consumption per head of 1·90 gallons; and then in order: West Australia 1·50 gallon, the Cape 1·00 gallon, Queensland 0·96 gallon, Victoria 0·82 gallon, New South Wales 0·75 gallon, New Zealand 0·66 gallon, Natal 0·60 gallon, and Canada 0·55 gallon. Of the spirits distilled in the United Kingdom, Scotland produces roughly one-half, Ireland nine-thirty-seconds, and England seven-thirty-seconds. Although the number of distilleries in England and Ireland has remained practically stationary since 1880, the number in Scotland increased from 120 to 161 in the same period. In 1900 the actual numbers were: Scotland 161, Ireland 29, England 10. It is difficult to arrive at any satisfactory figure with regard to the amount of capital invested in British and Irish distilleries, but it probably exceeds thirty millions. Illicit distillation has almost ceased to exist in Great Britain, but in Ireland the number of annual seizures under this heading is still considerable. During 1900, out of a total of 1845 detections and seizures, 1826 were in Ireland.

The spirit produced in the United Kingdom is made almost exclusively from malt, unmalted grain, and molasses. The proportion of unmalted grain to malt remained fairly constant during the period 1880–1900, but the relative quantity of molasses employed increased considerably. The estimated quantities of the various materials employed are as under:—

Year.	Malt (Quarters).	Unmalted Grain, &c. (Quarters).	Molasses and Sugar (Cwt.).	Rice (Cwt.).
1883	859,363	1,054,081	165,529	...
1889	907,971	1,055,222	242,616	57,721
1892	980,427	1,163,975	457,707	...
1900	1,410,932	1,542,458	774,125	*nil*

With regard to the materials employed in the manufacture of spirits in France, roughly 90 per cent. now consist of maize (and other starchy substances), beetroot, and molasses, whereas in 1840 nine-tenths of the alcohol produced was derived from the grape and other fruits. This change is due in part to the ravages of the *oidium* disease (1850–57) and the *phylloxera* (1876–90), which destroyed an immense number of vines, and in part to the increased demand for commercial spirit in the arts and manufactures, and also to the improved methods for obtaining a high-class spirit from practically any starchy or saccharine material.

The following table shows (in round figures) the quantities of alcohol produced from wine, cider, &c. (*Fruit Alcohol*), and from maize, molasses, &c. (*Trade Alcohol*), respectively, in France at various periods from 1840 to 1900:—

	Fruit Alcohol. (*Unit*=1000 *hectolitres pure alcohol.*)	*Trade Alcohol.*
1840	800	100
1852	400	400
1876	650	1050
1880	50	1550
1893	247	2230
1900	323	2333

In 1900 the number of alcohol units (see above) distilled from maize and other starchy materials was 563, from molasses 797, from beetroot 973, from wine 149, and from cider, lees, and other substances 174. Roughly one-seventh of the total spirit production of France is exported, and a large proportion of this is classed as "eau-de-vie de vin," or wine-alcohol; but as a matter of fact the amount so classed is in excess of the actual quantity distilled from wine. In Germany, roughly 83 per cent. of the spirit manufactured is derived from potatoes. In 1900 the total spirit distilled amounted to 3668 units (of 1000 hectolitres of pure alcohol), of which 2948 units were obtained from potatoes, 599 units from grain, and 121 units from molasses and other materials.

The manufacture of spirits.

The materials used by the distiller, and the methods of preparation and treatment to which they are subjected before and after entering the distillery, differ materially from those employed by the brewer. It is true that (apart from the actual process of distillation) the main operations of the brewer and of the distiller are identical, in the sense that they consist in the conversion of starch into sugar, and of the latter into alcohol; but whereas the object of the brewer is to produce beer, of which alcohol forms only a relatively small proportion, the distiller, broadly speaking, desires to produce alcohol as such; and it is this fact which is responsible for the differences alluded to above. Thus the Chevalier type of barley, which is undeniably the best from the brewer's point of view, is not in great favour with the distiller. The nature of the husk, colour, and friability of the starch, qualities which are of the greatest importance to the brewer, are of little interest to the distiller, and provided that the grain is fairly sound, that it contains a high percentage of starch and a fair proportion of nitrogenous matter, it will pass muster as an average distillery material. After cleaning and grading, the barley intended for distiller's malt is placed in steep, where it remains for a somewhat longer period than is the case with brewing barley. It is now generally held to be advisable to treat the steep-water liberally with antiseptics—such as lime, sulphurous acid and its salt, or even with a trace of mineral acid—as the distiller has not the opportunity of lessening the dangers of bacterial infection at subsequent stages, which is afforded to the brewer by the boiling and hopping of the wort. Where maize is used for malting purposes this antiseptic treatment becomes a practical necessity. In distilleries using nothing but barley malt (Scots pot still whisky) the malting process is conducted in much the same way as that pursued with malt intended for brewing (see BREWING, vols. iv. and xxvi.), except that the period of germination is somewhat more prolonged. In grain (British and foreign patent spirit) and potato (Germany) distilleries, where barley malt is not used as the source of alcohol, but chiefly as a diastatic agent, that is to say, for its starch-converting properties, the "long" malt process is now widely employed. This consists essentially in subjecting the grain first to a somewhat lengthy steep (until the increase in weight due to the absorbed water is about 40–45 per cent.), and secondly to a very prolonged "flooring" at a moderate temperature, great attention being paid to the conditions of ventilation and humidity. It was formerly believed that the germinating barley grain attains its maximum of diastatic power after a very short period, and that when the acrospire is three-quarters "up" and the rootlets say one and a half times the length of the grain, the malt is ready for removal from the floor. Delbrück, Hayduck, and others have, however, shown that this is not the case, and the practical results obtained by adopting the twenty days' "flooring" period (and its

attendant conditions) have amply confirmed the scientific researches on this subject.

Hayduck has shown that the relative diastatic strengths of "short" (seven to ten days) and "long" (twenty days) malt are as follows:—

(1) For heavy barleys as 100 : 128·5 (average).
(2) For light barleys as 100 : 160·5 ,,

In contradistinction to the brewer (who can only use it on exceptional occasions and for special purposes), the distiller prefers, whenever this is feasible, to use green malt rather than kilned malt. One of the principal objects of kilning *brewing* malt is to restrict the diastatic power; but this is the very factor which the distiller desires to preserve; and as green malt possesses roughly twice the diastatic activity of high kilned malt, it is obvious that the distiller, who regards his malt merely as a starch-converting agent, will, *cœteris paribus*, use as little kilned malt as possible. The malt whisky distiller can, however, only make a restricted use of green malt, as he relies to a great extent on the kilning process for the development of the peculiar flavour characteristic of the article he produces. Moreover, it is frequently difficult during hot weather to obtain a satisfactory green malt supply, especially as the latter will not bear carriage for any distance, and distillers who make pressed yeast (commonly called "German" yeast) find that a proportion of kilned malt is necessary for the satisfactory manufacture of this article. When the distiller is unable to use green malt he will, by preference, use a malt which has been kilned at as low a temperature as possible. Under these conditions the kilning is little more than a drying operation, and the temperature is rarely raised above 130° F.

Although green or low-dried barley malt is the saccharifying agent usually employed both in the United Kingdom and on the Continent, malts prepared from other cereals are not infrequently employed for this purpose. According to Glaser and Moransky, the relative starch-transforming capacities of the various malted grains, taking barley malt as the unit, are as follows:

Barley malt	1·00
Rye malt	0·93
Wheat malt	1·08
Oat malt	0·30
Maize malt	0·28

Oat malt, notwithstanding its low transforming power, possesses certain advantages, inasmuch as it is easily and rapidly prepared, it acts very quickly in the mash-tun, and its diastatic power is well maintained during fermentation. Rye is best malted in conjunction with a little barley or oats, as it otherwise tends to superheat and to grow together in a tangled mass. The older methods at the disposal of the distiller for the transformation of starchy into fermentable material, namely, the use of malted grain or of acid, have of late years been enriched by the discovery that certain micro-organisms (or rather the enzymes contained in them) possess the power of converting starch directly into the dextrins, the latter into sugar, and finally of splitting up saccharine materials into the usual products of alcoholic fermentation. Two Japanese moulds, namely, *Aspergillus oryzœ* and *Eurotium oryzœ* (Japanese Koji and Taka-Koji), were the first micro-organisms of this type to be tried on anything like a large scale in Europe. The "Koji" malt (if the term may be used) is prepared by inoculating steamed rice with the spores of the mould, and then collecting the mycelium (which develops very rapidly) immediately prior to the fresh spore formation. Koji can be used as such in the form of a watery extract, or, after subjecting it to a suitable drying process, in much the same way as ordinary malt.

It would perhaps be somewhat premature to hazard an opinion in regard to the rôle which this type of micro-organism is likely to play in the future of the distilling industry, but it is a fact of considerable significance that another mould, namely, *Amylomyces Rouxii*, is used at the present time on a fairly extensive scale, and apparently with excellent results, both in France and Belgium. The process generally used in these countries (that of Collette and Boidin) consists essentially in inoculating a sterilized (mostly maize) mash in a closed vessel with a very small quantity of the spores of the mould—one-tenth of a gramme suffices—passing filtered air through the liquid contents for about twenty hours, thus causing the mould to develop very rapidly, and subsequently inducing fermentation by the addition of a pure yeast culture. The mould is of itself capable of fermenting the sugar produced, but it is found that the yeast acts more quickly and will stand a greater percentage of alcohol than the former. The yeast and the mould do not interfere with one another (as is usually the case in mixed cultures of micro-organisms), but lead a symbiotic existence, the mould transforming the starch into sugar, and the yeast splitting up the latter as rapidly as it is produced. It is said that one gramme of culture is sufficient for the transformation of twenty-five tons of grain, thus saving three tons of malt, besides a third of a ton of starch which would be lost during the malting process. One of the great advantages of this method is that the sterilizing of the mash and the working in closed vessels practically exclude the action of the undesirable micro-organisms (fission fungi) which are a source of the greatest trouble under ordinary conditions.

The mashing operations.

In brewing, all the necessary fermentable matter is formed from the starch by the mashing operation. The wort so obtained is then hopped and sterilized. This method of working, however, cannot be adopted by the distiller. The brewer must have a certain proportion of dextrinous, non-fermentable carbohydrate matter in his wort; the distiller, on the contrary, desires to convert the starch as completely as possible into fermentable, that is, alcohol-yielding, material. This result is obtained in two ways: firstly, by mashing at low temperatures, thus restricting the action of the diastase less than is the case in the brewer's mash; and secondly, by permitting the continuance of the diastatic action during the fermentation period. Low-temperature mashing alone will not have the desired effect, for a part of the dextrinous bodies resulting from diastatic starch-transformation are not further degraded by diastase alone, but are rendered completely fermentable by the combined action of diastase and yeast. Hence the distiller is unable to boil, that is, to sterilize, his wort, as he would thereby destroy the diastase entirely. In this the distiller is at a serious disadvantage compared with the brewer, as an unsterilized wort is very liable to bacterial infection. The latter danger prevents the distiller from taking full advantage of the benefits of low-temperature mashing, and he is obliged to heat his mash to a temperature which will, at any rate, be a partial safeguard against the bacterial evil. The method usually adopted is to bring the mash as rapidly as possible to about 130° F. (at which the maximum saccharifying action takes place), to keep the whole at this point for some little time, then to heat quickly to about 144° (maximum liquefaction point), and subsequently to 150–158°—according to the consistency of the mash—at which temperature the majority of the undesirable fission fungi are destroyed.

In the manufacture of whisky and grain spirits generally, the mashing apparatus (in the United Kingdom) is similar to that employed in brewing, but to ensure a better extraction of starch than is necessary or desirable in the brewery, several mashes (in Scotland generally three, in Ireland two) are made with each lot of grist, and the runnings from the last of these are, as a rule, used as "liquor" for the next batch of malt. Potato and maize (also flaked maize and rice) mashes are made on a somewhat different principle. The starch in these materials is first gelatinized and partially liquefied by steam, either in an open vessel or under pressure in a closed cylindrical converter—no false bottom being used in either case, as in grain mashes—and subsequently, after cooling to the proper temperature, saccharified by means of green or low-dried malt. Occasionally the materials mentioned are converted by means of mineral acid, either with or without pressure.

When the mash is finished, the wort—after (in the case of potato and maize mash) a portion of the skins, husks, &c., have been removed by special machinery—is run through the refrigerators, very similar in construction to those used in the brewery. An open flat-pan cooler is an exception in a well-conducted distillery nowadays, as distilling-worts do not need the prolonged hot aëration necessary for brewing-worts, and constitute dangerous sources of infection.

The fermenting operations.

The conditions and methods of distillery fermentation vary considerably, and in some respects radically, from those in the brewery. In order to obtain the maximum alcohol yield the distiller is obliged to work with an unsterilized wort, and at relatively high temperatures. The necessity for the former condition has already been explained, and the latter is due to the fact that the optimum working capacity of distillery yeast is reached at a temperature markedly above that most favourable to brewing types. Apart from this, if the distiller works at brewing temperatures, the brewing yeasts will predominate, and

these produce less alcohol than the distillery types. Thus at 75° F. (and above) distillery yeasts, at 60° F. beer yeasts, and at 40° F. wild yeasts, tend to predominate. The conditions of fermentation which are more or less forced upon the distiller are unfortunately also very favourable to the development of bacteria, and if special methods are not adopted to check their development, the result would seriously affect not only the quantity but also the quality of the alcohol produced. The micro-organisms chiefly to be feared are those belonging to the class of fission fungi (schizomycetes), such as the butyric, the lactic, the mannitic, and mucic ferments.

Souring.

It has long been known to practical distillers that in order to avoid irregular (bacterial) fermentations it is necessary either to let the wort "sour" naturally, or to add a small quantity of acid (formerly sulphuric acid was frequently employed) to it before pitching with yeast. The reason for this necessity was until recent times by no means clear. It has, however, now been demonstrated that a slightly acid wort is a favourable medium for the free development of the desirable types of distillery yeast, but that the growth of brewery yeasts, and especially of bacteria, is very much restricted, if not entirely suppressed, in a "soured" liquid. The acid which is the result of a properly conducted souring is lactic acid, formed by the decomposition of the sugar in the wort, by bacterial action, and according to the equation $C_6H_{12}O_6=2C_3H_6O_3$.

For various reasons (one being that, in order to restrict the lactic fermentation when sufficient acid has formed, it is necessary to heat the soured liquid to a higher temperature than is desirable in the case of the main wort) it is inexpedient to allow the souring process to take place in the main wort. It is usual to make a small mash, prepared on special lines, for the production of the "bub" (German *Hefegut*), as the soured wort is termed. This is allowed either to "sour" spontaneously, or better, by inoculating it with a pure culture of *B. acidificans longissimus*, which for this purpose is undoubtedly the best variety of the lactic acid bacteria. The optimum developing temperature of this organism is about 104° F., but it is better to keep the wort at 122° F., for at the latter temperature practically no other bacteria are capable of development. When the lactification is completed, the wort is raised to 165° F. in order to cripple the lactifying bacteria—otherwise souring would go on in the main fermentation—and after cooling to the proper point, it is pitched with yeast. When a good crop of the latter has formed, the whole is added to the main wort. The beneficial effects of souring are not due to any specific action of the lactifying bacteria, but purely to the lactic acid formed. It has been found that excellent—and in some respects better—results can be obtained by the use of lactic acid as such in place of the old souring process. Still more remarkable is the success which has attended the introduction of hydrofluoric acid and its salts as a substitute for lactic acid. Hydrofluoric acid is poisonous to bacteria in doses which do not affect distillery yeasts, and the latter can be cultivated in such a manner as to render them capable of withstanding as much as 0·2 per cent. of this acid. Bacteria can apparently not be "acclimatized" in this fashion. Worts treated with hydrofluoric acid produce practically no side fermentation, and it seems a fact that this substance stimulates diastatic action, and thus permits of the use of relatively low-mashing temperatures. The yeast employed in British distilleries is still occasionally obtained from breweries, but it is now generally recognized that a special type of yeast, such as the so-called "German" yeast—a good deal of which comes from Holland, but which is now also produced in the United Kingdom on a considerable scale—is desirable in the distillery. This variety of yeast, although closely allied botanically to that used in brewing (belonging as it does to the same class, namely, *Saccharomyces cerevisiæ*), is capable of effecting a far more rapid and far more complete fermentation than the latter. Probably the most widely known and best "pure-culture" distillery yeast is the one called "species II." first produced in the laboratories of the Berlin Distillers' Association. The optimum working temperature of distillery yeast is at about 81·5° F.; but it would be inexpedient to start the main fermentation at this temperature, as the subsequent rise may be as much as 36°. It is therefore usual to pitch at about 80° F., and then, by means of the attemperator, to cool down very slowly until the temperature reaches 60° F. The temperature subsequently rises as fermentation goes on, but should not exceed 85° F. Pot-still malt whisky distillers usually work at somewhat lower temperatures. Fermentation is carried on until practically all the saccharine matter is converted into alcohol; and when this is the case, the gravity of the mash is about equal to, or even a little below, that of water. In pot-still (malt whisky) distilleries the original gravity of the wort is usually from 1·050 to 1·060, occasionally lower, but in grain (patent or "silent" spirit) distilleries the worts are usually made up to a higher gravity. In Germany gravities as high as 1·110 are employed; but in that country "thick" mashes, owing to the method to raise the duty, are a matter of necessity rather than of choice.

Distillation.

The principles governing the distillation of the fermented wort—at this stage termed "wash"—are very much the same as those described in the 9th edition under Distillation and Whisky (*q.v.*). With regard to the apparatus, the old form of pot still employed in the manufacture of malt whisky in Scotland and Ireland, and of brandy in France, has undergone little change, as it is generally recognized that for the preparation of this class of spirits, which depend for their characteristic flavours on the retention of a considerable proportion of the volatile by-products of the wash, the simplest type of still is the best. It is curious to note in this respect that the stills used in the Charente district, where the genuine Cognac brandy is produced, are of the most elementary construction. The farther one gets away from the Cognac centre, the more complicated does the type of still become, and the quality of the brandy grows correspondingly inferior. On the other hand, the patent or grain stills which are employed for the manufacture of silent spirit, from which the by-products must be removed as far as possible, have been improved in many ways. It was formerly not considered possible to produce a high grade silent spirit, practically free from by-products, in a single operation; the spirit obtained, for instance, from the Coffey apparatus in British and Irish distilleries was invariably sent to the rectifier for further purification.

Stills are, however, now constructed which yield in one operation a spirit containing up to 98 per cent. of absolute alcohol, and free from all but the merest traces of aldehyde, fusel oil, &c. (foreshots and tailings). An excellent still of this kind is that of Ilges. The latter takes advantage of the fact that if a liquid containing 15 per cent. of alcohol is boiled, the quantity of fusel oil in the vapour is equal to the amount in the remanent fluid, and that if the percentage of alcohol is less than 15 per cent., the amount of fusel in the vapour is greater than that in the liquid. It is therefore, by working on proper lines, possible to remove the whole of the fusel from the mash by a single operation. By subjecting the vapours so obtained to a carefully regulated dephlegmation, the fusel oil condenses, together with the steam and a certain proportion of alcohol—in practice 15 per cent. By further cooling the liquid so obtained, the fusel separates out and, being specifically lighter, rises to the surface of the watery spirit, and is then easily removed. This form of still is so arranged that any change from the correct temperature necessary for the adequate separation of the concentrated "feints" into two layers, is automatically corrected by the admission of more or less cooling liquor to the refrigerating pipe coiled round the dephlegmating column. The "foreshots" (aldehyde, &c.) are removed by submitting the alcoholic vapour passing up through the main dephlegmator to further purification. The Ilges apparatus yields three continuous streams of fine spirit, fusel oil, and foreshots respectively. Other good forms of modern "patent" stills are those of Luck and Leaker, Pontifex and Wood, and Blair and Campbell.

Patent, grain or silent, spirit is principally used in the United Kingdom in the arts, for blending with malt whisky, and for the manufacture of gin, British brandy, and various liqueurs and cordials. As there are no official figures, it is impossible to state the exact amount of patent spirit which is blended with malt (pot) whisky, but the figures taken in evidence before the Select Committee on British and Foreign Spirits in 1891 indicated that the total quantity of whisky which went into consumption in 1890 was roughly 22½ millions of gallons, of which 16 millions represented pot and 6½ millions patent spirit. These figures, however, certainly do not represent the relative proportions of pot and patent spirits consumed as whisky at the present time. According to a competent trade authority, Irish whisky is now "patent" to the extent of at least four-fifths, and Scotch whisky to fully two-thirds, of the total amount

consumed. It certainly seems that the taste for a "dry" spirit, *i.e.*, one containing less of the malt or peat flavour characteristic of unblended whisky, is continually increasing.

For the production of *whisky* see under WHISKY in vol. xxiv. (9th ed.), and under DISTILLATION (vol. vii.); also above, and under *By-Products* (below).

Various spirits.

Genuine *brandy* is obtained by the distillation of wine in pot stills, similar in construction to, but smaller, than those employed by Scotch malt whisky distillers. The best brandies, those of the Cognac (Charente and Charente Inférieure) district are made from light white wines possessing no marked "bouquet," but which in distillation yield a spirit of a peculiarly fine and delicate character. It is remarkable that the fuller and more aromatic wines of the Gironde and Burgundy, for instance, are not so suitable for the manufacture of brandy as the relatively poor growths of the Charente. Apart from the latter, wine-brandy is also distilled in considerable quantities in the Armagnac, Marmande, Nantes and Anjou, and several other districts. The *eaux-de-vie de marc* obtained (chiefly in Burgundy) from the pulp of skins, pips, &c. remaining in the wine-press, by the addition of water and subsequent fermentation and distillation, are peculiarly rich in aromatic principles.

Rum in former times was made almost exclusively from the expressed juice of the sugar cane, but it is now largely obtained either from cane-sugar molasses or from cane-*megasse*, that is, the sugar-cane pulp from which the greater part of the juice has been expressed. Fictitious rums, made either wholly or in part from plain spirit and flavoured with essential oils ("rum essence"), are occasionally encountered, but this also applies to other spirits, such as wine and fruit brandies.

Gin is obtained by distilling plain spirit (of varying strength) in the presence of a number of flavouring agents, the chief of which are juniper, angelica, cinnamon, coriander, and sweet fennel. Occasionally flavouring agents are added after distillation. "Sweetened" gin contains 3 to 5 (or even more) per cent. of sugar.

Liqueurs may be defined as flavoured spirits of varying alcoholic strength, and sweetened by the addition of cane sugar. They are made (1) by distilling plain spirit with the flavouring agents, and adding the sweetening syrup to the perfumed distillate; (2) by macerating plain spirit with various essences and extracts, filtering, and adding the sugar; or (3) by adding alcohol and sugar to different fruit juices. *Absinthe* is a sweetened spirit containing 70 to 73 per cent. of alcohol, flavoured with wormwood, fennel, aniseed, &c., and coloured green by maceration with the leaves of the hyssop, mint, and wormwood plants. There is a popular belief to the effect that the green colour is due to copper, indigo, or other dye-stuffs, but in fact this is very rarely the case. Genuine *Vermouth* is obtained by adding an alcoholic extract of a number of flavouring and colouring agents to a fortified white wine, the whole being subsequently matured by exposure to the sun's rays. The nature and quantities of the flavouring agents employed in the preparation of genuine *Chartreuse*, *Benedictine*, and similar liqueurs are kept strictly secret, but numerous "recipes" may be found in special works dealing with this subject.

The by-products of fermentation and distillation.

The main constituent of spirits is, of course, ethylic alcohol—spirit of wine—but all spirits contain small but varying quantities of by-products, and it is by these that the character of a spirit is determined. The by-products are mainly formed during fermentation, but are also to a certain extent pre-existent in the raw materials, or may be formed during the operations preceding and succeeding fermentation. The nature of the by-products is complex, and varies sensibly according to the raw materials employed and the methods of malting, mashing, fermentation, and distillation.

The by-products may be classified as follows:—(*a*) Higher alcohols—usually going under the name of fusel oil; (*b*) compound ethers; (*c*) fatty acids; (*d*) fatty aldehydes and acetals; (*e*) furfurol; (*f*) terpene, terpene hydrate, and ethereal oils; and (*g*) volatile bases. The higher alcohols. These consist of mixtures of fatty alcohols containing three or more atoms of carbon ($C_nH_{2n+1}OH$), in which, as a rule, amyl alcohol ($C_5H_{11}OH$) predominates. The fusel oil of British pot still spirits (whisky) is chiefly composed of amylic and butylic alcohols, whereas in patent spirits propylic alcohol is the preponderating factor; that is, in the finished or fine spirit, for the fusel separated from patent spirit in the course of distillation consists mainly of amylic and butylic alcohols. Broadly speaking, the higher alcohols present in pot are of higher molecular weight than those in patent spirits. Potato fusel contains a high proportion of isobutylic, grain fusel of n. butylic, alcohol.

The formation of fusel oil is dependent on many conditions. It has been shown that at the commencement of fermentation, when the yeast is young and vigorous, very little, but that towards the end of this stage a relatively large quantity, is produced. Lindet found the amount formed thirty-eight hours after pitching to be 1·78 c.c. (per 100 c.c. of alcohol), and after seventy-two hours, 14·07 c.c. The presence of a large volume of yeast tends to check the production of fusel, probably owing to the overwhelming mass action of the yeast on the bacteria that may be present. Further, it is a fact that certain organisms form specific alcohols. Thus Perdrix has described a fission fungus which produces amyl alcohol, and Beijerinck has proved that B. *granulobacter butylicum* is responsible for the formation of isobutylic alcohol. Nevertheless there is considerable evidence to prove that the true yeasts are under certain conditions capable of giving rise to the formation of fusel oil. The acid present in spirits is chiefly acetic acid, but small quantities of other acids are also found. The compound ethers, formed by the interaction of alcohols and acids, chiefly during the fermenting and distilling operations, consist almost entirely of fatty acid radicles in combination with ethyl and, to a minor extent, amyl alcohol. Ethyl acetate (acetic ether) is the main constituent of the compound ethers, the others being mainly valerate, butyrate, and propionate of ethyl. Œnanthic ether (pelargonate of ethyl) is one of the characteristic ethers of brandy. *Furfurol*, the aldehyde of furfuran, one of the chief decomposition products of the *pentoses*—is invariably present in new pot, but rarely in patent, spirits, and it seems fairly certain that the presence of relatively large quantities of this substance in pot-still spirits is mainly due to the charring effect of the direct action of the fire gases on the carbonaceous matter adhering to the bottom and sides of the still. *Terpene* and *terpene hydrate* are characteristic constituents of grain fusel. Although the ethereal oils appear to play an important part in determining the character of a spirit, too little is at present known of these substances to warrant any closer description.

The effect of maturing on the by-products.

That potable spirits (excepting, of course, pure alcohol) and wine are greatly improved by age is an undeniable fact, and one that has been recognized for many hundreds, and even thousands, of years. Thus in the Gospel of St Luke we have the statement "that no man having drunk old wine, straightway desireth new: for he saith, The old is better." And again, in the Apocrypha, "New friends are like new wine: when it is old, thou shalt drink it with pleasure." There is little doubt that the beneficial effect of age on the character of spirits is due to the changes effected in the character and quantity of the by-products; but the exact nature of these changes is by no means clear. Such improvement as takes place is apparently connected in some way with the free access of air to, or rather the satisfactory ventilation of, the containing vessel; for spirits preserved entirely in glass undergo relatively little change, either in taste or in chemical composition, whereas cask storage materially affects both these factors.

Concerning the changes in the higher alcohols, considerable divergence of opinion exists, and it is, to say the least, doubtful whether the fusel oil, to which the baneful effects of new or raw spirits were formerly ascribed, actually does decrease with age. The experience of the author is rather to the contrary. With regard to the compound ethers, the general belief up till a few years ago was that

these bodies tend to increase with age, and it is to their development that the bouquet of spirits (as well as of wines) is mainly due. More recent investigations tend to throw doubt on this theory (although it may be true enough in particular cases). The author is inclined to favour the view that the ethers as a whole do not materially increase, and that with regard to the bouquet, the ethereal oils play a part at any rate equal in importance to that of the compound ethers.

Coming next to the acids, there is a consensus of opinion that they increase with age, both in the case of whisky and of brandy; and as increased acidity implies oxidation, there is little doubt that this factor to a great extent connotes age or improved condition. The *aldehydes* in whisky have been little investigated, but on the whole the results obtained seem to indicate an augmentation during maturation. In the case of brandy, the published analyses show a sensible increase of aldehyde with age. From the latest investigations it appears more than probable that the elimination or modification of *furfurol* and other pyro compounds (probably of an aldehydic and creosotic or phenolic nature) formed by fire action in the pot still, plays an important part in the improvement of spirits.

The following are analyses of whiskies and brandies of various ages and conditions:—

Whiskies.

(Excepting the alcohols, results are expressed in milligrammes per 100 c.c. alcohol.)

Description and Age, &c.	Alcohol per cent. By Vol.	Acid (as Acetic Acid).	Aldehyde (as Acetic Aldehyde).	Furfurol.	Compound Ethers (as Acetic Ether).	Higher Alcohols.	Total By-Products.	
Scotch. All malt (unblended). *New* *	62·22	25·4	11·4	5·6	62·2	208·9	313·5	I.
Scotch. All malt (unblended. *4 years* *	60·45	31·1	13·5	4·3	69·4	236·5	354·8	II.
Scotch. Ordinary Commercial (blended). Age?	47·56	138·7	18·4	1·7	83·2	182·5	424·5	III.
Brandies.								
Genuine. New	67·7	50·6	5·9	1·3	158·8	151·9	367·0	IV.
Genuine. 36 years	47·5	202·1	48·1	1·3	133·3	345·4	730·1	V.
Factitious	47·5	50·5	0·4	0·1	25 8	10·5	87·3	VI.
Ordinary Commercial	44 5	83·1	11·8	1·3	129·0	273·8	499·0	VII.

Note.—Analyses I.–III. and VII. by the author, Nos. IV.–VI., by Lusson.

* These samples represent the same quality of spirit from one distillery, and are therefore fairly comparable.

Physiological effects of spirit by-products.

The nature of the physiological effects produced by the ingestion of spirits varies considerably, not only according to the class of spirit (*i.e.*, whether whisky, brandy, rum, &c.) consumed, but also with the condition of the same (*i.e.*, whether new or old, and so on); and there is no doubt that the causation of these phenomena is intimately connected with the nature and quantity of the by-products, to which, as has been already said, the character of the spirit is due. Commenting on a statement in *Bailey's Book of Sports* to the effect that wine and brandy had a tendency to make a man fall on his side, whisky to make him fall forward, and cider and perry to make him fall on his back, Lauder Brunton (*Evidence, Spirits Committee*, 1891) suggests that these statements—if correct—might indicate definite injury to various parts of the cerebellum. Thus if the anterior part of the middle lobe of the cerebellum is injured, the animal tends to fall forward; when the posterior part is affected, the head is drawn backwards, &c. Brunton is inclined to believe that the varying action of different spirits may be due to the specific action of specific products on the separate nerve centres. Thus the cause of the epileptic convulsions produced by the injection of absinthe has been traced to the specific action of the chief flavouring agent of this liqueur.

In view of the doubt which modern research has thrown on the older theories, to the effect that the improved character of a mature, as compared with a new, spirit is due to the decrease in the quantity of the higher alcohols (*i.e.*, the fusel oil), a discussion of the specific action and relative toxicity of these bodies may seem superfluous, more especially as they occur in quantities which are apparently incapable of producing serious effects. As, however, there is considerable reason for believing that the higher alcohols do influence, at any rate, the flavour of the spirit, and the evidence as to the non-disappearance of these substances during maturing is not all on one side, a brief reference to their physiological action seems to the author not out of place. Broadly speaking, the toxicity of the fatty alcohols increases with their molecular weight. Dujardin-Baumetz and Audigé found that the lethal dose for dogs was 5-6 grammes per kilo-body-weight for ethyl (ordinary) alcohol; 3·75 grammes for propyl alcohol; 1·8 grammes for butyl; and 1·5 grammes for n. amyl alcohol. It is interesting to note that the experiments of these investigators were conducted chiefly with the pig, as the digestive organs of the latter animal are very similar to those of man, and also because the pig is apparently the only animal which willingly takes alcohol with its food. With regard to the action of spirits generally, the investigators named above found that the digestive organs of pigs fed for thirty months with pure alcohol alone were not affected, whereas the animals treated with similar quantities of imperfectly purified spirit (whether derived from the beet, the potato, or from grain) suffered considerably.

Of late years the attention of pharmacologists has been directed to *furfurol* especially, and the aldehydes generally, as being, at any rate in part, the cause of the unpleasant after or by-effects of certain spirits. Curci and others have shown that furfurol in certain doses is poisonous to animals; and Brunton and Tunnicliffe have demonstrated a poisonous action of this substance upon man, and have compared the after-effects upon animals of spirits containing, and freed from, aldehydes, and have found certain important physiological differences between them. Guareschi and Mosso first drew attention to the fact that numerous samples of reputedly pure spirits contained small quantities of certain volatile bases of an alkaloidal nature. They apparently belong to the pyridine series, and have effects similar to those of strychnine. Bamberger and Einhorn have discovered the presence of pyridine, dimethyl pyridine, and other bodies belonging to the same series, in commercial fusel oil. It is possible that the existence of these volatile bases in spirit may have given rise to the—on the face of it absurd—suggestion that wood spirit and tar bases have been used as adulterants of whisky. It appears likely that the formation of the bases in question is connected with the use of inferior or decaying grain or maize. Thus the spirit produced in Sweden in 1879 was particularly bad and had very curious effects, and it was found, on investigation by Husz, that it had actually been largely prepared from decomposing grain. Moreover, Lombroso discovered an alkaloidal body in decayed maize, the action of which was not unlike that of strychnine. The quantities of these bases which have been found in spirits are very small, but it must be remembered that substances are known—such as abrine, for instance—which have marked effects in practically unweighable quantities. It is possible that these volatile bases may be responsible for some of the effects—very similar to alkaloidal poisoning—produced by crude spirits such as Cape "Smoke" and the cheap Portuguese liquors.

Having described the nature and effects of spirit by-products, and the changes occurring in them during storage, the question that arises is: How is the knowledge gained by scientific research in this direction applied in practice?

It may be said that the old adage "Prevention is better than cure" holds good in the spirit industry as elsewhere, and the distiller, therefore, tries as far as possible to avoid the formation of those by-products which are objectionable, or at any rate to remove them during the course of manufacture. These methods for obtaining a satisfactory potable spirit are so far, however, only successful up to a certain point, and the distiller is therefore bound to have recourse to prolonged storage or to one of the many artificial processes of purification and maturing, the majority of which have been devised—with varying success—during recent years. Referring, in the first place, to what may be called the natural or "preventive" methods for the production of a well-flavoured spirit, it is necessary (*a*) that the water-supply (for steeping, mashing, &c.) be a good one; (*b*) that no mouldy or inferior material be used; (*c*) that mashing heats be kept within reasonable limits; (*d*) that refrigerators be constructed so as to avoid bacterial infection; (*e*) that the "souring" of the wort be conducted on proper lines; (*f*) that a favourable and vigorous type of yeast be used; (*g*) that the mash be cleared as far as possible of yeast, grains, &c., prior to distillation—stills are now constructed which automatically filter the mash; (*h*) and that stills, &c., be kept perfectly clean. Coming next to the methods ordinarily or frequently employed by distillers for eliminating the undesirable by-products, which, despite all care, are found in the course of manufacture, the most important undoubtedly is purification by rational fractional distillation. By properly regulating the distilling heats, by using a well-devised still, both in the first instance and also for rectifying, a product very free from fusel oil, and especially from fatty aldehydes and volatile ethers, may be obtained. The removal of acids —objectionable chiefly on account of the unpleasant decomposition products which they form in still—is carried out by neutralizing the still contents with an alkaline medium. The alkali so used also decomposes undesirable compound ethers, and retains some of the aldehydes by converting them into non-volatile polymers. For the elimination of fusel oil, filtering through charcoal is the most common method. Luck has suggested for this purpose the passing of the alcoholic vapours through petroleum, which is said to absorb the higher alcohols much more easily than it does ordinary spirit; and some distillers have successfully tried the method of Traube, which consists in treating the spirit with a saturated aqueous solution of various inorganic salts. This causes the formation of a supernatant layer, which is said to contain practically all the fusel oil as well as the greater part of the foreshot by-products, *i.e.*, fatty aldehydes, &c.[1]

Finally, there remain for consideration the *artificial maturing processes*. These are exceedingly numerous, but it may be said at once that the great majority of them are hardly to be taken seriously. Thus one inventor, acting on the alleged fact that spirits are improved by lengthy journeys, suggests that a miniature railway, with numerous obstacles to augment the rolling and shaking action, be laid down in the distiller's warehouse! Of the methods worthy of consideration may be mentioned, firstly, those depending solely on the action of currents of air, oxygen, and ozone. They exist in numerous modifications, but the principle involved, broadly speaking, is to pass a current of hot or cold air or oxygen, or alternate currents of hot and cold air, or a current of ozonized air, through the liquid, with or without pressure, as the case may be. According to the patent of Mills and Barr, new whisky rapidly acquires the character of the mature sherry-cask stored spirit if the action of alternate hot and cold air currents be assisted by the addition of a little sherry and a minute trace of sulphuric acid, the latter being subsequently neutralized by lime. Secondly, there are the processes which make direct or indirect use of the electric current. Of the indirect methods in this class may be mentioned that of Hermite, which consists essentially in adding an electrolized solution of common salt to the spirit, and subsequently redistilling. Thirdly, the processes which rely on accelerating natural cask action by artificially reproducing the conditions attendant on the latter in a purposely exaggerated or heightened form. One method strives to obtain this object by heating the spirit under pressure in an atmosphere of oxygen in a vessel containing a quantity of oak shavings. This process certainly seems calculated to remove a portion of the by-products, for the "grog" obtained in Allen's experiments by steaming the staves of an old whisky cask, contained appreciably more fusel oil and compound ethers than commercial whisky. Fourthly, we have the methods chiefly dependent on the action of cold. Pictet, by cooling a new brandy to $-80°$ C., is said to have obtained a liquid which had apparently acquired the properties of a twelve-year-old spirit. Scott's process consists in energetically treating spirit which has been cooled down to 0° C. with dry filtered air, and the operations are so conducted, it is said, that there is no loss of alcohol or of the important aromatic ethers. According to the published data, the quantity of the fusel oil is materially reduced by this method, and the quality of the spirit much improved. None of the above processes have apparently (although in practice they may give satisfactory results) been devised with a view to effecting the direct removal of those specific substances (furfurol, other aldehydes, and volatile bases) which later research has shown to be present to a greater extent in new or inferior spirits than in the matured or superior article, and to some of which, at any rate, owing to their acknowledged toxicity in very small quantities, it is more than reasonable (as Lauder Brunton and Tunnicliffe have pointed out) that at least a part of the evil effects produced by drinking new or inferior spirit may be ascribed. In this connexion a patent taken out by J. T. Hewitt is of interest, inasmuch as it deals with the problem of spirit purification on seemingly rational scientific lines. This patent takes advantage of the fact that furfurol and similar aldehydic bodies can be removed from spirits by distillation with phenyl-hydrazine-sulphonate of soda, which salt forms non-volatile products with the substances in question. (P. S.)

[1] The above applies chiefly to grain or "silent" spirit, in the manufacture of which a product which is practically pure alcohol is desired. These methods can only be used to a limited extent by whisky and brandy distillers, for a complete removal of by-products also entails destruction of the spirit's character.

Spitsbergen (the name being Dutch is incorrectly spelled with *z*), an Arctic archipelago, almost midway between Greenland and Novaya Zemlya, in 76° 26′–80° 50′ N. and 10° 20′–32° 40′ E., comprising the six large islands of West Spitsbergen or New Friesland, North-East Land, Edge Island, Barents Island, Prince Charles Foreland, and Wiche Islands, and many small islands divided by straits from the main group. Later exploration has shown the character of the interior of West Spitsbergen. In comparatively recent geological times this, the main island, was over most of its area a high plateau covered with an ice-sheet, which has gradually been withdrawn from the west towards the east, the western region being thus cut up into deep valleys and more or less rugged mountains. Farther east the mountains are more rounded, but still farther east the plateau character of the land remains. At the north-west angle of the island is a region of bold peaks and large glaciers, in the midst of which is Magdalena Bay, "the pearl of Arctic scenery." Farther south come the series of glaciers called by the whalers "The Seven Icebergs," which drain a high snowfield reaching east almost to Wood Bay and south to the head of Cross Bay. On the south-east it is drained by glaciers towards or into Dickson and Ekman Bays. South of this snowfield comes the mountainous King James Land, consisting of an intricate network of craggy ridges with glaciers between. A deep north and south depression is occupied by Wijde and Dickson Bays, bordered on the west by a range of fine mountains, a spur of which separates the two bays. East of this depression the plateau region occurs. Its edge is eaten away into deep valleys, down which the ice-sheet of

New Friesland sends glacier tongues into Wijde Bay. East of Dickson Bay the marginal valleys are larger, and no glaciers come far down them. The plateau between Dickson and Klaas Billen Bays is cut up by deep valleys such as the Rendal, Skansdal, and Mimesdal (all well known to geologists); it contains no big glaciers. Farther east is found a glaciated area called Garwood Land. The neck of West Spitsbergen is bounded on the N. by a line from near the head of Klaas Billen Bay to Wiche Bay, and on the S. by the Sassendal and the depression leading to Agardh Bay. It is a complicated area of fine craggy ridges with beautiful glaciers between. Adventure Land lies south of the neck, and is bounded on the S. by a line from the head of Van Keulen Bay to Whales Bay. It is an area of boggy valleys, rounded hills, and small glaciers, and may be described as the temperate and fertile belt, and is the only part of the island where many reindeer still linger. Near the west coast it contains some fine peaks and large glaciers. It is penetrated by the longest green valleys in Spitsbergen, *e.g.*, from Coles Bay, Advent Bay, and Low Sound (the valley of the Shallow river). The southern division of the island is very icy. There is a high snowfield along its east side, and ranges of peaks farther west. Two parallel ranges form the backbone of the island south of Horn Sound, the higher of them containing the famous Horn Sund Tind (4560 feet). Of the remaining large islands, North-East Land is covered with a true ice-sheet, while the neighbouring Wiche Islands sustain no large glaciers at all. Neither Barents Land nor Edge Island carries ice-sheets, and both are practically devoid of glaciers down their western coasts, but have large glaciers reaching the sea on the east. Prince Charles Foreland consists of a range of fine mountains, interrupted towards the southern end of the island by a flat plain of 50 square miles raised only a few feet above sea-level. There is a narrower depression a few miles farther north.

The nomenclature is in a state of hopeless confusion, the names given by the old explorers having been carelessly transferred from point to point, or capriciously set aside. The true names, English and Dutch, of the principal misnamed sites are here indicated in brackets after the current names:—South Cape (Point Look-out), Torrel's Glacier (Slaadberg), Recherche Bay (Joseph's Bay, Schoonhoven), Van Keulen Bay (Lord Ellesmere Sound, Sardammer Rivier), Van Mayen Bay (Low Sound, Klok Rivier), Coal Bay (Coles Bay), Advent Bay (Adventure Bay), St John's Bay (Osborn's Inlet), English Bay (Cove Comfortlesse), Foreland Sound (Sir Thomas Smith Bay, Keerwyk), Cross Bay (Close Cove), the bay called Smeerenburg (Fair Haven, Dutch Bay), Flat Hook (Fox Point), Biscayers' Hook (Point Welcome), Redbeach (Broad Bay), Liefde Bay (Wiche Sound), Grey Hook (Castlin's Point), Wijde Bay (Sir Thomas Smith Inlet), Verlegen Hook (Point Desire), Treurenberg Bay (Bear Bay), Agardh Bay (Foul Sound), Storfiord (Wybe Jans Water), North-East Land (Sir Thomas Smith Island), North Cape (Point Purchas). Stans Foreland is not the name of Edge Island, but of its south-eastern cape only.

Over 130 species of flowering plants have been found. Reindeer are approaching extinction; the theory that they came over the ice from lands to the east is now of course abandoned. The walrus is still occasionally seen in the waters of West Spitsbergen. Birds are rapidly diminishing in numbers, eider ducks being noticeably fewer of late years.

History.—All the purely modern expeditions—Swedish (1890, 1892, 1896, 1898), German (1889, Kükenthal; 1891, Cremer), French (1892, La Manche), Austrian (1891, 1892), and British (1894, Fielding; 1895, H.M. Training Squadron)—were sailing expeditions, and confined their attentions almost entirely to the coast. In 1892 M. Rabot made the first serious attempt to penetrate the interior from the head of Ice Fiord, exploring a part of the Sassendal; and in 1896 Sir Martin Conway led an expedition which crossed the island for the first time, and surveyed the region between Ice Fiord and Bell Sound on the east coast. In 1897 Conway and Garwood surveyed the glaciated area north of Ice Fiord to about 78° 10′ N., and climbed Horn Sund Tind. In the same year Herr André made his fatal balloon ascent from Dane's Island with the intention of floating over the Pole. The first tourist trip to Spitsbergen was made by a small Hammerfest steamer in 1871. In 1896 a weekly service of Norwegian steamers was established in summer, and a small inn was built at Advent Bay in Ice Fiord. The west coast is now frequently visited by tourist steamers during the height of summer.

AUTHORITIES.—Important papers on the geology by Nordenskiöld, Gregory, and Garwood will be found in the *Journal of the Geological Society;* on birds in the *Ibis;* on exploration in the *Journal of the Royal Geographical Society;* but the chief source of scientific papers is the publications of the Swedish Vetenskaps Akademie. A few descriptive works are:—W. SCORESBY. *Account of the Arctic Regions.* Edinburgh, 1820.—J. LAMONT. *Yachting in the Arctic Seas.* London, 1876.—TH. v. HENGLIN. *Reisen in 1870, 1871.* Brunswick, 1872–74.—W. M. CONWAY. *First Crossing of Spitsbergen.* London, 1897. *Arctic Glaciers.* London, 1898.

(W. M. C.)

Spokane, a city of Washington, U.S.A., capital of Spokane county. It is situated in 47° 40′ N., and 117° 25′ W., on both sides of the river Spokane, at the falls, in the eastern part of the state, at an altitude of 1910 feet. It is regularly laid out on a level basalt plain, and has excellent water supply and sewerage systems, but few of its streets are paved. It is the chief city of eastern Washington, and the largest place between Butte, Montana, and the Pacific coast. The city is entered by the main transcontinental lines of the Northern Pacific and of the Great Northern; it is the north-eastern terminus of the Oregon Railway and Navigation Company, and the terminus of the Spokane Falls and Northern Railway. Spokane river here falls over a succession of beds or flows of basalt, affording magnificent water-power, which has been utilized for manufactures, for operating street cars, and for electric lighting. The possession of this power is making Spokane a manufacturing city. It has many flour mills, supplied from the great wheat fields of eastern Washington, and lumber mills, for which tribute is levied on the yellow pine forests to the north and east, and smelters for the ores of north-eastern Washington and British Columbia. In 1900 there were 213 manufacturing establishments with a capital of $2,678,823, employing 1779 hands, and having a product valued at $5,427,540. The assessed valuation of real and personal property was in 1899 $19,479,232, the net debt of the city was $2,868,977, and the rate of taxation was $37·00 per $1000. The city dates from 1877, but in 1880 it had only 350 inhabitants. Upon the completion of the Northern Pacific Railroad in 1884 a boom commenced, resulting in a population in 1890 of 19,992. Immediately after the taking of the census in August 1890, the city was almost totally destroyed by fire. It was, however, quickly rebuilt, and in a much more substantial form. In 1900 the population was 36,848, of whom 7833 were foreign-born and 747 coloured, including 376 negroes. Of 14,944 males 21 years of age and over, 304 were illiterate (unable to write).

Spoleto, a town and archiepiscopal see of the province of Perugia, Umbria, Italy, 18 miles north-north-east of Terni, and 88 miles north by east of Rome by railway. Traces of the Roman theatre (375 feet in diameter) were

unearthed in 1891. The citadel, which stoutly resisted the Piedmontese in 1860, is now a convict prison. In 1892 the city was adorned with a monument to Victor Emmanuel. The principal industries are the collection of truffles and the preparation of preserved foods. Population (1881), 11,885; (1899), about 12,000.

Sponges.—The growth of our scientific knowledge of the phylum of the sponges has been more rapid during recent years than in the case of any other group of the animal kingdom. This statement is especially true with regard to those fundamental facts of development and life-history which are all-important for a proper understanding of the affinities of the group as a whole, and for determining its natural position in the scheme of classification of animal life. Formerly there was scarcely any problem in natural history more puzzling and obscure than that of the embryonic development of sponges, considered from the comparative standpoint. Researches, it may be fairly claimed, have brought order out of chaos, and rendered it possible to trace a common plan through the various types of sponge-development.

As may be seen by reference to the article SPONGES in the 9th edition of the *Encyclopædia Britannica*, it seemed formerly as if the "amphiblastula" type of development, characteristic of the greater number of Calcarea, was in contrast in essential points with the "planula" or "parenchymula" type found in the great majority of sponges, even in many Calcarea. In the development of *Sycandra* (*loc. cit.*, Fig. 25), so thoroughly investigated by Metschnikoff and Schulze, the ciliated cells of the larva were proved to become the collared epithelium (so-called endoderm) lining the gastral cavity of the adult. In all other sponges, however, it was alleged that the destiny of the ciliated cells of the larva was to furnish the outer or dermal layer (so-called ectoderm) of the adult. The latter notion, in spite of the many apparent instances upon which it was based, has proved to be simply an error of observation or interpretation, originating to a great extent from the assumption that in view of the great similarity between sponge-larvæ and Cœlenterate planulæ, the destiny of their component layers and their share in building up the adult body would be the same in the two phyla. As a matter of fact, however, the development of the sponge-planula proceeds in a manner precisely opposite to that of the very similar larva of Cœlenterates, and agrees with the amphiblastula-type as regards the fate of the layers. It has now been shown in all sponges which have been carefully investigated, that the fate of the ciliated cells of the larva is to become in the adult the collar-cells, lining the gastral cavity or the flagellated chambers, and no other cell-elements but these. Where the remaining cells are so placed as to form the inner mass of the larva, a complete reversal of the two layers takes place at the metamorphosis. The inner mass in such cases (planula-type) passes to the exterior, on the fixation of the larva, and after surrounding the formerly external ciliated cells becomes the dermal layer of the adult. In other cases (amphiblastula-type) the cells of the future dermal layer are placed not in the interior, but at the hinder pole of the larva as in *Sycandra*. The metamorphosis is then correspondingly simpler, and the dermal cells, which usually mark the posterior non-ciliated pole of the larva, simply grow round the ciliated gastral cells, a process which may begin in *Sycandra* even before fixation. In *Oscarella*, however (and perhaps also in *Plakina*), the superficially placed cells of the dermal layer are also ciliated, both at the hinder pole of the larva and when forming the flat epithelium of the external surface or of the canal-system of the adult.

The most primitive type of sponge-larva is probably to be seen in the Ascons among *Calcarea*, or in *Oscarella* among *Demospongiæ*. In the former the larva is set free in the genus *Clathrina* (Fig. 1, A, B) as an oval ciliated blastula, carrying a small number of undifferentiated blastomeres or *archæocytes*, usually marking the hinder pole, and destined to become the wandering and reproductive cells of the adult sponge. During larval life an inner mass of cells is formed by differentiation and immigration of cells from the ciliated layer. The result is a *parenchymula* larva, with (1) an outer layer of ciliated cells (gastral layer), (2) an inner mass of non-ciliated rounded elements (dermal layer), and (3) the archæocytes; the latter may be of large size and few in number, protruding from the surface at the hinder pole (Fig. 1, A), or of small size and more numerous, and lodged in the interior (Fig 1, B). The larva fixes itself and the inner mass breaks out and surrounds the ciliated cells. Two types of parenchymula may be distinguished according as the immigration takes place at any point (multipolar, Fig. 1, A) or only at the hinder pole (unipolar, Fig. 1, B). The latter condition is only possible when the archæocytes are lodged in the interior, as in *Cl. reticulum*, and it leads by a simple modification to the well-known amphiblastula-larva of *Leucosolenia* and *Sycandra*. To understand the origin of the amphiblastula it is only necessary to imagine that in a parenchymula, such as that of *Cl. reticulum* (Fig. 1, B), the shape and disposition of the ciliated cells become such as to greatly reduce the internal cavity, so that the archæocytes alone suffice to fill it (Fig. 1, C). Then the dermal cells formed by modification of the ciliated cells at the hinder pole cannot pass inwards, but must remain where they are. The result is an amphiblastula-larva with an anterior ciliated pole, a posterior non-ciliated pole, and a central mass of archæocytes (Fig 1, D). At first the non-ciliated posterior cells are few in number or absent (so-called pseudogastrula stage), but as they are continually being formed by modification of the ciliated cells at the hinder pole, the surface of the larva is ultimately made up of the two kinds of cells in approximately equal proportions. The larva

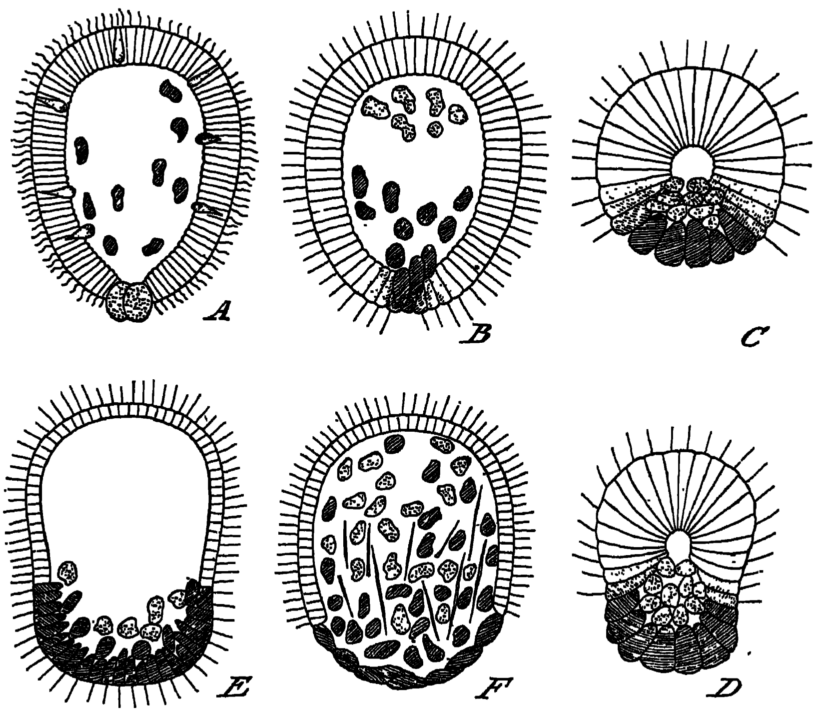

FIG. 1.—Types of sponge larvæ (semidiagrammatic). The ciliated (gastral) cells are left blank, the dermal cells are shaded, and the archæocytes are granulated. A, larva of *Clathrina blanca*; B, of *Clathrina reticulum*; C, young larva of *Leucosolenia* (or pseudogastrula stage of *Sycon*); D, older larva of *Leucosolenia* (or newly hatched larva of *Sycon*); E, larva of *Oscarella*; F, of a silicious Monaxonid sponge (*Myxilla*).

is then ready for fixation, an event preceded in *Sycandra* by the commencing growth of the non-ciliated cells round the others.

Oscarella (Fig. 1, E), on the other hand, has an oval blastula with a very large internal cavity. The cells at the posterior pole are all destined to become dermal cells, but for the most part retain their cilia and do not immigrate. Only a few lose their cilia and pass to the interior, representing, probably, the archæocytes and the connective-tissue layer of the adult, while those remaining at the surface become the ciliated dermal epithelium. *Oscarella* is the most primitive of the *Demospongiæ*, and its larva may be taken as the prototype of the other forms in this group. No larvæ are known as yet in *Tetractinellida*, a gap in our knowledge for which it is difficult to account satisfactorily; but in *Monaxonida* and *Keratosa* a type of larva occurs which may be derived from *Oscarella* by supposing (1) that all dermal cells are non-ciliated, as in *Calcarea*, whether superficial in position or not; (2) that the dermal cells are placed internally in the larva, either completely filling up the interior, or leaving a small excentric cavity, as in *Spongilla;* and (3) that the cells of this inner mass have become precociously differentiated to form the various classes of tissue cells found in the adult, so that the larva after fixation has but to rearrange its cells during the metamorphosis, and then finds itself, so to speak, in working order. It is clear that a great saving of time is effected by this precocious histogenesis, and the period of development is greatly shortened. Two sub-types can further be recognized in the larvæ of *Demospongiæ;* in the *Keratosa* and in *Spongilla* the ciliated gastral layer completely surrounds the non-ciliated inner mass of dermal cells, but in other *Monaxonida* the inner mass is exposed and protrudes at the hinder pole (Fig. 1, F). Further differentiations among Monaxonid larvæ correspond in a striking way to the systematic divisions of the group.

Recent discoveries in sponge-embryology have a very considerable bearing upon the problem of the position of sponges in the animal kingdom. Although it cannot be said that any one theory of their actual place in nature is as yet definitely proved and established to the exclusion of any other, it is at least possible to narrow the controversy and to eliminate that view in particular which has hitherto been most dominant in zoological literature, the theory, namely, especially associated with the names of Leuckart and Haeckel, that sponges are to be included, in a phylogenetic sense, amongst the Cœlentera. Any speculations as to the relations of sponges to other animals must take into consideration their larval as well as their adult structure, and from both these points of view the theory of their cœlenterate affinities was formerly considered to be as completely established as it now appears, with a better knowledge of the facts, to be overthrown. For if the larvæ of sponges and of the Cœlentera be compared, and their layers homologized in accordance with their relative positions, then the adult animals must appear totally dissimilar from the morphological point of view, since the corresponding layers occupy reversed positions in the two cases. If, on the other hand, the layers composing the body of a simple sponge be homologized with the corresponding layers of a typical Cœlenterate, then sponge-larvæ appear altogether anomalous, since they must be regarded from this standpoint as having a ciliated *endoderm*, often derived from *micromeres*, surrounding partially or even completely a non-ciliated *ectoderm*, often derived from *macromeres*. It would seem, therefore, that at the present day only two views of the morphology and affinities of sponges are possible. On the one hand, they may be regarded as composed of the same two primary germ-layers as other Metazoa, inheriting these layers from an ancestor common both to them and to the Cœlentera, and pursuing the same course of development up to the end of the larval period. From the metamorphosis onwards, however, sponges go their own way, the ciliated *ectoderm* passing inwards to become the gastral layer or collared epithelium, while the *endoderm*, usually non-ciliated, passes out to become the dermal layer, *i.e.*, the contractile flat epithelium and the skeletogenous layer. This view, formerly put forward by Balfour, is now upheld by Maas and Delage, and is expressed by the name *Enantioderma* or *Enantiozoa* (ἐνάντιος, inside out), coined by the last-named for the phylum. On the other hand, the anomalies of sponge-development, coupled with the invariable presence in sponges of the peculiar collar-cells, have led many to separate them altogether from other Metazoa and to regard them as a group separately descended from the Protozoa, and in particular from the *Choanoflagellata*. On this hypothesis sponges must have acquired independently a mode of development by means of ova fertilized in the usual way, which segment and form an embryo with two germ-layers similar to, but not homologous with, the germ-layers of the Metazoa *sens. strict.* This view was put forward by Bütschli and Sollas, and was formerly supported by Delage; it is expressed by the term *Parazoa*, coined for sponges by Sollas, and signifying a group distinct from, but in many respects parallel to, the true Metazoa (see Lankester [11], pp. 1 and 158). To give a final decision between these two views is not possible in the present state of knowledge.

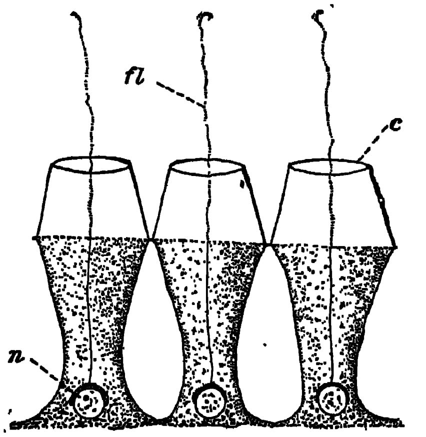

FIG. 2.—Three collar-cells of *Schaudinnia arctica* (Hexactinellid), after F. E. Schulze. *n*, nucleus; *fl*, flagellum; *c*, collar.

In many other fields our knowledge of sponges has received noteworthy extensions, to which only brief reference can here be made. The splendid monographs of Schulze [14, 15, 16] have made the Hexactinellids one of the best-known groups of sponges, save only as regards life-history and development, for the study of which their habitat in the abyssal depths of the ocean makes them inaccessible. Schulze [17] has also made known the minute structure of the collar-cells of Hexactinellids (Fig. 2), and has thus brought them completely into line with other forms of sponges. It is, however, amongst the *Calcarea* that the most striking discoveries have been made. A very important type of sponge has been found by Willey in the Western Pacific, and described by Lister [7] under the name of *Astrosclera willeyana;* another specimen of it has been found by Kirkpatrick [6] in a collection from Funafuti. *Astrosclera* (Fig. 3) has a calcareous skeleton, composed, however, of aragonite and not of calcite as in the true Calcarea. The skeleton takes the form of spherules, each

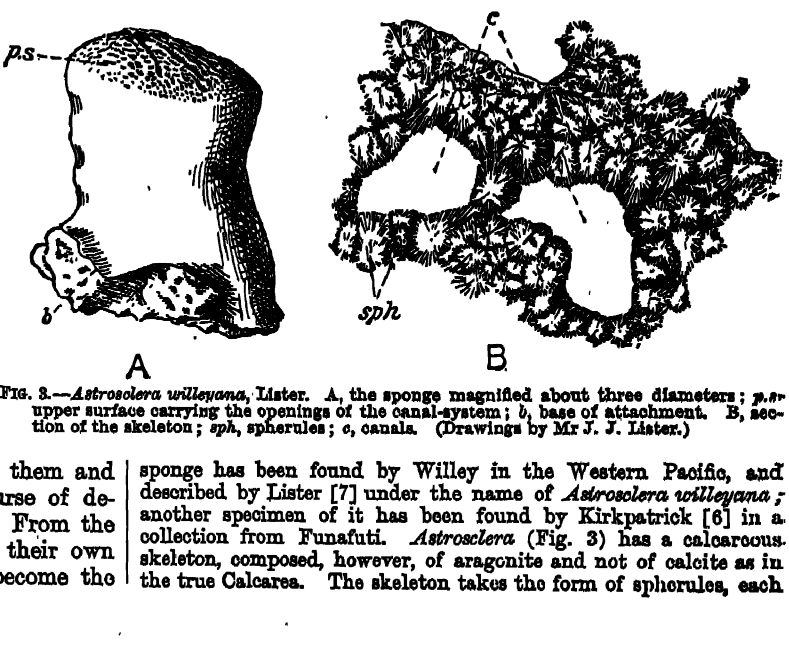

FIG. 3.—*Astrosclera willeyana*, Lister. A, the sponge magnified about three diameters; *p.s.* upper surface carrying the openings of the canal-system; *b*, base of attachment. B, section of the skeleton; *sph*, spherules; *c*, canals. (Drawings by Mr J. J. Lister.)

of which is secreted in a single cell, and grows until it fuses with other spherules to form a compact, rigid skeleton, traversed by channels and passages containing the soft tissues and canal-system. Another interesting calcareous sponge has been described by Döderlein [2] from Japan, under the name of *Petrostroma schulzei*. It represents a new sub-family of the *Pharetronidæ*, termed the *Lithonina*, in which the calcareous spicules forming the main skeleton of the body are fused together to form a rigid framework. Hinde [5] has described other species of genuine *Lithonina* from the Eocene of Australia, including a new genus *Plectroninia*, and Kirkpatrick [6] has discovered a species of *Plectroninia* amongst a collection of recent sponges from Funafuti. In other fields the researches of Minchin [12] upon the histology and spicule-formation of Ascons have shown the artificiality of Haeckel's system of the *Calcarea* and paved the way for a natural classification, while the investigations of Maas [10] upon the post-embryonic growth of Sycons have brought out clearly the important fact that the flat epithelium lining the gastral cavity and efferent canal-system is derived from the dermal layer, and not in any way by modification or flattening of the collared gastral layer, as formerly supposed on purely theoretical grounds. We also owe to this author the first accurate observations [9] upon the fertilization and maturation of the ovum, processes which are found not to differ essentially from those typical for other animals. In silicious sponges (*Demospongiæ*) the monograph by Topsent [18] upon the sponges of the coast of France will be of the greatest value in helping to clear up the confusion of nomenclature which has prevailed with regard to sponges of the British Fauna ever since the publication of Bowerbank's well-known monograph (Ray Society). In fossil forms Hinde [4] has described two remarkable extinct groups of silicious sponges which appear to be equivalent in systematic value to the *Hexactinellida* or *Demospongiæ*; the first, termed by him *Octactinellida*, has octactinal or 8-rayed megascleres (Fig. 4), and contains the Silurian and Devonian genus *Astræospongia*, Roemer; the second, termed *Heteractinellida*, has polyaxon megascleres, and contains two Carboniferous genera, *Tholiasterella* and *Asteractinella* (Fig. 5).

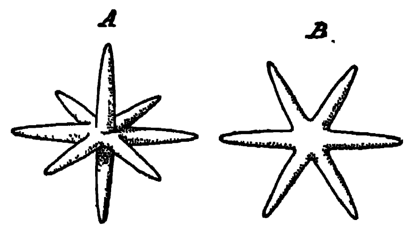

FIG. 4.—Spicules of *Astræospongia*. A, octactine; B, hexactine. (After Hinde.)

In the field of general morphology and histology, recent work has tended to discredit some generalizations or allegations formerly accepted. In the first place, it is becoming increasingly apparent that the term mesoderm cannot be applied with propriety to the skeletogenous parenchyma of sponges, and that they can no more be characterized as "Mesodermalia" than can the Alcyonarians. In the second place, the once much advertised nervous system of sponges has become in the course of years altogether discredited; and such drawings as Fig. 22 of the article SPONGES in the *Encyclopædia Britannica* (9th edition) are now considered inaccurate or incorrect in every detail.

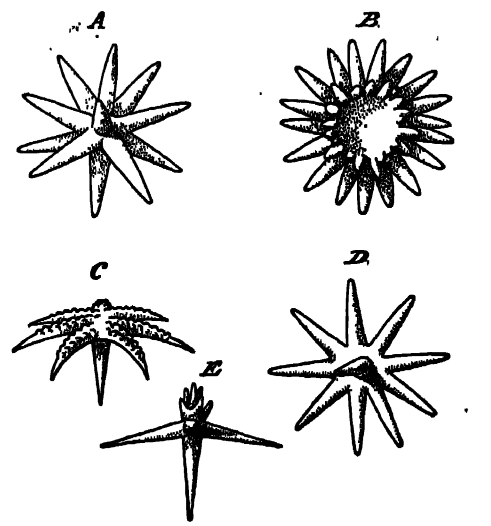

FIG. 5.—Spicules of Heteractinellida. A, typical polyactine; B, rosette-like form; C, D, E, nail-like forms, C and E in profile, D from below. (After Hinde.)

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Sponges in Commerce, Spongiculture.

Much has been done to describe and make known the various kinds of sponges suitable for commercial purposes in extra-European waters. Smith [4] has published a fully illustrated monograph of Florida sponges, and Whitelegge [5] enumerates the species of Australian sponges with serviceable qualities. A summary of accessions to our knowledge of sponges from the economic point of view will be found in Seurat [3].

Practical experiments in the cultivation of bath-sponges have been limited for the most part to attempts to propagate sponges by means of cuttings. A number of such trials have been made in Florida, and are summarized by Allen [1] and Whitelegge [5]. The results of these experiments were encouraging on the whole as regards the growth of the cuttings. The chief difficulty is that of attaching the sponge-cuttings to their support; and for the subsequent growth, the locality and position chosen for the cutting is all-important. Whitelegge points out that in nature the finest specimens are found on the underside of stones or rocky ledges, and suggests that an inverted position would probably be most favourable for rapid growth of the cuttings. Wilson [6] and other writers have suggested that sponges might be grown from the "spawn," that is to say, by rearing the larvæ in aquaria. There is little difficulty in getting sponge-larvæ to fix themselves in captivity and to undergo their metamorphosis into tiny sponges, differing from the parent only in size and sexual immaturity; but it appears to be almost impossible to get the young sponges to grow to any size, or even to increase in dimensions at all, under artificial conditions. It seems possible, however, that young sponges which have been reared in an aquarium might subsequently be placed in the sea, in situations favourable for their further growth. For this it would be necessary that the larvæ should be got to fix themselves upon some suitable object, which could afterwards be placed, with the little sponge attached to it, in a favourable locality. Detailed experiments upon this method of culture are needed. Even a question so simple, and yet so important, as that of the time required for a young sponge to grow under natural conditions to a marketable size, is as yet unanswered.

With regard to the regulations of sponge-fisheries, an important point to be determined is whether it is desirable that a close season should be instituted for sponges or not. A female sponge sends out at the proper season many thousands of larvæ, and it is clearly contrary to the interests of the sponge-fishery that the sponge should be destroyed before it has spawned. It would, therefore, be a great gain if the sponges could be protected until the spawning season is past. Observations are urgently needed in order to ascertain whether this is possible. The points upon which information is required may be illustrated by the present writer's experiences with regard to the simple calcareous sponges known as Ascons. In studying the development of this group, it was found that in the family *Clathrinidæ* all the females of any given species were ripe at about the same time, the interval between the earliest and the latest being not much more than a fortnight. Eggs could be recognized in the sponges about six weeks before the larvæ were emitted. In the family *Leucosoleniidæ*, however, it was found that each species spawned throughout the warmer months of the year, and that, at any time, one specimen might be found with eggs, another with larvæ, and a third empty. Clearly, therefore,

it would be possible by methodical observations to establish a close season for any species of *Clathrinidæ*, but not so for *Leucosoleniidæ*. If the various species of commercially valuable sponges were studied carefully from this point of view, it might be found possible to increase the numbers of some of the species, at least, by sagacious legislation. The sponges should be protected from the time when eggs are first recognizable in them, until the larvæ have been sent out. It should be the duty of a special commissioner in each locality to determine and report upon such points. There is much work of practical importance yet to be done by naturalists upon sponges.

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(E. A. M.)

Sporozoa.—The class of Sporozoa, notable both for the numerous forms included (nearly 600 species) and for its pathological importance, has in the last few years formed the subject of an enormous number of memoirs, which in many points have largely modified the old ideas held about these organisms. Even since the completion of the section Sporozoa in the *Tierreich*, which included a revision of the entire group up to the end of 1897, works have appeared which have completely changed our knowledge of the life-histories of these forms. Notable among these are the confirmation by Simond, Schaudinn, and Siedlecki of the old theory of R. and L. Pfeiffer on the dimorphism of the Coccidea; the discovery by Ross and Grassi of the alternation of generations in the malarial parasites (a metagenesis connected with the occurrence of intermediate hosts); finally, the discovery by Schaudinn and Siedlecki of a true fertilization in a certain number of Sporozoa, for which the present writer's announcement in 1896 of the sexual dimorphism of macrosporozoites and microsporozoites prepared the way. Nevertheless, despite these new discoveries, the division of all Sporozoa into Cytosporidia and Myxosporidia does not yet seem to have been justified; the names Neosporidia and Telosporidia, recently proposed by Mesnil and Schaudinn, are perhaps better, but lack priority. We shall therefore divide them into the sub-classes Cytosporidia and Myxosporidia, leaving unclassed all those forms which are still so little known as not to fall into either section.

I. CYTOSPORIDIA (Labbé).—Adult form generally permanent; usually uninucleate. There is an initial intracellular phase in most cases. The phase of growth always precedes the phase of sporulation. Sporulation results in a definite or indefinite number of archispores,[1] each of which gives rise to a spore or sporozoite. The spore has no polar capsule with evaginable filament. The sporozoite is not amœboid. There are four orders:—

1. *Gregarinida.*—The older works have well described the life-histories of Gregarines, and later research has altered but little the knowledge which we owe to Stein, Ray Lankester, Bütschli, A. Schneider, &c. A fairly detailed account of the order will be found in *Ency. Brit.*, vol. xix., under the heading of PROTOZOA. A few new points, however, are worthy of notice here.

As regards the intracellular stage of the young Gregarine, Léger and Dubosq (1899), in opposition to the received opinions, hold that the sporozoites penetrate between cells, and that the intracellular condition is an exception; the question cannot yet be considered as decided. We know that Gregarines, in addition to their power of association into pairs or chains, may also undergo a true copulation after encystation. Wolters (1891) noticed, in addition to typical mitoses, a nuclear copulation preceded by the expulsion of polar globules. Cuénot, Mrazek, Léger, and Dubosq have taken up the question, but their results are so different as to lead to the opinion that the phenomena vary in different species. (The same is held of Coccidiida.) As regards sporulation, the case of *Aggregata*, observed by Frenzel (1883) in Crustacea, has till now remained exceptional; in these Gregarines the archispores are transformed directly into sporozoites. Generally speaking, the archispores form spores with a double envelope containing eight, rarely four (*Polyrhabdina*), sporozoites. An intermediate case is furnished by *Porospora* of the Lobster, the spore of which is naked. Siedlecki (1900) in *Monocystis ascidiæ*, Léger (1901) in *Stylorhynchus*, Cuénot (1901) in *Monocystis*, observed the interesting fact of a copulation of archispores inside the cyst, but it is not possible as yet to generalize from this single instance. Another point of interest

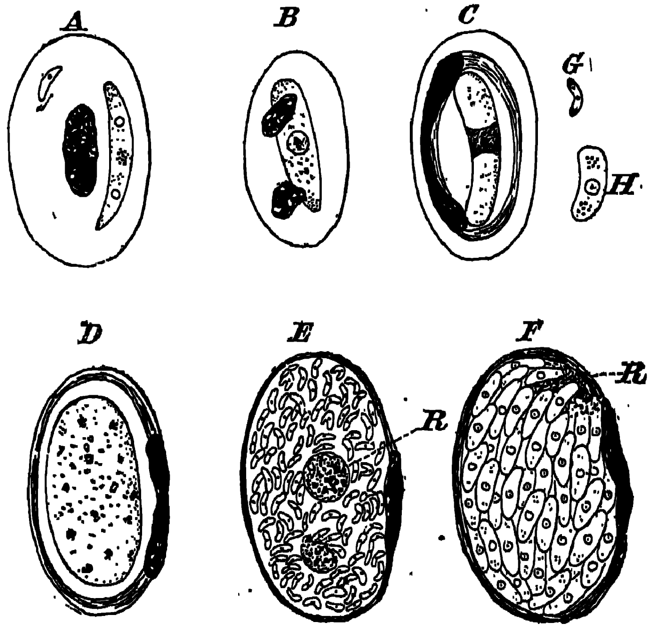


FIG. 1.—Hæmosporidia: A, two *Lankesterella* in the blood corpuscle of a frog; B–H, *Caryolysus*, from blood corpuscles of lizards; B, fragmentation of the nucleus of the corpuscle; C, commencement of encystation, the nucleus of the corpuscle has elongated, lying parallel to the parasite; round the latter is a fibrillar zone, produced by disintegration of the corpuscle; D, commencement of formation of sporozoites, the nucleus of the parasite proliferating, the corpuscle reduced to a mere sac; E, cyst with microsporozoites; F, cyst with macrosporozoites; G, an isolated microsporozoite; H, an isolated macrosporozoite; (R, residual core). (Original.)

is that of cœlomic cysts, already attacked by A. Schneider and Léger; how does the sporozoite penetrate from the alimentary canal into the cœlom to form cœlomic cysts? Again, is there an endogenous reproduction among Gregarines, resulting in self-infection, as is the case in other Sporozoa? Opinions are divided. Caullery and Mesnil, on a single inconclusive observation, believe in a direct reproduction of sporozoites in the epithelium. Cuénot saw intracellular stages in the cricket: the hypothesis of Léger and Dubosq, previously put forward by the present writer and Racovitza, of a direct passage of sporozoites across the epithelium, seems the most tenable.

The order of Gregarinida, containing nearly 70 genera and 200 species, splits quite easily into two sub-orders:—Cephalina, which always have an apparatus for fixation, the epimerite (genera *Porospora, Didymophies, Gregarina, Actinocephalus, Stylorhynchus,* &c.) and Acephalina, which lack an epimerite (genera *Monocystis, Pterospora, Urospora, Polyrhabdina,* &c.).

2. *Hæmosporidiida.*—A small group of minute forms, living in the blood corpuscles of Vertebrates, intermediate in character between Gregarines and Coccidians (Fig. 1). A small sporozoite penetrates into a blood corpuscle and there grows, assuming all the characters of a small acephaline Gregarine. At this stage it may become free in the serum, and even undergo conjugation. Sporulation occurs in a blood corpuscle where the animal encysts. Two

[1] In the present writer's nomenclature the archispore is the spore before formation of its characteristic investing case; the "sporozoite" corresponds to the falciform body; but while the term "falciform body" was applied originally to the asexual sporogonic form, sporozoite includes both these and the more recently discovered macrogametes and microgametes of the schizogonic cycle.

forms of cysts may be distinguished, those with macrosporozoites are very different from those with microsporozoites. The present writer has been unable to detect conjugation between these two forms of sporozoites. It appears probable that neither an alternation of generations, such as we know in other Sporozoa which live in blood corpuscles, nor a phase in an intermediate host, occur in these forms; it is more likely that infection occurs by the intestine directly.

These minute organisms are classed in three genera:—Lankesterella (Labbé), Caryolysus (Labbé), Hæmogregarina (Danilewsky), living in the blood of Reptilia and Batrachia. This group has been attacked by numerous authors, who place its members among the Gymnosporidiida; it is difficult to see on what grounds this is based, for both in form and life-history these organisms are very different from Gymnosporidiida. Some, such as Caryolysus in the blood of Lizards, are extremely interesting from their actions on the blood corpuscles in which they lodge: namely, the reduction and disappearance of the hæmoglobin, hypertrophy of the corpuscle, with a mechanical and chemical action on the nucleus which excites amitotic division. (Labbé, *Arch. zool. exp. gén.*, 1894.)

3. *Coccidiida.*—A group of extreme importance, owing to the diseases to which these parasites give origin; a group on which recent researches have thrown a vivid light, showing in the life-history two distinct cycles which former writers had distinguished as two specific forms (Fig. 2). These are as follows:—

A. Sporogonic cycle (*Dauersporen* of R. and L. Pfeiffer, *Cycle sporulé* of Simond, *Sporogonie* of Schaudinn). A sporozoite penetrates into an epithelial cell; it becomes rounded, and increases in size, secreting reserve granules (coccidine). It then invests itself with a resistent capsule (sometimes provided with a micropyle), breaks away from the epithelium, and falls into some cavity of the host's body. The protoplasm draws itself together within the capsule (oocyte of Léger and Schaudinn), the nucleus divides by mitosis or by chromatic fragmentation, resulting in the formation of archispores; each archispore is then directly transformed into a spore containing 1 to n sporozoites. A cystal residue may occur after formation of the archispores, a sporal residue after that of the sporozoites. Most often, the formation of spores is exogenous, that is to say, occurs outside the host in the fæces.

B. Schizogonic cycle. This cycle includes two phases:—(*a*) Intracellular divisions, which may occur in the intracellular stage, the Coccidian dividing several times. Although denied by some authors, this is a very general mode of reproduction in acute cases. (*b*) Schizogonic cycle proper (*Schwärmersporen* of R. and L. Pfeiffer, *Cycle asporale* of Simond, *Schizogonie* of Schaudinn). A sporozoite penetrates an epithelial cell, becomes rounded, grows, and is directly transformed into sporozoites. This is a case of absolutely endogenous sporulation, occasioning self-infection. The sporozoites thus

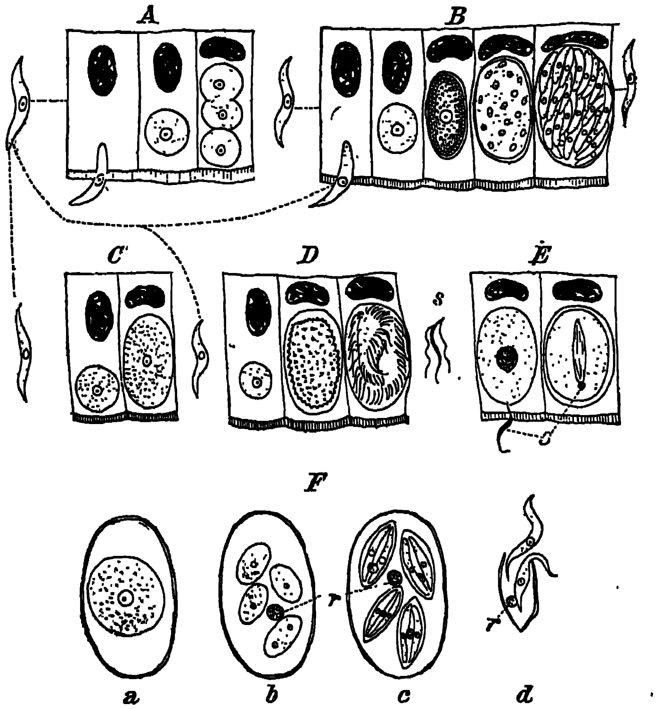


FIG. 2.—*Coccidium*: diagram of the life-history. A, intracellular divisions in an epithelial cell; B, formation of macrogametes; a sporozoite penetrates into a cell, becomes rounded and grows; granules of coccidine appear in it, the nucleus divides many times, and the protoplasm segments into macrogametes; C, formation of an oocyte at the expense of a macrogamete; D, formation of a microgamete (*s*, a free microgamete); E, fertilization of an oocyte from a macrogamete (*s*, microgamete); F, sporogonic cycle, resulting from the fertilization; *a*, cyst with concentrated protoplasm; *b*, division of the contents into four archispores; *c*, formation of sporozoites in the spores (*r*, residual core of the cyst); *d*, ruptured spore, showing two sporozoites, and *r*, residual core of the spore.

formed are of two kinds. In 1894, the present writer discovered that in this schizogonic phase (then considered as a separate specific form) there existed cysts with macrosporozoites and others with microsporozoites, and he (like Schuberg) propounded the theory of a sexual

The old classification of Coccidia does not seem to need much recasting in the light of recent research; it will suffice, therefore, to complete that which the present writer put forward in the *Tierreich* (1897–99).

Polyplastina: oocyte with an indefinite number of archispores	Monogenica or Asporea: oocyte gives direct origin to sporozoites					Eimeria (Schn.).
	Digenica or Polysporea: oocyte gives indirectly origin to sporozoites. The spores are	provided with filaments				Minchinia (Labbé).
		without filaments	spherical: with	more than 2 sporozoites		Klossia (Schn.).
				2 sporozoites		Adelea (Schn.).
			ovoid: with	1 sporozoite, which is	valved, Endosp. smooth	Barroussia (Schn.).
					valved, Endosp. villous	Echinospora (Léger).
					not valved	Diaspora (Léger).
				2 or 4 sporozoites		Hyaloklossia (Labbé).
Oligoplastina: oocyte with a definite number of archispores.	Tetrasporea, with 4 sporozoites	spore bi-pyramidal				Crystallospora (Labbé).
		spore ovoid, and	bivalve			Goussia (Labbé).
			non-bivalve			Coccidium (Lkt.).
	Disporea, with 2 spores	the sporozoites are	2			Cyclospora (Schn.).
			4			Diplospora (Labbé).
			n			Isospora (Schn.).

dimorphism and of a fertilization. Schaudinn and Siedlecki (1897–98) have the credit of having actually observed the fertilization of macrosporozoites by microsporozoites; these elements have therefore the value of macrogametes and microgametes. Wasiliewski and Léger have discovered locomotor cilia in the microsporozoites which give them a resemblance to zoospores. Fertilization has been seen in several cases. The microgamete may effect penetration, either before the formation of the capsule on the assumption by the macrogamete of the character of an oocyte (*Adelea ovata*), or after formation of the capsule (*Coccidium propium*).

The life-history of a typical Coccidian exhibits, therefore, a sporozoite which has come from a spore, and penetrates into a cell; it then, whether after or without intracellular division, is transformed into a microgamete or macrogamete (oocyte). Schizogony may, like the intracellular division which is one of its phases, occur several times in succession. This constitutes the ordinary type of life-history, but there exist numerous modifications of the scheme. In *Klossia Eberthi*, for example, both microgametes and spores are formed, but there is no schizogonic cycle, only a sporogonic. On the other hand, there exists a whole group of Coccidiida, the *Goussia* and *Coccidium* of fish, of which only the sporogonic cycle is known, the microgametes being perhaps represented by the old *Rhabdospora* (Laguesse). Finally, the old genus *Eimeria* (schizogonic cycle) has a real existence. There are therefore a certain number of obscure points in the general life-history of Coccidians, and it would be somewhat hazardous to draw too wide an inference from the development known in certain species. (See classification table on previous page.)

4. *Gymnosporidiida*.—This name was applied in 1894 by the present writer to a whole series of minute organisms then recently discovered, of extreme importance in zoology and pathology, inhabitants of the blood corpuscles of birds and mammals. They were first discovered by Danilewsky in birds; then by Laveran (1881) in human blood, where they cause marshy fevers or malaria; finally, the researches of Ross and Grassi indisputably demonstrated by experiment the occurrence of an alternation of generations, and opened new horizons to us. As with the Coccidians, we find in these parasites both schizogonic and sporogonic cycles, as well as a sexual reproduction; but the cycles which in Coccidians are passed in the same host, in this case are found in different hosts. We commence our study of the life-history with the most important of these organisms, the parasite of malaria, *Plasmodium malariæ* (Figs. 3, 4).

A. The schizogonic cycle, the only one known till recently, occurs in human blood, giving rise to malarial fever. After the discovery by Laveran of the forms presented by this parasite, the researches of Marchiafava, Celli, Golgi, Mannaberg, and Grassi have thoroughly determined the developmental phases as occurring in man. A small sporozoite, hardly $\frac{3}{1000}$ of a millimetre long, enters a human red blood corpuscle, grows, and becomes amœboid, charged with pigment (melanin), at the expense of the hæmoglobin of the corpuscle. It then becomes round, and without forming a cyst divides into a certain number of minute sporozoites.

Two other forms occur in malarial blood. The macrogametes (*formes en croissant* of Laveran) are found chiefly in malignant tertian and quotidian fevers, and the summer-autumn fever of Marchiafava; they are considered by Grassi the adult form of a special genus (*Laverania*). These macrogametes, at first intraglobular, are possibly conjugated forms (Mannaberg), and become afterwards free in the serum. The microgametes (*formes flagellées* of Laveran, *Polymitus* of Danilewsky) are not formed in circulating blood, a fact which gave rise to the old opinion of Grassi and Labbé, that they were forms of degeneration. As a matter of fact, the flagella of flagellate forms are filiform microgametes, very active and mobile, and rich in chromatin. Microgametes and macrogametes only meet in the intestine of the second host, the mosquito, where fertilization occurs. Successive schizogonic cycles may be produced in human blood, each sporulation resulting in an attack of fever.

B. Sporogonic cycle. The idea that mosquitos played a part in malarial fever is extremely ancient, but was first definitely formulated by Patrick Manson, who thought of the possibility of an intermediate host as the outcome of his beautiful researches on the migration of *Filaria sanguinis hominis*. Bignami and the present writer had only thought of the possibility of an inoculation by the puncture of the insect. Ronald Ross (1897–99) succeeded in discovering in mosquitos the stages of the sporogonic cycle, while Grassi elucidated and completed these researches,

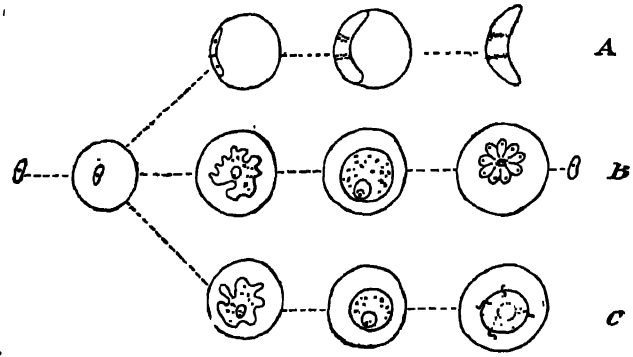


FIG. 3.—*Plasmodium malariæ*: schizogonic cycle, in blood corpuscles—A, formation of macrogametes (*corps en croissant*); B, formation of sporozoites (asexual cycle); C, formation of microgametes (flagellate bodies).

and at the same time discovered the actual intermediate host, *Anopheles*. Nowadays, owing to the conclusive experiments of Grassi, and although some points are still obscure, we know the sporogonic life-history of Anopheles. The insect when sucking the blood of malarial patients absorbs numerous parasites, but the macrogametes and microgametes are not digested. Fertilization of the macrogametes then occurs. Each macrogamete, possibly after a reduction of the chromatin, becomes an oocyte; this assumes a fusiform shape instead of a spherical, and, penetrating the wall of the intestine, surrounds itself with a membrane as the "Black spore" of Ross, and after growing forms an enormous number of archispores, each of which becomes a small falciform sporozoite. At this

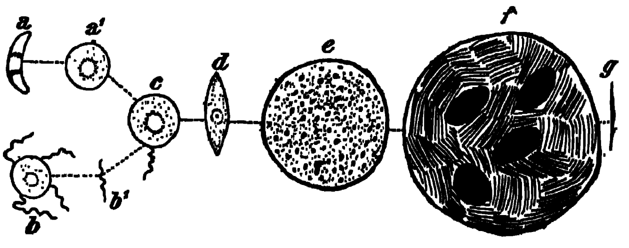


FIG. 4.—*Plasmodium malariæ*; sporogonic cycle in *Anopheles*: *a*, free macrogamete; *a'*, the same spherical; *b*, microgametocyst setting free a microgamete, *b'*; *c*, fertilization; *d*, the resulting cyst (ookinete); *e*, proliferation of nuclei in the cyst; *f*, cyst with thousands of sporozoites and with residual cores; *g*, isolated sporozoite.

stage the cyst breaks, and the sporozoites fall into the body cavity, whence they are carried by the circulation to cells of the salivary gland, where they remain till the mosquito, in biting, inoculates the man. To recapitulate, in *Plasmodium malariæ* there is an asexual schizogonic cycle in man, a sexual sporogonic cycle in *Anopheles*, and these form an alternation of generations as in Coccidiida, but one which occurs in different hosts. The question then arises, are there several species of parasites in malarial fever or only one with several varieties? Grassi

admits two different genera, *Plasmodium* and *Laverania*, with numerous species. Laveran formerly admitted but one polymorphic species; in former works, the present writer recognized two, possibly three, varieties of the same species:—

Var. *tertiana*, Golgi: inactive, slightly amœboid, with few sporozoites, with minute microgametes; apparently characteristic of tertian fever, developing (schizogonic cycle) in 48 hours.

Var. *quartana:* active, markedly amœboid, with numerous sporozoites and large microgametes; apparently characteristic of quartan fever, developing in 72 hours.

The quotidian form would seem to be the product of a complication of the two cycles. The malignant type would be the result of a variety *immaculatum*, and a variety *præcox*—Grassi and Feletti. The point is highly controversial, and can only be settled by a number of new observations.

Other Gymnosporidia are known besides the *malariæ*. In birds Labbé distinguished a genus *Proteosoma* (*Hæmoproteus*) almost comparable to *Pl. malariæ*, with an acute and often mortal infection in various birds; and a genus Halteridium, distinguished by the elongation of its body, with a separate sporulation at its two extremities (dumbbell-shaped), which determines a chronic infection in birds. The schizogonic cycle alone was known. Since then MacCallum, Opie, and Ross have demonstrated that mosquitos (*Culex pipiens*), in which a sporogonic cycle occurs, inoculate the birds. These genera are the only Gymnosporidia in which the life-history is well known; but many other similar forms have been detected. Kossel in African monkeys, Kolb in oxen of South Africa, Dionisi in bats (*Polychromophilus* and *Achromaticus*), Smith and others in Texas fever (*Piroplasma bigeminum*), Babes in hæmoglobinuria—cases of cattle in Rumania (*Babesia*)—have discovered parasites resembling Gymnosporidia. But our knowledge is too inadequate to permit of general conclusions.

II. Myxosporidia. — As contrasted with the Cytosporidia, these organisms are generally multinucleated, amœboid, free in organic cavities or encysted in organs (muscular and connective tissues, at times in epithelia); their phase of growth coincides with their phase of sporulation; the spore itself has polar capsules with evaginable filament, and contains the single amœboid sporozoite (Fig. 5). No case of copulation or of sexual reproduction has been

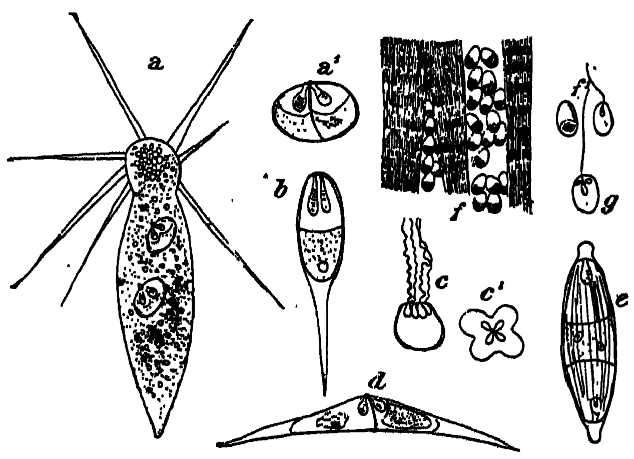


Fig. 5.—Myxosporidia: *a*, *Leptotheca agilis*, protoplasmic mass with two spores; *a'*, spore of the same, showing the two polar capsules, the line of dehiscence, of the valves, and the sporoplasm; *b*, spore of *Henneguyia psorospermica*; *c*, spore of *Chloromyxum quadratum* in profile, and *c'* from above; *d*, spore of *Ceratomyxa*; *e*, spore of *Myxidium Lieberkuehni*; *f*, muscle infected by a *Nosema*, parasite of *Apus cancriformis*; *f'*, spores of the latter, with a single polar capsule; *g*, spore of *Nosema bombycis*. (*a–e*, after Thélohan; *f*, *f'* original.)

observed. The older works of Balbiani, Bütschli, and Thélohan, and the more recent studies of Döflein and Cohn, have thrown light upon the group; it is separated systematically by many characters from the other Sporozoa, and should be contrasted with them as certainly having a different phylogenetic origin. The life-history is as follows:—a small mass of protoplasm, either parasitic in muscular and connective tissues, or free in some organic cavity, grows and becomes amœboid, exhibiting an ectosarc, with an endosarc full of nuclei. Unlike the Cytosporidia, this present group is generally multinucleate. The stage of growth is not distinct from the stage of sporulation; a nucleus is isolated and surrounded by a small quantity of protoplasm, and becomes a sporoblast which may give rise to two or to several spores. Each spore secretes one or more polar capsules with an evaginable filament and contains a little mass of protoplasm. The structure of the polar capsules in the spore is quite comparable to that of nematocysts in Cœlentera, and has been well worked out by Thélohan, whose researches marked a great advance in our knowledge. A process of endogenous reproduction exists in addition to the ordinary process of reproduction by spores.

Thélohan failed to obtain artificial infection and to discover the endogenous reproduction; as a matter of fact, the spores never hatch out in the host's body. Cohn and Döflein have discovered cases of plasmotomy, in which a kind of protoplasmic bud of ectosarc and endosarc containing some nuclei becomes detached; these little masses have but to grow in order to form the ordinary protoplasmic masses, and one may imagine that a rapid multiplication of the parasite within the host is the result of this unequal division. Cohn also observed reproduction by a kind of swarm spores, but Döflein and Mrazek think them not swarm spores, but accidental processes of degeneration.

We may follow Gurley in dividing Myxosporidia into two orders; (1) *Phænocystidia*, and (2) *Cryptocystidia* = *Microsporiidia*.

In the *Phænocystidia* the spore has 1 to 4 polar capsules always visible in the fresh state; these are the true Myxosporidia. Some of these, the Disporea, have a single pansporoblast, which then forms two spores; after the formation of the latter, no active nucleus remains in the residual core. In *Ceratomyxa* these spores have the shape of two hollow cones united at their bases; in *Leptotheca* they are oval or subspherical. The remainder, the Polysporea, have always more than two sporoblasts. They include three families: the Myxidiidæ (*Sphærospora, Myxidium, Myxosoma*, &c.), in which there is no iodophile vacuole, and the spore has two polar capsules; the Myxobolidæ (*Myxobolus, Henneguya*, &c.), which have an iodophile vacuole; and the Chloromyxidæ (*Chloromyxum*), the spore of which has four polar capsules. The *Microsporiidia* = *Cryptocystidia* are incompletely known, despite their wide occurrence in the Animal Kingdom. They have a single polar capsule in a minute spore rarely larger than 2 or 3 μ. They may have numerous (*Plistophora*), eight (*Thélohania*), or four (*Gurleya*) spores in each pansporoblast. These organisms are very common in Insects and in the lower Crustacea; they are also found in Batrachia, Reptiles, and Fish. The "Pebrine" of silkworms is due to *Nosema bombycis*; *Thélohania octospora* and *Th. Giardii* produce serious disease in Prawns and Shrimps; *Th. contejeani* is possibly the cause of a plague among Crayfish.

Sarcosporidia.—Our knowledge of *Sarcocystis*, found in the muscular and connective tissues of numerous Mammals, Birds, and Reptiles, has made but little progress. The initial stage is always in a muscle-cell; the organism forms an elongated tube, often surrounded by a double membrane, the outer part of which is formed by apposed rods; the interior of the cyst becomes divided into a series of chambers, in which are formed reniform or falciform sporozoites. Researches have shown that, along with this mode of development, there exist true spores, with evaginable filament but without polar capsule, each a little mononucleate mass of protoplasm. This fact approximates Sarcosporidia to Myxosporidia, from which, however, they differ in numerous other characters. The question of an intermediate host and alternation of generations has not been settled.

By the side of these larger groups we find among Sporozoa a considerable number of forms which cannot at the moment be relegated to any of them. The Amœbosporidia (Schneider, Léger) are multinucleate and amœboid; they reproduce by division and sporulation after isogamic conjugation, and form a single spore with 8 sporozoites. They are parasites of Insects (*Ophryocystis*, in

Blaps and *Acis*). The SERUMSPORIDIA (L. Pfeiffer and others) in lower Crustacea are still less known; the APLOSPORIDIA (Caullery and Mesnil), such as *Bertramia*, *Aplosporidium*, &c., are, like Microsporidia, without polar capsule. There are also numerous genera not yet classed at all: *Botellus*, *Cœlosporidium*, *Toxosporidium*, *Metschnikovella*, but little understood; it is also possible that the *Amœbidium* of Cienkowsky, in which endoparasitic forms have been described, belongs to them; as also *Siedleckia* (Mesnil), a parasite of *Amœbæ*, a very interesting form, a possible link between Gregarines and Mesozoa.

Besides the older works of Balbiani, Bütschli, Celli et San Felice, Danilewsky, Golgi, Grassi et Felitti, Laveran, Marchiafava, Ray Lankester, Rivolta, Aimé Schneider, Stein, &c., the student should consult the following:—BERTRAM. *Zool. Jahrb. Anat.*, v., 1892.—B. DANILEWSKY. *Parasitologie comparée du sang: I. et II.* Charkof, 1889.—B. GRASSI. "Studi di una zoologo sulla malaria," *R. Acc. Lincei*, ccxcvi., 214 pp., 4 Pl., 1900.—H. HAGENMÜLLER. "Bibliotheca sporozoologica," *Ann. Mus. Hist. nat. Marseille*, i., 232 pp., 1899.—A. LABBÉ. "Recherches zoologiques et biologiques sur les parasites endoglobulairs du sang des Vertébrès" (*Arch. Zool. Exp.*, ser. 3, ii., 56–258, Pl. 1–10, 1894). "Recherches zoologiques, cytologiques et biologiques sur les Coccidies" (*Arch. Zool. Exp.*, ser. 3, iv., 517–654, Pl. 12–18, 1896. "Sporozoa" (*Tierreich*, 5e livr., 180 pp., 196 fig., 1899).—A. LAVERAN. *L'Hématozoaire du paludisme.* Paris, 1891; and numerous notes by the same author in C. R. Soc. Biol., Paris, 1890–1901, and in the Bulletin Ac. Med. Paris, 1880–1901.—L. LÉGER. "Recherches sur les Grégarines" (*Tabl. Zool.*, iii., 1892), and numerous notes by the same author in C. R. Ac. Sci., 1892–1901, et C. R. Soc. Biol., 1892–1901.—M. LÜHE. "Ergebnisse der neueren Sporozoenforschung" (*Centralbl. Bakter.*, xxvii., 367 and 436, 1900).—MANNABERG. *Die Malaria-Parasiten.* Vienna, 1893.—P. MINGAZZINI. "Contributo alla conoscenza degli Sporozoi" (*Mem. Lab. Anat. Roma*, 31–85, 3 Pl., 1894).—G. H. F. NUTTALL. "Die Mosquito-Malaria Theorie" (*Centralbl. Bakt.*, xxv., 161–170, 209–216, 245–247, 285–296, 337–346, 1899).—L. PFEIFFER. *Protozoen als Krankheitserreger.* Jena, 1891, et Supplem. 1895.—R. PFEIFFER. *Beiträg. zur Protozoenforschung—Die Coccidien-Krankheit der Kaninchen.* Berlin, 8vo, 1892.—R. ROSS. *Brit. Med. Journ.*, 1899 and 1900.—F. SCHAUDINN. "Ueber den Generationswechsel der Coccidien und die neuere Malariaforschung" (*Zool. Jahrb. Anat.*, xiii., 197–293, 3 Pl., 1900).—SCHUBERG. "Ueber Coccidien des Mäusedarmes" (*S. B. Ges. Würzburg*, 1892).—SIEDLECKI. *Ann. Inst. Pasteur*, 1898–1900.—L. SIMOND. *C. R. soc. Biol. et Ann. Inst. Pasteur*, 1897–98.—P. THÉLOHAN. "Recherches sur les Myxosporidies" (*Bull. scient. Fr. Belgique*, xxvi., 100–395, 3 Pl., 1895).—WASIELEWSKY. *Sporozoenkunde.* Jena, 8vo, 1896.—M. WOLTERS. "Die Conjugation und Sporenbildung bei Gregarinen" (*Arch. mikr. Anat.*, 99–139, Pl. v.–viii., 1892).

It is enough to mention here the pathological intracellular productions which have been noticed in a large number of human and animal diseases, and have been assigned to Sporozoa. Many writers have observed and studied these formations in cases of epithelioma, sarcoma, herpes zoster, cow-pox, smallpox, Oriental sore, &c. We have at present no certain indication whether we are to regard these as organisms in the nature of Sporozoa, or rather, as some hold, to consider them as special cases of cell-degeneration having nothing to do with parasitism. (A. L*.)

Spottsylvania, capital of Spottsylvania county, Virginia, U.S.A., situated about 50 miles north of Richmond. It was the scene in May 1864 of one of the longest and hardest fought battles of the Civil War. Early in May, General Grant, with the army of the Potomac, advanced against the Confederates under General Lee in Northern Virginia. A series of bloody battles ensued, beginning with those of the Wilderness, in which neither side was really victorious, though the Union forces constantly gained ground. Grant then made a flanking movement towards Spottsylvania Court House, 15 miles to the south-east, where fighting continued for ten days, with no decisive results, but with heavy loss on both sides. The Union losses were estimated at over 10,000 in killed and wounded; the Confederate loss was much less, since they were fighting on the defensive, and on familiar ground.

Spree, a river of Prussia, rising in the district of Upper Lusatia, in the kingdom of Saxony, close to the Bohemian frontier, and flowing nearly due N., past Bautzen, Spremberg, and Kottbus, dividing between the first two towns for a time into two arms. Below Kottbus the river splits into a network of channels, and swings round in a big curve to the W., forming the peculiar marshy region (30 miles long and 3 to 6 miles wide) known as the Spreewald. Having returned to its predominant direction, it turns W.N.W., and passing Fürstenwalde and Köpenick threads Berlin in several arms, and joins the Havel at Spandau. Its length is 227 miles, of which 112 are navigable; the area of its drainage basin is 3660 square miles. It is connected with the Oder by the Frederick-William or Müllrose Canal (made in 1862–68, 17 miles long), and by the Oder-Spree Canal (made in 1887–88), and with the Havel by the Berlin-Spandau Navigation Canal (5½ miles long).

Spreewald, a marshy depression of the middle Spree, in the province of Brandenburg, Prussia, extending to some 106 square miles, its length being 27 miles and its width varying from 1 to 7 miles. It owes its marshy character to the river Spree, which above Lübben splits into a network of over two hundred arms, and in seasons of flood generally overflows considerable portions of the region. In the parts which are especially liable to inundation, as, for example, the villages of Lehde, Leipe, and Burg, many of the homesteads are built each on a little self-contained island, approachable in summer only by boat, and in winter over the ice. In spite of its marshy character the Spreewald is in part cultivated, in part converted into pasturage, and almost everywhere, but more especially in the lower districts, wooded in a park-like way, the predominant trees being willows. Fishing, cattle-breeding, and the growing of vegetables, more particularly small pickling cucumbers, are the chief occupations of the people, about 30,000 in all. In great part they are of Wendish blood, and though the majority have been Germanized, there is a small residue who have faithfully preserved their national speech, customs, and their own peculiar styles of dress. The attractive blending of wood and water makes the Spreewald in summer a resort of the people of the Prussian capital, which is only from 50 to 70 miles distant. The chief town is Lübben (47 miles south-east of Potsdam).

Springfield, a city of Illinois, U.S.A., capital of Sangamon county and of the state. It is situated near the river Sangamon in the central part of the state, at an altitude of 582 feet. It is regularly laid out on a level site, is divided into seven wards, has good water supply and sewerage systems, and is well paved with brick and wooden blocks. Springfield is one of the most important railway centres in the Mississippi Valley; it is entered by the Baltimore and Ohio South-Western, the Chicago and Alton, the Chicago, Peoria and St Louis, the Illinois Central, and the Wabash. Its manufactures are not of importance commensurate with its railway facilities. In 1900 there were 320 manufacturing establishments, with a total capital of $5,030,438. They employed 3871 hands, and the product had a value of $6,612,286. In 1900 the assessed valuation of real and personal property was $5,594,097, a very low valuation; the net debt of the city was $1,026,924, and the rate of taxation was $76·92 per $1000. Population (1890), 24,963; (1900), 34,159, of whom 4654 were foreign-born and 2227 negroes.

Springfield, a city of Massachusetts, U.S.A., capital of Hampden county, situated in 42° 06′ N. and 72° 35′ W., on the river Connecticut, in the southern part of the state, at an altitude of 70 feet. It is rather irregularly laid out on a level plain with broad streets.

It has three railways—the Boston and Albany; the New York, New Haven, and Hartford; and the Boston and Maine, which join in a fine new Union Depôt. Springfield is a manufacturing town of great prominence. In 1900 it contained 817 establishments, with a total capital of $17,105,947. They employed 10,123 hands, and their product was valued at $21,207,039. The principal of the varied products were envelopes, $659,445; paper goods, $1,164,985; foundry and machine-shop products, $1,482,742; firearms, cotton goods, steam railway cars, and sewing-machines. In 1900 the assessed valuation of real and personal property was $72,358,481, the net debt was $2,181,204, and the rate of taxation was $13·80 per $1000. Population (1890), 44,179; (1900), 62,059, showing a rapid and substantial growth. Of the population in 1900, 14,381 were foreign-born and 1021 negroes.

Springfield, a city of Missouri, U.S.A., capital of Greene county, situated in 37° 14′ N., and 93° 17′ W., on a high prairie in the south-western part of the state, at the intersection of the Kansas City, Fort Scott and Memphis, and the St Louis and San Francisco railways, at an altitude of 1350 feet. It is regularly laid out on an undulating site, and is divided into eight wards. It has good water supply and sewerage systems, and its business streets are paved with brick. In 1900 it contained 245 manufacturing establishments, with a total capital of $2,111,048. They employed 2127 hands, and their products had a value of $4,126,871. The principal of these establishments were flour mills, the product of which had a value of $985,398. The assessed valuation of real and personal property was in 1898 $8,202,546, the net debt was only $128,477, and the rate of taxation was $23·00 per $1000. Springfield is the site of Drury College, a Congregational institution, opened in 1873, which had in 1899 a faculty of 18, and was attended by 325 students. Population (1890), 21,850; (1900), 23,267, of whom 1057 were foreign-born and 2268 negroes.

Springfield, a city of Ohio, U.S.A., capital of Clark county, situated in 39° 54′ N., and 83° 46′ W., on the river Mad, south-west of the centre of the state, at an altitude of 988 feet. The city is well laid out, is divided into six wards, has good water supply and sewerage systems, and is well paved, mainly with brick. It is an important railway centre, being at the intersection of four railways—the Cleveland, Cincinnati, Chicago and St Louis, the Erie, the Ohio Southern, and the Pittsburg, Cincinnati, Chicago and St Louis. Its manufactures are extensive. In 1900 there were 305 establishments, with a total capital of $14,091,175; they employed 6638 hands, and their products had a value of $12,777,173, of which $5,272,636, or nearly half, was agricultural implements. Foundry and machine-shop products had a value of $3,097,910. The assessed valuation of real and personal property was in 1900 $17,894,095, the net debt of the city was $926,186, and the rate of taxation was $23·10 per $1000. Population (1890), 31,895, of which only 3735 were of foreign birth; (1900), 38,253, of whom 3311 were foreign-born and 4253 negroes.

Springfontein. See Orange River Colony.

Spring Valley, a city of Bureau county, Illinois, U.S.A., in the northern part of the state, at the intersection of three railways, in a coal mining region. Population (1890), 3837; (1900), 6214, of whom 2845 were foreign-born.

Spurgeon, Charles Haddon (1834–1892), English Baptist preacher, born at Kelvedon, Essex, on 19th June 1834, was the grandson of an Essex pastor, and son of John Spurgeon, Independent minister at Upper Street, Islington. He became usher at a school in Newmarket, and joined the Baptist communion in 1851. His work at once attested his "conversion"; he began distributing tracts and visiting the poor; joined the lay preachers' association, and gave his first sermon at Teversham, near Cambridge. In 1852 he became pastor of Waterbeach. He was strongly urged to enter Stepney (now Regent's Park) College to prepare more fully for the ministry, but an appointment with Dr Angus, the tutor, having accidentally fallen through, Spurgeon interpreted the *contretemps* as a Divine warning against a college career. The lack of early systematic theological training certainly had a momentous effect upon his development. Broad in every other respect, he retained to the last the narrow Calvinism of the early 19th century. His powers as a boy preacher became widely known, and at the close of 1853 he was "called" to New Park Street Chapel, Southwark. In a very few months' time the chapel was full to overflowing. Exeter Hall was used while a new chapel was being erected, but Exeter Hall could not contain Spurgeon's hearers. The enlarged chapel at once proved too small for the crowds, and a huge Tabernacle was projected in Newington Causeway. The preacher had recourse to the Surrey Gardens Music Hall, where his congregation numbered from seven to ten thousand. At twenty-two he was the most popular preacher of his day. The Metropolitan Tabernacle, with a platform for the preacher and accommodation for 6000 persons, was opened for service on 25th March 1861. The cost was over £30,000, and the debt was entirely paid off at the close of the opening services, which lasted over a month. Spurgeon preached habitually at the Tabernacle on Sundays and Thursdays. He frequently spoke for nearly an hour, and invariably from heads and subheads jotted down upon half a sheet of letter paper. His Sunday sermons were taken down in shorthand, corrected by him on Monday, and sold by his publishers, Messrs Passmore and Alabaster, literally by tons. Clear and forcible in style and arrangement, they are models of Puritan exposition and of appeal through the emotions to the individual conscience, illuminated by frequent flashes of spontaneous and often highly unconventional humour. In his method of employing illustration he is suggestive of Thomas Adams, Fuller, Baxter, Thomas Manton, and Bunyan. Like them, too, he excelled in his vigorous command of the vernacular. Among more recent preachers he had most affinity with Whitefield, Richard Cecil, and Joseph Irons. Collected as *The Tabernacle Pulpit*, the sermons form nearly fifty volumes. Spurgeon's Lectures, Aphorisms, Talks, and "Saplings for Sermons" were similarly stenographed, corrected, and circulated. He also edited a monthly magazine, *The Sword and Trowel*, an elaborate exposition of the Psalms in seven volumes, called *The Treasury of David* (1870–85), and a book of sayings called *John Ploughman's Talks; or, Plain Advice for Plain People* (1869), a kind of religious *Poor Richard*. In the summer of 1864 a sermon which he preached and printed on *Baptismal Regeneration* (a doctrine which he strenuously repudiated, maintaining that immersion was only an outward and visible sign of the inward conversion) led to a difference with the bulk of the Evangelical party both Nonconformist and Anglican. Spurgeon maintained his ground, but in 1865 he withdrew from the Evangelical Alliance. Subsequently in 1887 his distrust of modern Biblical criticism led to his withdrawing from the Baptist Union. His powers of organization were strongly

exhibited in the Pastors' College, the Orphanage (at Stockwell), the Tabernacle Almshouses, the Colportage Association for selling religious books, and the gratuitous book fund which grew up under his care. He died at Mentone on 31st January 1892 (and was buried at Norwood Cemetery), leaving a widow with two sons, both preachers, one of whom, Thomas, succeeded him at the Tabernacle. An *Autobiography*, compiled by his widow and his private secretary from his diary, sermons, records, and letters, was published in 4 vols., 1897–1900.

(T. SE.)

Spy (MILITARY).—Halleck says: "Spies are persons who, in disguise, or under false pretences, insinuate themselves among the enemy in order to discover the state of his affairs, to pry into his designs, and then to communicate to their employer the information thus obtained." According to this definition, an officer or soldier of the British army who should give "aid and comfort" to the King's enemies could not be included in the category of spies. He is guilty of high treason, and is dealt with accordingly. It was ruled by the Brussels Conference, 1874, Art. 22, that "military men who have penetrated within the zone of operations of the enemy's army, in order to collect information, are not considered as spies, if it has been possible to recognize their military character." As Halleck points out, "it is the disguise, or false pretence, which constitutes the perfidy and forms the essential of the crime." It was perhaps superfluous of the Brussels Conference to rule that "a spy, if taken in the act, shall be tried and treated according to the laws in force in the army which captures him" (Art. 20). The practice of courts-martial in sentencing spies is almost invariably founded upon the simple principle of Appian, quoted by Grotius: "It is usual to kill them." "Spies are generally condemned to capital punishment, and with great justice," says Vattel.

Srinagar (=city of the sun), capital of the native state of Kashmir, in Northern India, 5263 feet above the sea, on both banks of the river Jhelum, which is crossed by seven wooden bridges. Area, 3795 acres. Population (1891), 139,410, of whom 118,960 lived in the city proper; (1901), 122,536. The city is exposed to both fire and flood. In 1891 six of the seven bridges were swept away. A regular water-supply has been provided. The artizans of Srinagar enjoy a high reputation. Unfortunately the historic industry of shawl-weaving is now practically extinct. The loss of the French market after the war of 1870 was followed by the famine of 1877–79, which drove many of the weavers into the Punjab, and the survivors have taken to the manufacture of carpets. In 1893–94, the export of shawls was valued at only Rs.22,850: other industries are paper, leather, papier-mâché, silver and copper ware, wood-carving, and boat-making. The three chief routes of communication with India are: (1) along the Jhelum valley to Murree and Rawalpindi, which has been opened throughout for wheeled traffic (195 miles); (2) over the Banihal pass (9200 feet above the sea) to Jammu (163 miles); (3) over the Pir Panjal pass (11,400 feet) to Gujrat (180 miles).

See WALTER R. LAWRENCE. *The Valley of Kashmir.* London, 1895.—M. A. STEIN. *Chronicle of the Kings of Kashmir.* London, 1900.

Sryetensk, or STRYETENSK, a Cossack village of Asiatic Russia, in the province of Transbaikalia, 245 miles by rail east of Tchita, and a terminus of the Trans-Siberian Railway. It was at one time intended to be a passing station on the way to Vladivostok, but this last city is now connected with the Trans-Siberian line at Kaidalovo, 230 miles west of Sryetensk. It is situated in a very picturesque valley, enclosed between high mountains, on both banks of the river Shilka, and its population, which was only a few hundred persons a few years ago, has now reached 8000, and is swollen to over 10,000 during the navigation season. It has two schools, a Cossack hospital, large storehouses belonging to the Crown, a steam flour-mill, and soap works. Its trade is valued at 7,000,000 roubles annually.

Stafford, a parish, municipal, and parliamentary borough, market town, and county town in the western division of Staffordshire, England, on the Sow, 133 miles north-west of London by rail. Modern erections are the county council offices and the county technical institution. The brine baths have been enlarged. A theatre and several new blocks of buildings have been added to the Coton Hill institution for the insane. There are iron-works and works for the preparation of salt from brine wells in the neighbourhood. The parliamentary borough was extended in 1885, and is now coextensive with the municipal borough. Area, 1084 acres. Population (1881), 19,977; (1901), 20,894.

Staffordshire, a west midland county of England, bounded on the S. by Worcester, on the S.E. by Warwick, on the N.E. by Derby, on the N.W. by Cheshire, and on the W. by Shropshire.

Area and Population.—The area of the ancient county is 749,601 acres, or 1171 square miles, with a population in 1881 of 981,009; in 1891 of 1,083,408, of whom 540,693 were males and 542,715 females; and in 1901 of 1,234,382, the number of persons per square mile being 1054, and of acres to a person 0·60. The area of the administrative county as given in the census returns is 731,089 acres, with a population in 1891 of 818,290, or, including the four county boroughs, 749,713 acres, with a population of 1,087,161. Since 1891 certain changes have been made in the administrative area; in 1895 the part of the parish of Sheriff Hales in Stafford was transferred to Shropshire, and the parish of Upper Anley was transferred to Worcester, and to Stafford were transferred the part of the parish of Drayton Bassett in Warwick, the part of the parish of Croxall in Derby, and the part of the parish of Babbington in Shropshire; and in 1897 part of the urban district of Smethwick in Stafford was transferred to the county borough of West Bromwich in Stafford. The area of the registration county is 767,102 acres, with a population in 1891 of 1,103,452, of whom 870,660 were urban and 232,792 rural; and in 1901 of 1,251,888, of whom 622,318 were males and 629,570 females. Within the registration area the increase of population between 1881 and 1891 was 9·60 per cent. The excess of births over deaths between 1881 and 1891 was 176,201, and the increase of population was 96,685.

The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Male.	Females.
1880	7,592	38,198	20,686	930	970
1890	9,202	37,371	22,293	819	852
1898	10,185	41,663	23,399	906	856

The number of marriages in 1899 was 10,472, of births 41,715, and of deaths 23,289. The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years:—

	1870–79.	1880.	1880–89.	1890.	1888–97.	1898.
Marriage-rate	17·2	15·2	15·1	16·8	16·1	17·3
Birth-rate	41·7	38·2	36·8	34·6	35·1	35·3
Death-rate	22·8	20·7	19·7	20·3	19·7	19·8
Percentage of illegitimate births	5·0	4·8	4·9	4·4	4·4	4·2

Both birth- and death-rates are high. In 1891 the number of Scots in the county was 3357, of Irish 9712, and of foreigners 1564.

Constitution and Government.—The parliamentary and judicial arrangements are stated in the earlier article on the county. There are fourteen municipal boroughs: Burslem (38,766), Burton-

on-Trent (50,386), Hanley (61,524), Lichfield (7902), Longton (35,825), Newcastle-under-Lyme (19,914), Smethwick (54,560), Stafford (20,894), Stoke-upon-Trent (30,456), Tamworth (7271), Walsall (86,440), Wednesbury (26,544), West Bromwich (65,172), and Wolverhampton (94,179). Hanley, Walsall, West Bromwich, and Wolverhampton are county boroughs. The following are urban districts: Amblecote (3128), Audley (13,679), Biddulph (6247), Bilston (24,034), Brierley Hill (12,040), Brownhills (15,252), Cannock (23,992), Coseley (22,218), Darlaston (15,391), Fenton (22,742), Handsworth (52,921), Heath Town (9441), Kidsgrove (4551), Leek (15,484), Perry Barr (2348), Quarry Bank (6912), Rowley Regis (34,669), Rugeley (4447), Sedgley (15,951), Short Heath (3531), Smallthorne (6263), Stone (5680), Tettenhall (5337), Tipton (30,543), Tunstall (19,492), Uttoxeter (5133), Wedensfield (4883), and Willenhall (18,513).

The ancient county, which is chiefly in the diocese of Lichfield, contains 320 entire ecclesiastical parishes or districts and parts of 17 others.

Education.—At Stoke-on-Trent is the North Staffordshire joint boards blind and deaf school. The total number of elementary schools in the county on 31st August 1899 was 628, of which 191 were board and 437 voluntary schools, the latter including 349 National Church of England schools, 24 Wesleyan, 52 Roman Catholic, and 12 British and others. The average attendance at board schools was 100,377, and at voluntary schools 99,159. The total school board receipts for the year ended 29th September 1899 were £420,300. The income under the Technical Instruction Act was over £972; that under the Agricultural Rates Act was over £2804.

Agriculture.—More than three-fourths of the total area of the county is under cultivation, and of this more than two-thirds is in permanent pasture, cattle being largely kept, and especially cows for the supply of milk to the towns. About 1200 acres are under orchards, and about 39,000 acres under wood. The acreage under corn crops is steadily diminishing, and wheat, which formerly was the principal corn crop, is now superseded in this respect by oats, which now occupies nearly one-half of the corn acreage, considerably more than one-third being under wheat, and more than one-fifth under barley. Turnips are grown on about half the acreage under green crops, and potatoes on only about one-fourth. The following table gives the larger main divisions of the cultivated area at intervals from 1885:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	604,757	95,683	44,211	48,740	409,047	7074
1890	606,404	90,850	42,174	49,400	419,081	4749
1895	604,067	83,333	41,241	49,145	427,349	2635
1900	596,836	80,620	39,270	45,509	429,921	1716

The following table gives particulars regarding the principal live-stock for the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1885	23,630	157,099	74,485	258,509	52,300
1890	23,735	151,222	73,166	274,698	59,471
1895	28,357	152,896	75,066	246,905	61,720
1900	27,729	164,058	79,185	236,351	50,533

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 212,274, as compared with 205,969 in 1896. Of these 5211 were employed in textile factories, cotton industries employing 2317, and silk 2823. Non-textile factories employed 183,918 persons, there being an increase between 1895 and 1896 of 5·0 per cent., and between 1896 and 1897 of 3·9. As many as 46,145 were employed in the manufacture of machines, appliances, conveyances, and tools, &c., into the list of which bicycles especially have of late been introduced; the total number employed in the founding and conversion of metal was 35,869; in the clay and stone industries (potteries, &c.) 50,613 were engaged, and the drink industries (chiefly ale at Burton-on-Trent) employed 5954 persons, furniture making 6782, clothing industries 7497, the galvanizing and finishing of metals 2962, the extraction of metals 2315, glass manufacture 2920, manufacture of paper 3081, and the manufacture of chemicals 2087. The total number employed in workshops was 23,145, there being an increase between 1895 and 1896 of 9·4 per cent., and a decrease between 1896 and 1897 of 0·0 per cent., or 8 persons in all. As many as 10,015 were employed in the manufacture of machines, &c., 5264 in clothing industries, 1309 in food industries, and 1122 in furniture making. The total number of persons employed in connexion with mines and quarries in 1899 was 48,162. The same year 1,790,480 tons of clay were raised, 313,731 tons of limestone, 165,529 tons of igneous rocks, and 64,057 tons of sandstone. A considerable quantity of salt is produced from brines, but the returns are now bracketed with those of Cheshire. In 1885 the pig iron made amounted to 545,365 tons, in 1890 to 545,425 tons, in 1895 to 459,058 tons, and in 1899 to 621,495 tons. The following table gives particulars in reference to fireclay, coal, iron ore, and gypsum for the years stated:—

Year.	Fireclay.		Coal.		Iron.		Gypsum.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	211,750	£55,842	13,773,629	£5,128,006	1,224,510	£434,737	20,583	£8,500
1899	249,008	£67,880	13,881,220	£4,787,013	1,069,758	£356,776	48,998	£18,000

The gypsum production is next to that of Nottingham, which however is nearly double.

Authorities.—Langford. *Staffordshire and Warwickshire*, 4 vols. London, 1884.—Poole. *Customs and Legends of the County of Stafford.* London, 1886.—Sims. *Bibliotheca Staffordiensis.* Lichfield, 1894.—Dent. *Historic Staffordshire.* Birmingham, 1896.—See also the *Collections* of the William Salt Archæological Society.

Stage Mechanism and Spectacle.—

A movement known as "Stage Reform" originated in Austria about 1880, with the primary object of encouraging the greatest possible imitation of nature in the presentation of opera and drama. **Stage reform.** The rudiments of art as understood by painters, sculptors, architects, and the cultured public of the day were to be applied to the stage, and a true scenic art was to take the place of the nondescript mounting previously given. To facilitate the efforts of the scenic artist, the fullest application of modern science, notably of mechanics and hydraulics, and the introduction of up-to-date methods of lighting were considered essential. The numerous fatal conflagrations which had originated on the stage caused the question of protection from fire to be closely associated with this movement, and the enterprise made great headway, more particularly on account of the protective measures against fire proposed soon after the burning of the great Court Theatre at Vienna. The movement gradually developed throughout Austria and Germany and spread beyond the frontiers of these countries. Concurrently, independent movements originated elsewhere, and from 1885 to 1895 a transitional period may be said to have existed for the stage, both in Europe and in the United States, but by the close of the 19th century the necessity for reform was recognized in every country. During the transitional time various unsatisfactory experiments were made, some of the boldest experiments proving costly failures, yet serving, because of such features as were valuable, as a basis for further developments. England and France were almost the last countries touched by this movement, although in England throughout the 'nineties there was considerable improvement in actual scenic art and stage-mounting, as far as this could be brought about without the aid of improved stage mechanism.

Among those primarily responsible for this new epoch in scenic art in England were Sir Henry Irving and Mr Beerbohm Tree, both actor-managers, Mr Hubert von Herkomer, R.A., Sir L. Alma-Tadema, R.A., and Mr Edwin O. Sachs, architect. Although almost last in the application of stage reform in its best sense, England really completed the experimental period with the modernization of the Royal Opera House, Covent Garden, where, by the opening of the season of 1902, the directorate were provided with the latest improvements of mechanical skill for the almost complete re-equipment of stage scenery. This work of remodelling was carried out by the Grand Opera Syndicate, with Mr Edwin O. Sachs as technical

adviser and architect. Modern mechanism has also been applied at the Apollo Theatre, London, where, however, the stage mechanism was bodily imported from the Continent and is of German pattern.

Mechanism.

The stage mechanism which was employed in the equipment of the Royal Opera House, Covent Garden, embodies the Sachs system of dividing the stage-floor into a few large sections and working them with the aid of electrical power, the Brandt system of counter-weighting for the suspension of all scenery from above, the application of light in four colours by electricity, and the designing of all scenery to accord as much as possible with nature, the whole mounting being built up on the basis of a flat stage as distinct from the sloping stage of old. The classification of stages, whether for the production of opera or plays, should be made as follows: wood stages, wood and iron stages, and iron stages, with subdivisions according to the power chiefly employed in working the appliances. These subsections are: manual labour, hydraulics, and electricity. Owing to the almost entire absence of steam for motor power in connexion with stage machinery, a separate subdivision for appliances where steam is employed is not required. With the wood stage and the wood and iron stage manual labour alone is utilized. But in the iron stage manual labour, hydraulic power, and electric power are either used individually, or a combination of any two or three of these classes is applied. The first series of stages built in accordance with the principles of Stage Reform was erected on what was termed the "asphaleia" system, in which direct hydraulic power was utilized throughout. The stage-floor is divided into innumerable small sections supported on rams (some working telescopically), whilst everything suspended from above is also worked mechanically by hydraulic power. Notable examples are the Budapest Opera House and the Municipal Theatre at Halle.

The next type is that of the stage of the Court Theatre, Vienna, which, although based to a considerable extent on the "asphaleia" system, showed somewhat larger sections. These are suspended by cables and worked indirectly by small hydraulic rams placed at the side, whilst the whole of the top work is manipulated by manual labour with the partial assistance of counter-weights. The next type is the Brandt type, where the number of divisions of the stage is further reduced to a few medium-sized sections, worked by means of a combination of a central hydraulic ram and suspended cables duly counter-weighted. The top work in this case is entirely counter-weighted, and requires the least possible manual labour for manipulation. An example will be found at the Wiesbaden Court Theatre. We next have the Sachs system, where electric power is substituted for hydraulic power, the number of stage divisions limited to several large sections, suspended on cables partly counter-weighted and partly worked by electric motors, while the whole of the top work is balanced on a system similar to that of the Brandt, with intermediate electric motors for the manipulation of particularly heavy loads. It is this last system that has been adopted at the Covent Garden Opera House, with the modification that the top work is entirely operated on the German Brandt system of manual labour and counter-weights. Another example of the Sachs system, as far as individual stage sections are concerned, will be found in a portion of the Theatre Royal, Drury Lane.

Regarding the question of expense and practicability, the hydraulic system has generally been found to be expensive and impracticable. The system of the Court Theatre, Vienna, though practicable, is costly both in capital and annual outlay. The Brandt method has been found particularly suitable for medium-sized theatres, and not expensive. The Sachs system has been found practicable, of moderate initial cost and minimum annual outlay. The advantages of electricity over hydraulic power have been most marked both in capital and in annual expense. There is of course a far greater initial outlay required to-day than with the wooden stage of old, but the saving in staff and wear and tear of the scenery, and the absence of expensive temporary makeshifts, compensate for this by a material reduction of annual charges. The stage carpenter has long reigned supreme in England and France, although in England there are already one or two notable exceptions of men who are advancing to the position of engineers rather than carpenters. In Germany and Austria the stage carpenter is already being replaced in most theatres by men of engineering or technical training, as the more complex arrangements of a modern stage demand intelligent and careful control.

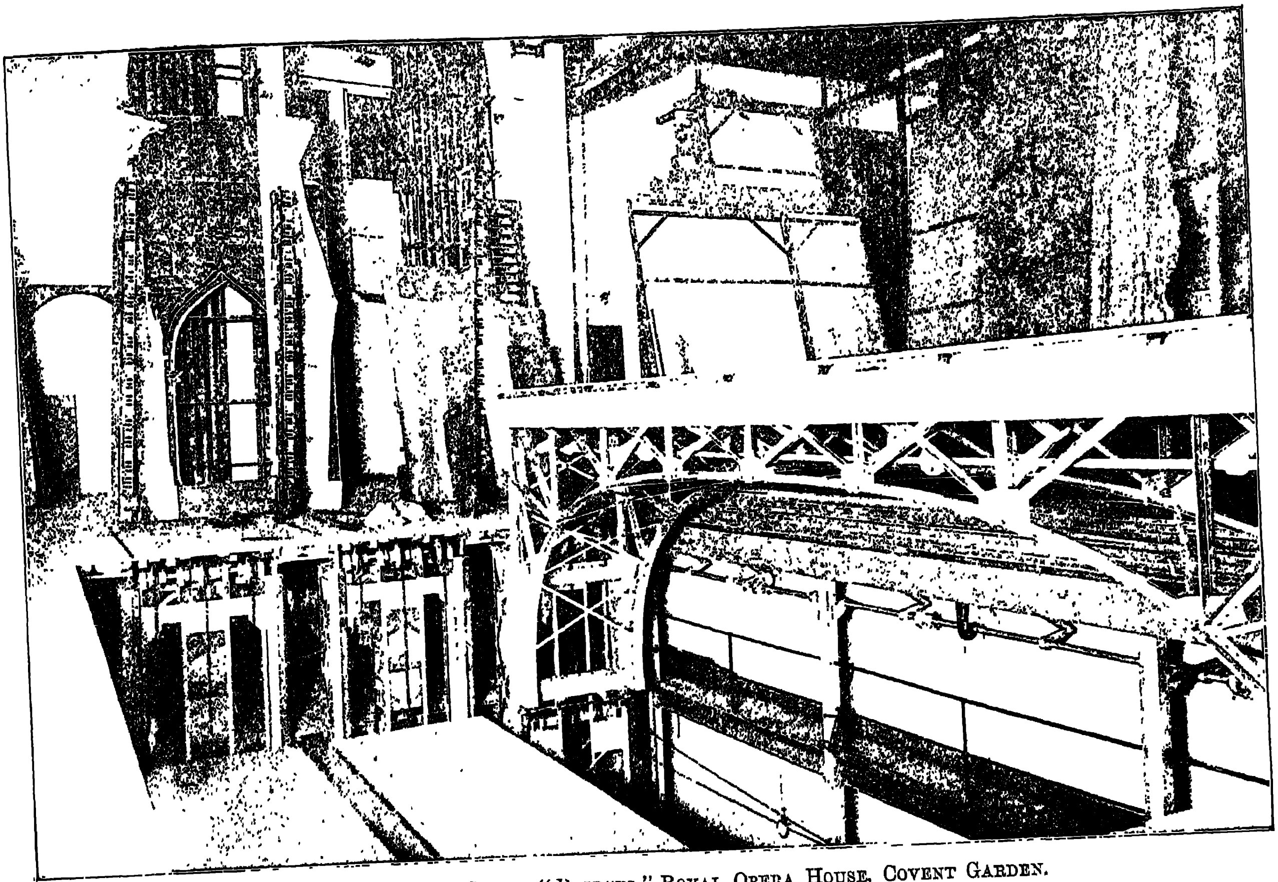
Scene-painting.

Regarding the actual designing and painting of the scenery, the English scene-painter may now be considered in advance of his Continental and American colleagues, although the productions of some notable ateliers at Vienna and Munich run the English scene-painter's work very closely. In 1890 Vienna was in advance of England in scene-painting, but the English scene-painters have since then rapidly come to the front, and it is to be anticipated that it will never again be necessary to import scenery from Austria, as has been the case, both at the Theatre Royal, Drury Lane, and at the Royal Opera House, Covent Garden. As a matter of fact, scenery from Covent Garden and Drury Lane is already exported to the United States. The position of the scene-painter is particularly difficult, inasmuch as whilst artistic temperament and thorough knowledge of art are essential for the practice of his vocation, it is equally essential that he should be thoroughly practical and to a considerable extent a mechanic.

Modern inventions.

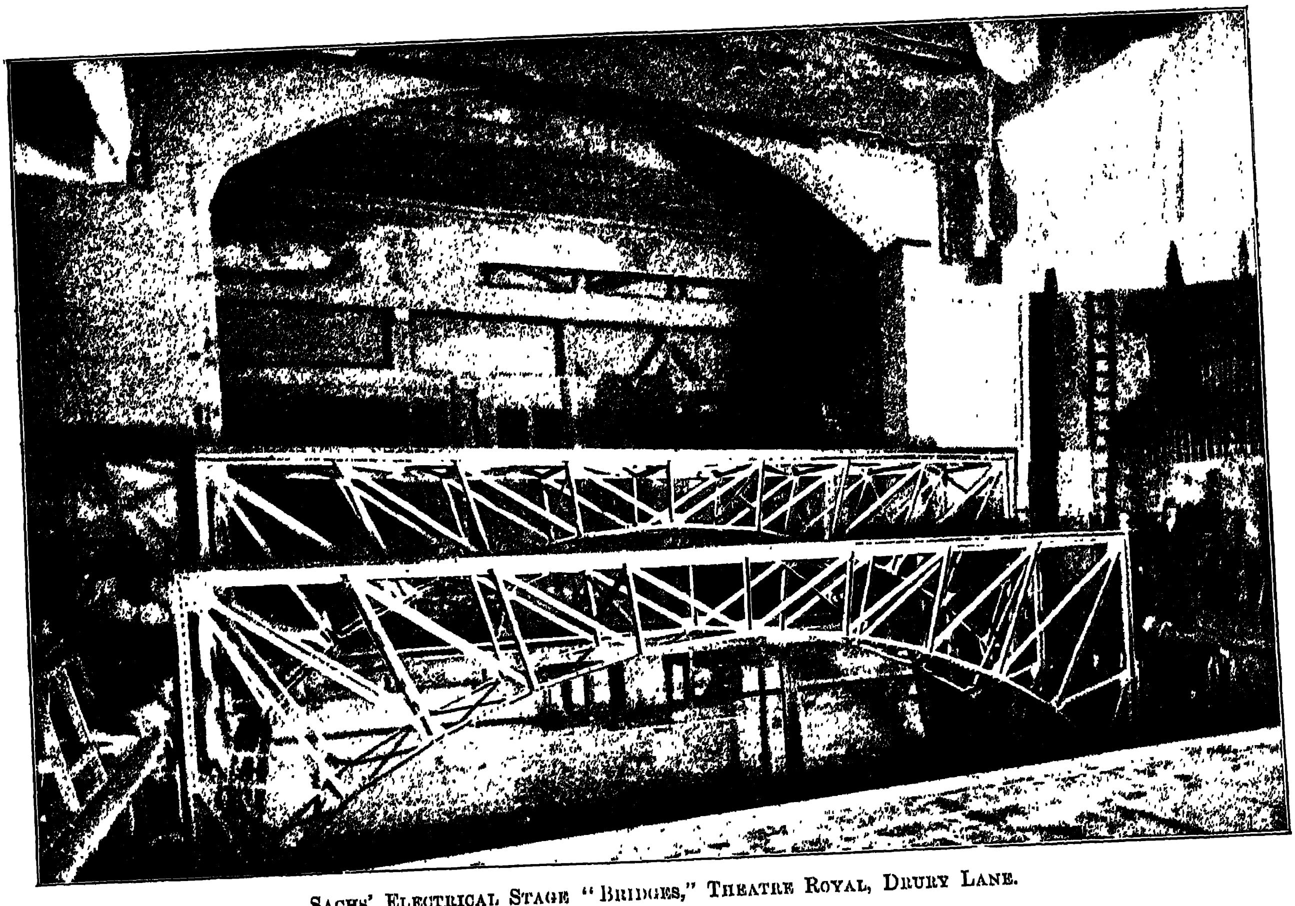
During the period of interregnum in stage reform there appeared a number of faddist inventions which, while creating public interest, cannot be considered of lasting practical utility. Thus in the United States an attempt was made to have a large platform constructed like a lift, bodily rising and falling, with three different tiers or stages on which scenery could be mounted at different levels and then raised or lowered into position. Again, at Munich, a scheme of turn-tables based on the Japanese revolving stage was put forward, but this can only be looked upon as an interesting experiment of little practical value. Numerous methods of illuminating the stage have similarly been attempted, with the aid of search-lights, and proscenium-lights, or by the absence of footlights, and the like, but the general method of lighting the stage from the top with battens, from the side with wing-ladders, and from below with foot-lights, if carefully regulated and skilfully handled, produces excellent results. The lighting arrangements as practised at the Royal Opera House, Covent Garden, and at the Royal Theatre, Wiesbaden, leave nothing to be desired from an artist's point of view. The great difficulty of the light coming too strongly from below, *i.e.*, from the foot-lights, can be overcome by the regulation and colouring of the lights.

As examples of modern mechanism, two photographs have been reproduced showing views of the electrical stage "bridges" of the Royal Opera House, Covent Garden, and of the Theatre Royal, Drury Lane, respectively, both on the Sachs system (see Plate). A small general plan and section of the Covent Garden stage are also shown (see



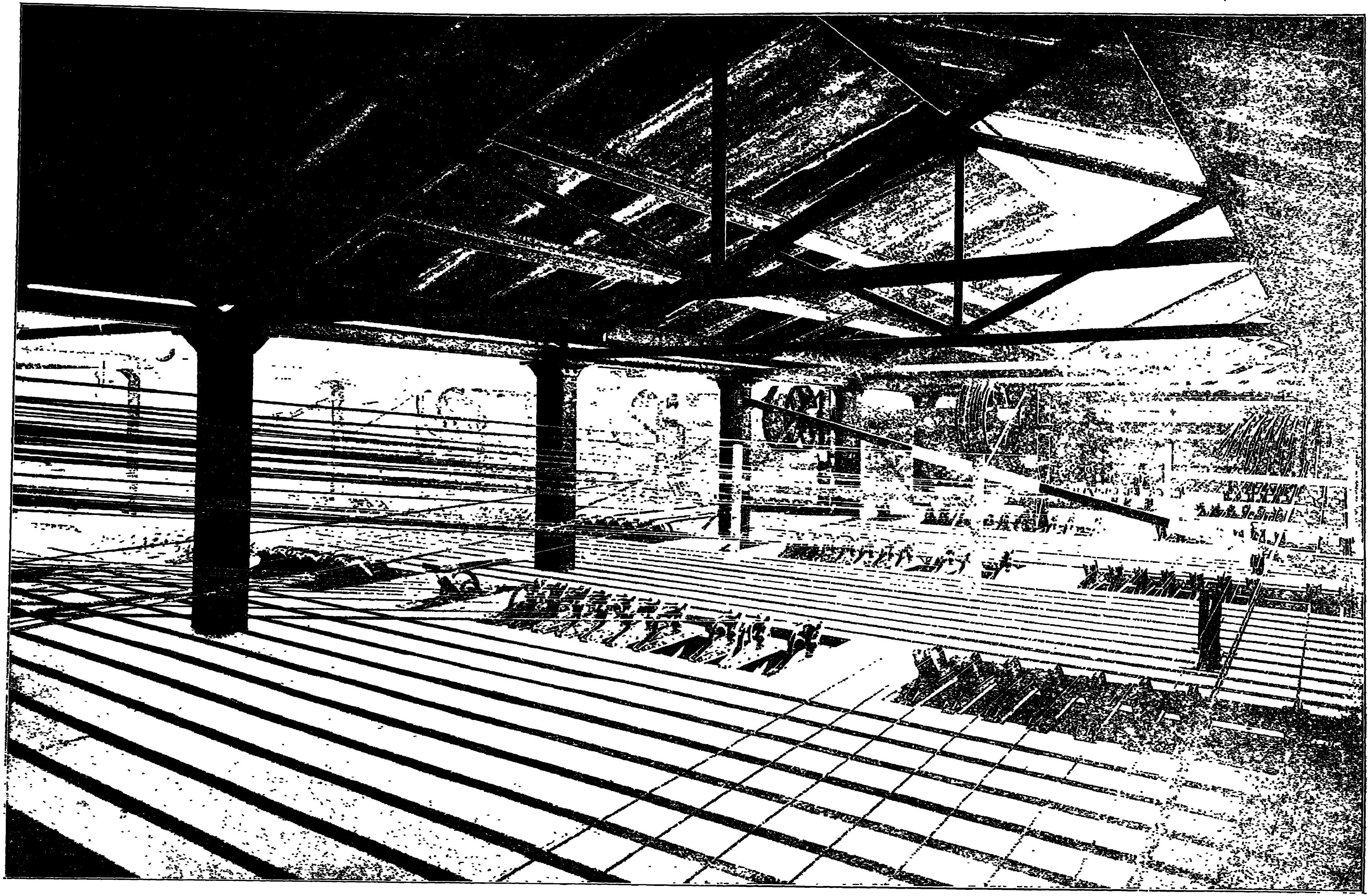
SACHS' ELECTRICAL STAGE "BRIDGES," ROYAL OPERA HOUSE, COVENT GARDEN.

(From a Photograph by S. B. Bolas and Co.)



SACHS' ELECTRICAL STAGE "BRIDGES," THEATRE ROYAL, DRURY LANE.

(From a Photograph by Alfred Ellis and Walery.)



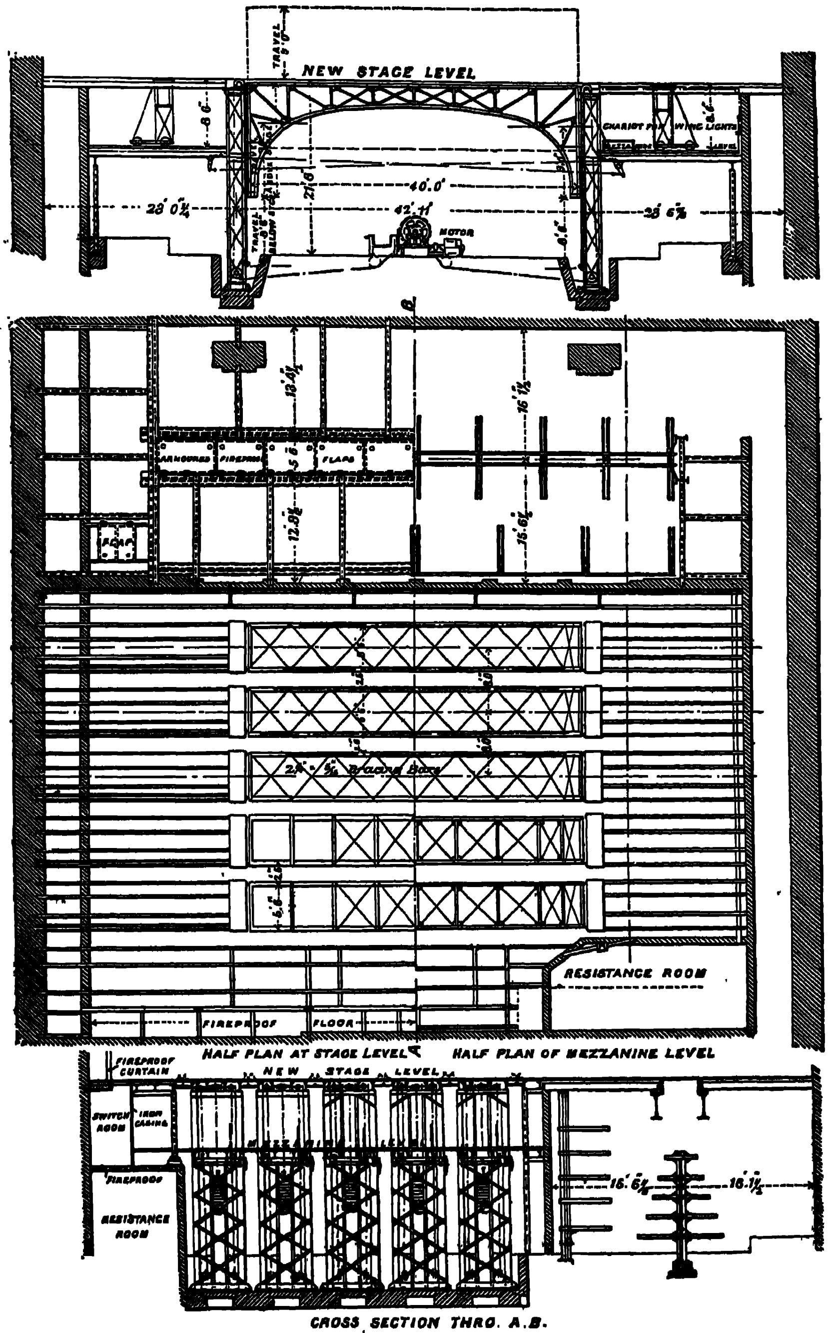
THE NEW "GRIDIRON," ROYAL OPERA HOUSE, COVENT GARDEN.

(*From a Photograph by Alfred Ellis and Walery.*)

Figure), and another illustration (see Plate) presents the "gridiron" at Covent Garden on the Brandt system.

The following is a detailed description of the Covent Garden installation.

The stage may be described as consisting of a series of six horizontal sections running parallel with the curtain line from front to back, each section being 8 feet wide, and the whole being followed by a large back or rear stage. The first section contains nothing but a plain "carpet cut," and openings to take the old-fashioned "grave" trap, "star" trap, or other similar contrivances. The second and third sections comprise large bridges, which can be raised 6 feet above the stage or lowered 8 feet below the stage, constructed in two levels, on the lower level of which appliances can be installed for the purpose of raising minor platforms above stage level or sinking traps and the like. The fourth, fifth, and sixth sections comprise large bridges running right across the stage front, which can be raised 9 feet above the stage or lowered 8 feet below it. The back stage has no openings or mechanism beyond certain trap-doors to a scenery store, and the necessary electrical mechanism for raising and lowering scenery for storage purposes. Between the various sections of the stage, long longitudinal flaps, 2 feet wide, have been formed, which can be easily opened to allow scenery to be passed through below for transformation scenes and the like. Each section is equipped with what is termed a pair of chariots, to hold "wing" lights placed on so-called wing ladders. All the electrical bridges are worked from the "mezzanine" level and from ordinary switch-boards, and can be raised and lowered at various speeds, and take loads up to 2 tons. They can be moved without vibration or noise at a cost of about ½ for power on a full rise when loaded.



PLAN AND SECTION OF COVENT GARDEN STAGE.

Above the stage level each section has its series of lines to take cloths, borders, &c. Each section has a batten, from which the electric battens are suspended, and has also a large wooden lattice girder, from which heavy pieces of scenery can be hung. There are, on the average, about ten lines for ordinary battens, a girder batten, and a light batten to each section; besides these lines, there are the equipments of flying apparatus and the like, whilst in front there are, of course, the necessary lines for tableaux curtains, act-drops, and draperies. Everything that is suspended from above can be worked at stage level or at either of the gallery levels, every scene being counter-weighted to a nicety, so that one man can easily handle it. No mechanical contrivance is required, and in practice quite a number of scenes can be rapidly changed in a very short time. Throughout the structure and mechanism steel has been used; with iron pulleys and wire cable; and the inflammable materials have been absolutely reduced to the flooring of the gridiron and galleries and the hardwood flooring of the stage and mezzanine. In other words, an absolutely minimum of inflammable material replaces what was almost a maximum; and seeing that the electric light has been installed, the risk of an outbreak of fire or its spread has been materially reduced.

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(E. O. S.)

Spectacle.

The appeal to the eye has been the essential feature of treatment of "Spectacle" in its many stages of development from the earliest times of the miracle plays and "moralities," mummers and morris-dancers, down through the centuries, in the form of masques and ballets, to the luxuriance of scenic and costume display that is lavished on the latest forms of theatrical entertainment. Considering the enormous advance that has been made in mechanical appliances, more especially in the increased powers of illumination supplied by gas and electricity[1] as compared with oil and candles, we must acknowledge that the artistic achievement of spectacle has hardly kept pace with the times. If we may credit the veracity of contemporary chroniclers, the most elaborate effects and illusions were successfully attempted in the various courtly entertainments that are recorded under the Tudor and Stuart dynasties, and found perhaps their

[1] The Savoy Theatre, London, was first entirely lighted by electricity in 1882.

most sumptuous expression in the Courts of Louis XIV. and Louis XV. It would be a difficult task for the most experienced of modern stage managers to rival the splendours of apparel and the ingenious devices that were exploited in increasing magnificence during successive periods, as described by Froissart, Holinshed, Cavendish, Stow, Pepys, and other writers. The sums expended on these entertainments were prodigious, and a perusal of the extraordinarily detailed descriptions of such lavishly appointed masques as those designed by Inigo Jones in particular renders credible the statement that a certain masque presented before Charles I. at the Inns of Court in 1633 cost £21,000. Spectacle in its earlier phases appears to have existed chiefly in connexion with court and civic ceremonial: as evidenced in the wonderful pageantry of the Field of the Cloth of Gold; in such princely entertainment as the Revels at Kenilworth, when the Earl of Leicester welcomed Queen Elizabeth in a series of splendid fêtes; and in the more accomplished imaginings of Ben Jonson, decorated by Inigo Jones, such as the Inns of Court masque, already cited. The scenic effects and illusions which had evidently been brought to great perfection in these masques were not devoted to the service of the Drama in the public theatres until Davenant introduced them at the period of the Restoration, although simple scenery, probably mere background "cloths," had been seen on the stage as early as 1605. The built-up stage pictures, familiar to us as "set-scenes," are said to owe their origin to Philip James de Loutherbourg, R.A., and to have been first used in 1777; but it is difficult to believe that some such elaborate constructions had not already enjoyed a term of popularity in view of the contemporary paintings and engravings of the epoch of Louis XIV., who was himself not averse from appearing (in 1653) as "Le Roi Soleil" in the midst of an *entourage* combining much that was artistic and fanciful with the most pompous and most absurd incongruities of character and costume. A greater measure of elegance and refinement distinguished the spectacles of the reign of Louis XV., inspired by the delicate art of Watteau, Boucher, and Lancret, and preserved for our delectation in their delightful canvases. Under the French Revolution the spectacular ballet lost much of its prestige; and its decorative features were for a time principally associated with the fêtes inaugurated by the Republic, and presented in the classic costume which the severity of the new régime adopted as a reaction, or as a protest against the frivolities and furbelows of the obliterated monarchy. The Festival of the Supreme Being, decreed by the National Convention, designed by David and conducted by Robespierre, was perhaps the most impressive spectacle of the close of the 18th century.

The 19th century saw spectacle devoted almost exclusively to theatrical entertainment. In London, melodrama, both of the romantic and domestic description, claimed its illustrative aid. At Drury Lane Theatre (which, with Covent Garden, the Adelphi, and Astley's, was first illuminated by gas in 1817–18) the "Cataract of the Ganges," with its cascade of real water and its prancing steeds, made a great sensation in 1823, and the same stage in 1842, under Macready's management, displayed the "moving wave" effect in the Sicilian views, painted by Clarkson Stanfield for "Acis and Galatea." The Lyceum Theatre, under the control of Madame Vestris and Charles Mathews in a memorable management lasting from 1847 to 1855, introduced a long series of elegant extravaganzas from the pen of J. R. Planché, elaborately illustrated by the scenery of William Beverly. The "Golden Branch," the "King of the Peacocks," and the "Island of Jewels" (Christmas 1849) were the most remarkable of these productions, and were noteworthy as originating the fantastic fairy pictures that became known as "transformation scenes," and were copied and popularized in all directions. Beverly's skilful brush was at a later date employed at Drury Lane to enhance the attractions of a succession of spectacular versions of Sir Walter Scott's novels, "Amy Robsart" (1870), "Rob Roy" (with a beautiful panorama of the Trossachs scenery), "Rebecca," "England in the Days of Charles II.," and others. More recently still, under the régime of Sir Augustus Harris and his immediate successors, spectacle at Drury Lane assumed even more costly proportions, and modern melodramas, representing well-known localities with extraordinary fidelity and all kinds of disasters from earthquakes to avalanches, have been alternated with sumptuously mounted pantomimes (so-called), in which the nominal fairy-tales were almost smothered by the paraphernalia of scenery and costume. It is remarkable that for a "run" of ten weeks only such a sum as £16,000 each can have been profitably expended on more than one of these productions.

London playgoers will recall the processional glories of "A Dream of Fair Women," designed by Alfred Thompson; "The Land of Fairy Tales," by Percy Anderson; and "The Silver Wedding" (Puss in Boots), "The Paradise of the Birds" (Babes in the Wood), and "The Gods and Goddesses of Olympus" (Jack and the Beanstalk), for which Mr Wilhelm was responsible. "The Armada," a historical drama (1888), also deserves to be remembered for the completeness and excellence of its spectacular features. In addition to the names of Clarkson Stanfield and Beverly, already cited as masters of scenic art, it must not be forgotten that the skill of David Roberts was also devoted to the embellishment of the stage; and the names of Grieve, the Telbins (father and son), Hawes Craven, and J. Harker have in successive years carried on the best traditions of the art. Alfred Thompson was one of the first to revise the conventionalities of fanciful stage costume, and to impart a French lightness of touch and delicacy of colour. A ballet, "Yolande," which he dressed for the Alhambra in the 'sixties, was the first Japanese spectacle to grace the English stage; and he was also mainly responsible for the attractions of "Babil and Bijou," which cost upwards of £11,000 at Covent Garden Theatre in 1872, and was at the time considered to have surpassed all former spectacular accomplishments. It achieved, however, merely a *succès d'estime*, and has bequeathed to a later generation only the recollections of its "Spring" choir of boys, and of the brilliant danseuse, Henriette d'Or, who revived memories of the great days of the ballet, when Taglioni, Cerito, Elssler, Duvernay, and other "Déesses de la Danse" appeared under Lumley's management at Her Majesty's Theatre in the Haymarket. Since the memorable tenancy of Sadler's Wells Theatre by Phelps (1844–62), Shakespeare and spectacle have been honourably associated. Charles Kean's revivals at the Princess's Theatre (1850–59) deservedly attracted considerable attention for the splendour and accuracy of their archæology. Byron's "Sardanapalus" was also a triumph for the same management in 1853; and the same theatre three decades later witnessed the production (December 1883) by Wilson Barrett of "Claudian," a romantic poetic drama of classic days, mounted so exquisitely as to gain Ruskin's enthusiastic praise. But undoubtedly the most noteworthy alliance of spectacle with Shakespeare has been made by Sir Henry Irving, whose Lyceum triumphs in this connexion have been equally familiar and appreciated in the United States and in Great Britain. The art of Royal Academicians was happily enlisted to add lustre and distinction to his productions. "Ravenswood" and the sumptuously presented "Henry VIII." (1892) owed much to the co-operation of Mr Seymour Lucas. Sir Lawrence Alma-Tadema supervised "Cymbeline" and "Coriolanus" (1901), whilst Sir Edward Burne-Jones inspired the decoration of "King Arthur" (1895). In Tennyson's "Cup" (produced in January 1881) and in the beautiful revival of "Romeo and Juliet" it was felt that perfection of stage illusion could scarcely go farther, but the next production, "Much Ado about Nothing," with its superb church scene by Telbin, was admittedly Irving's crowning success, alike from the artistic, the dramatic, the spectacular, and the financial standpoints. Great praise was equally won by the version of "Faust," which was frankly spectacular, and by the more recent "Robespierre" by Sardou. Shakespeare and the poetic drama were also finely illustrated by Mr Beerbohm Tree, who secured Sir Lawrence Alma-Tadema's interest for "Hypatia" at the

Haymarket, and "Julius Cæsar" at Her Majesty's; whilst for his later productions, "King John," "A Midsummer Night's Dream," "Herod" (by Stephen Phillips), and "Twelfth Night" (1901), he was assisted by the designs of Percy Anderson, an artist who made his mark in the costumes for a series of the operas at the Savoy Theatre, notably the 15th-century dresses for the "Beauty Stone."

Spectacular features of exceptional refinement distinguished the pantomime of "Cinderella," presented by Mr Oscar Barrett at the Lyceum Theatre in Christmas 1893, and designed by Mr Wilhelm. This production also enjoyed a prosperous season in New York. The system of international exchange seems to hold good in stage spectacle as in other cases, and in return for English successes that have been welcomed in America, Augustin Daly's Shakespearean productions were greatly admired in London. Other entertainments of a more absolutely spectacular order found acceptance in London. In connexion with Barnum and Bailey's Hippodrome, Imré Kiralfy's show, "Nero," constituted a "mammoth combination," and attracted crowds to "Olympia" in 1890. The success of this latter spectacle of colour and movement, which was also designed by Mr Wilhelm, induced Mr Kiralfy to produce a still more ambitious entertainment the following season, "Venice," designed by the same artist. A spectacle on these lines may be regarded as the outcome of such ballets as have long been popular on the continent of Europe—especially in Italy, where grace of movement and spontaneity of gesture are natural to the people, and greatly facilitate such an enterprise as the famous "Excelsior" ballet of Manzotti, which lasted a whole evening, in several acts, and required the services of hundreds of figurantes. "Excelsior" was originally produced at La Scala, Milan, in January 1881, and was subsequently given with great success at the Eden Theatre, Paris, in 1883. But at Her Majesty's Theatre, London, it obtained indifferent success. The English temperament hardly assimilates ballet in the sense in which it appeals to more Southern races, and apart from an occasional furore for a particular dancer, the success of the ballet as an institution seems to depend rather on the brilliancy of its features than on its display of choregraphic skill. Amongst the latest compositions that occupied Sir Arthur Sullivan was a ballet, "Victoria and Merrie England," for the Alhambra Theatre.

There has been a growing tendency to abandon the romantic in favour of a more realistic and more modern element in ballet, introducing features hitherto chiefly associated with performances of the Revue or Vaudeville description to the extent even of choruses and spoken dialogue to eke out the resource of the less fluent and less practised exponents of the art of pantomime. Even under these restricted conditions some memorable successes have been achieved, especially at the Empire Theatre, London, where the dances were long directed by Madame Katti Lanner. To quote the names of "Cleopatra," "Rose d'Amour," "Orféo," "Faust," "Versailles," "Round the Town," "Monte Cristo," "The Press," "Alaska," and "Les Papillons" will suffice to show the wide range of subjects laid under contribution. With all of these Mr Wilhelm was closely identified as designer-in-chief to originate the varied schemes of colour and fancy, and the illustrative effects generally. In Paris, the birthplace of Délibes' ballets "Sylvia" and "Coppélia," such spectacles as "La Vénus Noire" and "Rothomago," or, to name a later example, Massenet's "Cendrillon," achieved a success to which the scenic art of Messrs Amable and Gardy, and the fantastic costumes of Grévin and Draner, largely contributed. In Vienna, also, ballet and spectacle enjoy a great popularity.

See E. O. Sachs. *Modern Opera Houses and Theatres*, 1896–1897-98.—Planché. *The History of Costume*.—G. Vuillier. *A History of Dancing*. — E. L. Blanchard. *Histories of the London Theatres* (*Era* Almanacs). (C. Wi.)

Stainer, Sir John (1840–1901), English composer and organist, was born at Southwark, 6th June 1840. He was the second son of the schoolmaster of the parish school of St Thomas's, Southwark, who was enough of a musician to teach his son the organ and the art of reading music, in which he was already proficient when, in 1847, he entered the choir of St Paul's Cathedral. He remained there till 1856, and often took the organ in emergencies; he held the post of organist of St Benet's and St Paul's, Upper Thames Street, during the last year of his choristership; and in 1856 was given the appointment of organist to St Michael's College, Tenbury, where his musical and general education benefited greatly from the intercourse with Sir Frederick Gore Ouseley. He was appointed to Magdalen College, Oxford, in 1860, and became university organist in the following year. While at Oxford he did much to bring the choir of Magdalen to a remarkable state of excellence; he took a keen interest in the foundation of various musical societies; and as a sign of his appreciation of the value of general culture, it is worth recording that he took the degree of B.A. in 1864, that of Mus. D. 1865, and procured M.A. in 1867, being appointed a university examiner in music in the same year. In 1868 he was engaged frequently as solo organist at the Crystal Palace; and in 1872 was appointed organist of St Paul's, where he raised the standard of choral music to something very like perfection. He was professor of the organ in the National Training School of Music from 1876, and in 1881 succeeded his lifelong friend, Sullivan, as principal. In 1878 he was a juror at the Paris Exhibition, and was created Chevalier of the Légion d'Honneur. In 1882 he became inspector of music in training colleges. In 1888 he retired from the organistship of St Paul's, owing to failing eyesight, and was knighted. In 1889 he succeeded Ouseley as professor of music in the University of Oxford, holding the post till 1899. Besides these official distinctions, he received a great number of honorary degrees; he was vice-president of the Royal College of Organists, and president of the Plain-song and Mediæval Music Society, the London Gregorian Association, and the Musical Association. His compositions include four oratorios—*Gideon* (1865), *The Daughter of Jairus* (Worcester, 1878), *St Mary Magdalen* (Gloucester, 1887), *Crucifixion* (London, 1887); forty-two anthems, some of them very elaborate; many hymn-tunes, organ pieces, madrigals, &c. His professorial lectures were of great value, and he made many contributions to the literature of music. He was a man of wide influence, with a remarkable faculty of organization, and his work in regard to the conditions of the musical profession was of considerable importance. His own music has many of the defects of his qualities, for his breadth of artistic views led him to admire and adopt many styles that are not always compatible with each other. He died while on a holiday at Verona, 31st March 1901. (J. A. F. M.)

Staines, town, railway station, and parish, Middlesex, England, in the Uxbridge parliamentary division of the county, 6 miles south-west of Windsor, on the Thames, at its junction with the Colne. A bridge, erected in 1832 at a cost of about £70,000, connects the town with Egham. The church of St Mary the Virgin, which occupies the site of a more ancient building, is in debased Gothic style, and dates from 1631. The interior was restored in 1885 and the chancel extended. St Peter's, the parish church, was erected in 1894 at a cost of £10,000. Breweries and mustard mills employ many hands. A rifle range for the metropolitan volunteers and others was opened in 1892. In the immediate neighbourhood, though included in the parish of Egham, is Runnymede, where, in 1215, King John signed Magna Charta. The population of the parish and urban district was in 1891, 5535; in 1901, 6688.

Stalybridge, parliamentary and municipal borough of Cheshire, England, 7½ miles east of Manchester by rail. The chief industries are cotton spinning and weaving. There are also iron works and machinery factories. The municipal borough was extended in 1881, the parliamentary borough in 1885. In 1885 the gasworks were acquired by the corporation at a cost of £126,000, and in the following year a large new water reservoir was constructed at Greenfield. Sewage works were completed in 1897. The town hall was enlarged 1886, and the Astley-Cheetham Free Library opened in 1901. The population of the municipal borough was in 1881, 25,977; 1901, 27,674.

Stamboloff, Stefan (1854–1895), Bulgarian statesman, was born on 31st January 1854 at Trnovo, the ancient Bulgarian capital, where his father kept a small inn. Under Turkish rule it was impossible to obtain a liberal education in Bulgaria, and young Stamboloff, after attending the communal school in his native town, was apprenticed to a tailor. During the politico-religious agitation which preceded the establishment of the Bulgarian exarchate a number of Bulgarian youths were sent to Russia to be educated at the expense of the Imperial Government; among them was Stamboloff, who was entered at the seminary of Odessa in order to prepare for the priesthood. His wayward and independent nature, however, rebelled against the discipline of school life; he was expelled from the seminary on the ground of his association with Nihilists, and making his way to Rumania, he entered into close relations with the Bulgarian revolutionary committees at Bucharest, Giurgevo, and Galatz. In 1875, though only twenty years of age, he led an insurrectionary movement at Nova Zagora in Bulgaria, and in the following year organized another rising at Orekhovitza. In the autumn of 1876 he took part as a volunteer in the Servian campaign against Turkey, and subsequently joined the Bulgarian irregular contingent with the Russian army in the war of 1877–78. After the signature of the Berlin Treaty Stamboloff settled at Trnovo, where he set up as a lawyer, and was soon elected deputy for his native town in the Sobranye. His force of character, his undoubted patriotism, his brilliant eloquence, and his disinclination to accept office—a rare characteristic in a Bulgarian politician—combined to render him one of the most influential men in Bulgaria. The overthrow of the Zankoff Ministry in 1884 was largely due to his influence, and in that year he was nominated to the presidency of the Sobranye. He held this important office for the next two years, a critical period in the national history. The revolution of Philippopolis, which brought about the union of Bulgaria with Eastern Rumelia, took place on 18th September 1885, and it was largely owing to Stamboloff's advice that Prince Alexander decided to identify himself with the movement. The war with Servia followed, and Stamboloff, notwithstanding his official position, served as an ordinary soldier in the Bulgarian army. After the abduction of Prince Alexander by a band of military conspirators (21st August 1886) Stamboloff, who was then at Trnovo, acted with characteristic promptitude and courage. In his capacity as President of the Sobranye he established a loyal government at Trnovo, issued a manifesto to the nation, nominated his brother-in-law, General Mutkuroff, commander-in-chief of the army, and invited the prince to return to Bulgaria. The consequence of these measures was the downfall of the provisional government set up by the Russophil party at Sofia. On the abdication of Prince Alexander (8th September) Stamboloff became head of a council of regency, with Mutkuroff and Karaveloff as his colleagues; the latter, however, soon made way for Jivkoff, a friend and fellow-townsman of the first Regent. Invested with supreme power at this perilous juncture, Stamboloff displayed all the qualities of an able diplomatist and an energetic ruler. He succeeded in frustrating the mission of General Kaulbars, whom the Tsar despatched as special commissioner to Bulgaria, in suppressing a rising organized by Nabokoff, a Russian officer, at Burgas, in quelling military revolts at Silistra and Rustchuk, in holding elections for the Grand Sobranye, despite the interdict of Russia, and in securing eventually the election of Prince Ferdinand of Coburg to the vacant throne (7th July 1887). Under the newly-elected ruler he became prime minister and minister of the interior, and continued in office for nearly seven years (see BULGARIA, Part II.). The aim of his foreign policy was to obtain the recognition of Prince Ferdinand, and to win the support of the Triple Alliance and Great Britain against Russian interference in Bulgaria. In his dealings with Turkey, the suzerain Power, he displayed considerable acuteness; he gained the confidence of the sultan, whom he flattered and occasionally menaced; and aided by the ambassadors of the friendly Powers, he succeeded in obtaining on two occasions important concessions for the Bulgarian episcopate in Macedonia (see MACEDONIA), while securing the tacit sanction of the Porte for the technically illegal situation in the principality. With the assistance of Austria-Hungary and Great Britain he negotiated large foreign loans which enabled him to develop the military strength of Bulgaria. Under Prince Ferdinand he pursued the same despotic methods of government which had characterized his administration during the regency; Major Panitza, who had organized a revolutionary conspiracy, was tried by court-martial and shot at Sofia in 1890; four of his political opponents were hanged at Sofia in the following year, and Karaveloff was sentenced to five years' imprisonment. His tyrannical disposition was increased by the assassination of his colleague, Beltcheff, in 1891, and of Dr Vlkovitch, the Bulgarian representative at Constantinople, in 1892, and eventually proved intolerable to Prince Ferdinand, who compelled him to resign in May 1894. He was now exposed to the vengeance of his enemies, and subjected to various indignities and persecutions; he was refused permission to leave the country, and his property was confiscated. On 15th July 1895 he was attacked and barbarously mutilated by a band of Macedonian assassins in the streets of Sofia, and succumbed to his injuries three days later. His funeral, which was attended by the representatives of the Powers at Sofia, was

STEFAN STAMBOLOFF.

interrupted by disgraceful riots, and an effort was made to perpetrate an outrage on his remains. No attempt was made to arrest his murderers; two persons were, however, arraigned for the crime in 1896, and subjected to almost nominal penalties. (J. D. B.)

Stamford, a town and city of Fairfield county, Connecticut, U.S.A. The town has an area of 38 square miles of hilly country, in the south-western part of the state. The city, lying within it, is on the shore of Long Island Sound, and on the New York, New Haven and Hartford Railroad. Its harbour is excellent, and it has steamer connexion with New York and other ports of the Sound. It received a city charter in 1893. Population of the town (1890), 15,700; (1900), 18,839; of the city in 1900, 15,997, of whom 4078 were foreign-born and 256 negroes.

Stamp Revenue.—Stamp duties in the United Kingdom form part of the Inland Revenue, and are placed under the control of the Commissioners of Inland Revenue. The principal Acts in force on the subject are the Stamp Act, 1891, and the Stamp Duties Management Act, 1891. Amendments of the law are also included in the Customs and Inland Revenue Act, 1893, the Finance Acts of 1894, 1895, 1896, 1897, 1898, 1899, 1900, and 1901, and the Revenue Act, 1898. The death duties, the corporation duty, the duties on patent medicines and playing cards, and postage duties, are also technically "stamp duties"; but in ordinary use the expression is limited to those imposed on the various classes of legal instruments, such as conveyances, leases, transfers, mortgages, bonds, &c., on bills of exchange, promissory notes, contract notes, bank notes and bankers' drafts, receipts, insurance policies, bills of lading, and a few other documents. Stamps are either adhesive or impressed. The adhesive stamps, which can only be used for certain documents, can be obtained at Inland Revenue offices throughout the United Kingdom, and at all post offices which are money order offices. Stamps can only be impressed at the Inland Revenue offices in certain of the larger towns. For duties not exceeding 2s. 6d. the adhesive Inland Revenue or postage stamps may (in most cases) be used indiscriminately. This arrangement was first introduced in 1881, when it was applied to the penny stamp, and it has since been extended to other denominations. The Commissioners of Inland Revenue are authorized to make allowance under certain conditions for stamps which have been inadvertently spoiled or rendered useless for their intended purposes. In order to obtain such allowance the parties must present the stamps within two years from the time when they became useless. The commissioners may be required by any person to express their opinion as to the amount of duty, if any, which is chargeable on any instrument; and such person, if dissatisfied with the assessment made, may appeal to the courts. No instrument chargeable with duty can be used in any legal proceedings (except criminal proceedings) unless it has been duly stamped; and if on production it should appear to be insufficiently stamped, the proper duty must be paid in court, together with the penalty imposed in such cases. The stamp duty on the transfer of certain kinds of securities can be commuted by the payment of a lump sum or (in some cases) an annual composition, and the transfers then become exempt from duty. This facility is largely used in the case of municipal and colonial stocks.

The revenue from stamp duties increased from £5,833,341 in 1894–95 to £7,772,423 in 1901–02. During the latter year the principal items of receipt were bills of exchange and promissory notes, £701,223; companies' capital duty, £559,091; receipts and drafts, £1,478,392; deeds and other instruments, £3,646,823. The last item included about £1,407,000 charged on transfers of stock exchange securities. (G. H. M.)

Standerton. See Transvaal.

Stanford, Charles Villiers (1852– ——), Irish composer, was born in Dublin, 30th September 1852, being the only son of Mr John Stanford, examiner in the Court of Chancery (Dublin) and Clerk of the Crown, county Meath. Both parents of the composer were accomplished amateur musicians, the father being the possessor of a splendid bass voice, and the mother a very clever pianist. Under R. M. Levey (violin), Miss Meeke, Mrs Joseph Robinson, Miss Flynn, and Michael Quarry (piano), young Stanford's musical powers were trained in the early days; and Sir Robert Stewart taught him composition and organ. Various feats of precocity are recorded in an article in the *Musical Times* for December 1898. He came to London as a pupil of Arthur O'Leary and Ernst Pauer in 1862, and in 1870 won a scholarship at Queen's College, Cambridge, whence he migrated to Trinity College in 1873, and succeeded J. L. Hopkins as college organist, a post he held till 1892. His appointment as conductor of the Cambridge University Musical Society gave him great opportunities, and the fame which the society soon obtained was in the main due to Stanford's energies. Before his time, ladies were not admitted into the chorus, but during his tenure of the office of conductor many most interesting performances and revivals took place. In the years 1874 to 1877 he was given leave of absence for a portion of each year in order to complete his studies in Germany, where he learnt from Reinecke and Kiel. He took the B.A. degree in 1874 and M.A. in 1878, and was given the honorary degree of Mus. D., at Oxford in 1883, and at Cambridge in 1888. He first came prominently before the public as a composer with his incidental music to Tennyson's *Queen Mary* (Lyceum, 1876); and in 1881 his first opera, *The Veiled Prophet*, was given at Hanover (revived at Covent Garden, 1893); this was succeeded by *Savonarola* (Hamburg, April, and Covent Garden, July 1884), and *The Canterbury Pilgrims* (Drury Lane, 1884). A long interval separates these from his later operas, *Shamus O'Brien* (Opera Comique, 1896) and *Much Ado About Nothing* (Covent Garden, 1901). For the main provincial festivals, works by Stanford were commissioned as follows: Orchestral serenade, Birmingham, 1882; Elegiac Ode, Norwich, 1884; *The Three Holy Children*, Birmingham, 1885; *The Revenge*, Leeds, 1886; *The Voyage of Maeldune*, Leeds, 1889; *The Battle of the Baltic*, Hereford, 1891; *Eden*, Birmingham, 1891; *The Bard*, Cardiff, 1895; *Phaudrig Crohoore*, Norwich, 1896; *Requiem*, Birmingham, 1897; *Te Deum*, Leeds, 1898; *The Last Post*, Hereford, 1900. Besides these, there are a few choral works of importance, such as *The Resurrection*, Cambridge, 1875; Ps. XLVI., Cambridge, 1877; *Carmen Sæculare* (Jubilee Ode), 1887; Installation Ode, Cambridge, 1892; *East to West*, London, 1893; Ps. CL., Manchester, 1887; Mass in G., Brompton Oratory, 1893. He was appointed professor of composition at the Royal College of Music, 1883; conductor of the Bach Choir in 1885; professor of music in the University of Cambridge, succeeding Sir G. A. Macfarren, 1887; conductor of the Leeds Philharmonic Society, 1897, and of the Leeds Festival, 1901. His instrumental works include five symphonies, many chamber compositions, among them a string quartet in D minor, played by the Joachim Quartet. He has written many songs, part-songs, madrigals, &c., and his incidental music to *The Eumenides* and *Œdipus Rex*, as well as to Tennyson's *Becket*, attracted much attention.

His church music holds an honoured place among modern Anglican compositions; he has edited numberless Irish and other traditional songs; and has from time to time contributed articles on musical subjects to magazines, &c. His works have a wide range of subjects and styles, and are without exception remarkable for their entire fitness to the surroundings for which they are intended. The composer is a master of effect in the widest sense; he writes admirably both for instruments and voices; and whether in opera, in choral work, or in the classical forms, his creations reach a very high standard in design and treatment. His influence upon the renaissance of music in England has been of primary importance, and his work as a teacher has borne excellent fruit, his pupils numbering many of the best of the younger English composers.

Stanimaka, a town of Eastern Rumelia (department of Philippopolis), Bulgaria, situated on the Dérin Déré, an affluent of the Maritza, 12 miles S.S.E. of Philippopolis. It is an important seat of the wine trade, carried on by Greeks, and also possesses a distillery. A silk filature has also been established under British auspices, which in 1899 spun 75,000 kilogrammes of cocoons, producing 6000 kilogrammes of raw silk, all sent to the United Kingdom. To the south of the town are the ruins of the ancient castle. Under its Greek name, Steinmachos, the town is frequently mentioned in connexion with the Bulgarian wars from the 11th century onwards. Population, about 14,000, of whom about one-half were Greeks and a third Bulgarians.

Stanislau, the chief town of the district of the same name in Galicia, Austria, 70 miles south-east of Lemberg. Population (1890), 22,391; (1900), including garrison of 3397 men, 29,628 (estimated at 76 per cent. Polish, 14 per cent. German, and 10 per cent. Ruthenian; 54 per cent. Jewish, 29 per cent. Catholic, 16 per cent. Greek Catholic, and 1 per cent. Protestant). A large manufactory of railway stock, tanning, dyeing, tile-making, milling, and the production of yeast, and considerable trade in agricultural produce. The town has been rebuilt since a great fire which occurred in 1868.

Stanley, Sir Henry Morton (1841-——), English explorer, was born at Denbigh in 1841, being the son of Mr J. Rowlands of that place. His extraction was therefore British, not American; the name Stanley, however, he assumed after his adopted father, a citizen of New Orleans. Stanley's public career began with the Abyssinian expedition of 1867–68, in which he acted as a newspaper correspondent. Succeeding, by an accident, in sending the first news of the conclusion of the campaign to London, he made his mark with Mr James Gordon Bennett, the proprietor of the *New York Herald*, and received from that parent of the newer journalism a number of roving commissions. On one of these he ascended the Nile, on another he interviewed the chiefs of the Cretan Revolution 1868–69, and he was sent eventually to Spain in time to witness the scenes that followed the departure of Queen Isabella from Madrid, and to describe the government of the triumvirs—Prim, Serrano, and Topete. The novelty of this subject having waned, Stanley was not surprised when, in October 1869, he was summoned to Mr Bennett in Paris; but he was astonished enough at the nature of the new commission then proposed to him. Briefly, and "without much preamble," as he himself has put it, "I was commissioned to find a Dr Livingstone, who was supposed to be in Africa somewhere. Mr Bennett was sure he was alive somewhere, though where precisely was a mere matter of detail. It would be my duty to find him and help him to the best of my ability." Stanley may have pointed out that of Livingstone he knew no more than that he was a great traveller, ranking with Burton, Grant, and Speke. Mr Bennett's orders were peremptory. The journey, which was to be kept secret to avoid exciting competition, was to begin next day. As a matter of fact the mission thus vigorously entered upon was considerably delayed. The Suez Canal was opened in November 1869, and on his way East Mr Bennett required Stanley to report the opening. "Then, as I was so near Jerusalem, perhaps it would be well to ascertain what kind of work Captain Warren was engaged in there." Other little commissions were added, and it was not till January 1871 that Stanley reached Zanzibar. So long a time had now elapsed since October 1869 that both the proprietor of the *Herald* and his London agent seemed to have forgotten their explorer. There was no credit for him at Zanzibar, no one there had heard of him. However, an old letter from the *Herald's* London agent was produced, and through the sympathy and goodwill of the American consul, Captain Webb, Stanley succeeded in obtaining supplies for the African expedition at 25 per cent. premium, *i.e.*, for every £75 drawn he had to pay £100 by draft on New York. A well-known and popular work, *How I Found Livingstone*, made the successful issue of this expedition familiar. Livingstone was found, and Stanley's reputation as a man of unusual determination and an explorer of promise was established. He had, however, a narrow escape from being prosecuted on the charge of obtaining on false pretences the money advanced to him at Zanzibar. By some error the drafts on New York were there protested, and the American consul and the Hindu banker at Zanzibar were up in arms. Fortunately, and before he reached the coast, letters came to Stanley making his credit at Zanzibar practically unlimited. He returned to England, bringing with him Livingstone's journals.

Stanley's next visit to Africa was in the quality of war correspondent. He accompanied Sir Garnet Wolseley's expedition to Coomassie, which he described in a volume entitled *Coomassie and Magdala: Two British Campaigns.* On reaching the island of St Vincent from Ashanti in 1874 he first heard that Livingstone was dead, and that the body was on its way to England. After the funeral some time was spent in negotiations for sending Stanley again to Africa, there to determine various problems of geographical interest left unsolved by the deaths of Livingstone and Speke, and the discovery by Sir Samuel Baker of Albert Nyanza, a lake then reputed to extend illimitably in a southerly direction. Finally, Sir Edward Lawson, the editor and proprietor of the *Daily Telegraph*, and Sir Edwin Arnold of that journal, induced Mr Gordon Bennett to join them in raising a fund for an Anglo-American expedition under Stanley's command. The story of its experiences will be found in due detail in its commander's well-known work, *Through the Dark Continent.* It is enough to state here that the expedition lasted from October 1874 to August 1877, and was successful in settling a number of the more interesting problems which had puzzled geographers. The principal source of the Nile, the unity and area of Victoria Nyanza, the true length and area of the Tanganyika and the whereabouts of its outlet, the extension of Albert Nyanza south of the equator, and the discovery of a new lake, and, finally, the connexion of Livingstone's Lualaba with the Congo, are some of the discoveries which resulted. The last was by far the most important, as the voyage down the river, from the farthest point which Livingstone had reached to the Atlantic Ocean, had revealed a magnificent

waterway right into the very heart of Africa. Stanley spent nearly the whole of 1878 in trying to induce English capitalists to seize their commercial opportunities in this region. The King of the Belgians had early made overtures to him, even before his return, but had magnanimously confessed the superior claims of England to profit by such knowledge as the explorer had to communicate and such practical service as he could give to turn that knowledge to account. It was a friendly rather than a necessary scruple. Whether or not Stanley's efforts to move the British public were always adroitly made, they were in vain. The press was sceptical if not contemptuous, and in November 1878 Stanley crossed over to Brussels and engaged himself to prove to King Leopold that all he had written and spoken about the Congo was true. The king, though he wanted nothing better, and accepted with alacrity, behaved with great consideration. Before actually sending Stanley to Africa in his service he consented to extend the date of that enlistment till Christmas 1878 that Englishmen might be convinced that England would have nothing to do with the Congo. After a last attempt, in which numbers of intelligent people helped in disseminating his views as to the possibility of establishing another India in Africa, Stanley gave in, and set out in January 1879 in the service of King Leopold as agent of a *Comité d'Étude;* in his own words, "to prove that the Congo natives were susceptible of civilization, and that the Congo basin was rich enough to repay exploitation." By June 1884 this had been accomplished with success and without bloodshed or any degree of unpleasantness with the often ferocious native tribes. The details of the six years' labours between 1878 and 1884 are given in the *Congo and the Founding of its Free State,* published in 1885. In the latter part of February 1885 a convention with the Powers had established that the major part of the Congo basin should be known henceforth as the Congo Free State, under the sovereignty of King Leopold. The story of the Congo is important by reason of its influence on African colonization. Prior to the formal foundation of the State by the Powers, and during the sittings of the Berlin Conference in 1884–1885, Stanley had not only lectured in the capital upon the value of Africa before the assembled ambassadors, but had made a tour of the larger cities of Germany. Alike in these as in Berlin he discovered that the Germans were much more alive than the British. Possibly not by reason of his lectures, but certainly directly after them, and dating from the doings in the Congo basin then and otherwise revealed, the struggle on the part of the Powers for the possession of African territory began.

During 1885 and 1886 Stanley was engaged with Sir William Mackinnon and Mr James F. Hatton of Manchester in two ventures, each of potential consequence to the future of British commerce in East Africa, one of which was, however, doomed to failure. The first project afterwards developed into the British East Africa Company; the other, the Royal Congo Railway Company, which in the event of its succeeding was to obtain a charter from the King of the Belgians, fell before the indifference of English capitalists, combined with a clause in the charter to which, in British interests, Stanley was unable to agree.

Stanley's last and most familiar expedition in Africa was for the ostensible purpose of succouring Emin Pacha (*q.v.*) from the Equatorial Provinces, where the abandonment of the Sudan by Egypt was supposed to have left him in danger. The story of the expedition and the results are set forth in Stanley's best-known work, *Through Darkest Africa,* a record of extraordinary effort and resolution. So far as Emin was concerned, however, the expedition was undertaken on a complete misunderstanding.

Returning to England after his last expedition Stanley was received with honour, and received the degrees of D.C.L. from Oxford and of LL.D. from Cambridge. On 12th July 1890 he married a lady whose graceful work as an artist was well known to the public, Miss Dorothy Tennant, second daughter of Mr Charles Tennant, formerly M.P. for St Albans. In 1891–92 he visited the United States, Australia, and New Zealand on lecturing tours. In 1892, at the general election, he contested North Lambeth in the Liberal Unionist interest, but was defeated by a small majority. In 1895 he again stood for the same constituency, and was elected as its parliamentary representative, but was compelled by ill-health to resign in 1900. In 1898 Stanley visited South Africa as the guest of the British South Africa Company, and spoke at the opening of the railway from the Cape to Bulawayo. In 1899 his services in Africa were rewarded by a knighthood of the Bath. Too strong or too arbitrary a man perhaps to be invariably popular with his subordinates, too reserved to be popular in the general acceptation of the word, and gifted with immovable resolution, Stanley possessed a positive genius for the handling of native races. As governor of the Congo his task in this respect was enormously difficult, but was accomplished with great success.

Stanley, Thomas (1625–1678), poet and philosopher, was the son of Sir Thomas Stanley of Cumberlow, in Herts, where he was born in 1625. His mother, Mary Hammond, was the cousin of Richard Lovelace, and Stanley was educated in company with the son of Edward Fairfax, the translator of Tasso. He proceeded to Cambridge in 1637, in his thirteenth year, as a gentleman commoner of Pembroke Hall. In 1641 he took his M.A. degree, but seems by that time to have proceeded to Oxford. He was wealthy, married early, and travelled much on the Continent. He was the friend and companion, and at need the helper, of many poets, and was himself both a writer and a translator of verse. His *Poems* appeared in 1647; his *Europa, Cupid Crucified, Venus Vigils,* in 1649; his *Aurora, Ismenia and the Prince,* in 1649; and a collection of these poems, and translations in 1651. Stanley's most serious work in life, however, was his *History of Philosophy,* which appeared in four successive volumes between 1655 and 1662, and again in one volume in 1687. In 1662 was issued his *History of Chaldaic Philosophy.* In 1663 Stanley published in folio a monumental edition of the text of Æschylus. He died at his lodgings in Suffolk Street, Strand, on 12th April 1678, and was buried in the church of St Martin's in the Fields. His portrait was painted by Sir Peter Lely; his wife was Dorothy, daughter and co-heir of Sir James Emyon, of Flower, in Northamptonshire. Stanley is a very interesting transitional figure in English literature. Born into a later generation than that of Waller and Denham, he rejected their reforms, and was the last to cling obstinately to the old prosody and the conventional forms of fancy. He is the frankest of all English poets in his preference of decadent and Alexandrine schools of imagination; among the ancients he admired Moschus, Ausonius, and the *Pervigilium Veneris;* among the moderns, Joannes Secundus, Gongora, and Marino. The English Metaphysical School closes in Stanley, in whom it finds its most delicate and autumnal exponent, who went on weaving his fantastic conceits in elaborately artificial measures far into the days of Dryden and Butler. When Stanley turned

to prose, however, his taste became transformed. He abandoned his decadents for the gravest masters of Hellenic thought. As an elegant scholar of the illuminative order, he secured a very high place indeed throughout the second half of the 17th century. His *History of Philosophy* was long the principal authority on the progress of thought in ancient Greece. It took the form of a series of critical biographies of the philosophers, beginning with Thales; what Stanley aimed at was the providing of necessary information concerning all "those on whom the attribute of Wise was conferred." He is particularly full on the great Attic masters, and introduces, "not as a comical divertisement for the reader, but as a necessary supplement to the life of Socrates," a blank verse translation of the *Clouds* of Aristophanes. Bentley is said to have had a very high appreciation of his scholarship, and to have made use of the poet's copious notes, still in manuscript, on Callimachus. Stanley's original poems were imperfectly reprinted in an edition of 100 copies in 1814, but never since; his "Anacreon" was issued, with the Greek text, by Mr Bullen in 1893. His prose works have not been collected. (E. G.)

Stapleton, formerly a village in Richmond county, New York, U.S.A., and since 1st January 1898 a part of Richmond borough, one of the five boroughs of which New York City is composed. It is situated on the east coast of Staten Island, just above the narrows of New York harbour. The population is not separately returned by the census.

Stára-Zagóra. See Eski-Zagra.

Stargard, a town of Prussia, in the province of Pomerania, 21 miles by rail east by south of Stettin. The walls have been for the most part converted into promenades, though nearly all the old gates are left. The town has a memorial of the war of 1870–71. It has an active trade in agricultural produce, and carries on iron-founding, making of machinery, soap, roofing, oil and spirit-refining. Population (1885), 22,112; (1900), 26,858. Stargard is also the name of a town in the province of West Prussia, 36 miles by rail south of Danzig. It has a couple of churches and a synagogue, iron foundries, and snuff factories. Population (1885), 6634; (1900), 9687.

Starocherkasskaya, a Cossack village of Russia, in the province of the Don Cossacks, on the Don, 27 miles from Novocherkassk. It was formerly the residence of the Ataman of the Don Cossacks. In consequence, however, of the frequent inundations to which it is subject, the seat of administration was moved to Novocherkassk. There is a brisk trade in cattle, which are exported. Population (1897), 10,314.

Staryi Oskoł, a district town of Russia, in the government and 92 miles E.S.E. of the town of Kursk, on the Elets-Valuiki Railway and the river Oskoł, in the midst of populous suburbs and villages. A fort was built here as early as the 10th century, but even four centuries later the region had the name of "Wild Prairie" (*Dikoye Pole*). In 1897 the population numbered 16,662, most of whom were engaged in agricultural pursuits. The only industrial establishments are a couple of tobacco factories and some tanneries, but there is a brisk trade in animal and agricultural products.

State.—As currently employed in that department of political science which concerns itself, not with the relations of separate political entities, but with the political composition of society as a whole, the word state expresses the abstract idea of government in general, or the governing authority as opposed to the governed, and is thus used by Herbert Spencer in all his discussions of government and society. Louis XIV.'s "L'État, c'est moi," Rousseau's theory of the "contrat social," Bastiat's "Donne à l'État le strict nécessaire et garde le reste pour toi," all imply this opposition. Hobbes regards the state, or, as he calls it, the commonwealth, as "one person for whose acts a great multitude by mutual covenants, one with another, have made themselves every one the author, to the end he may use the means and strength of them all as he shall think expedient for their peace and common defence."

Definition.

The term is also used to distinguish the civil from the ecclesiastical authority in countries where they are or have been in conflict.

A large number of definitions and classifications, according to political structure, international status, national homogeneity, &c., have been attempted, but it is beyond the scope of a short article to do more than mention these different senses of a word so variously employed.

In international law the term has a more precise meaning, according to which the state is the external personality or outward agency of an independent community. In its fullest form its attributes are: (*a*) possession of sovereign power to pledge the community in its relations with other similarly sovereign communities, (*b*) independence of all external control, and (*c*) dominion over a determinate territory. In practice, however, there are still incomplete forms of states which join in the international life of states, paramount states whose relations to subordinate parts of their empire are in a condition of uncertainty, and there is, at any rate, one body carrying on international state intercourse without dominion over any territory at all. Thus, Great Britain has diplomatic relations, purely formal though they may be, with several of the subordinate states forming the German empire. We saw in the Boer war the army of an annexed community wandering from place to place recognized as a belligerent with whom Great Britain had negotiated as an independent state. The Roman Catholic Church has permanent diplomatic relations as an independent state, though it has no territory against which international rights can be enforced. Egypt, while legally under the suzerainty of the Porte, is practically a British protectorate. Great Britain treats Cyprus as a dependency, though she is in mere occupation of the island for the purpose of carrying out certain reforms for the protection of Christians. Austria-Hungary considers herself in the same position, though she occupies Bosnia and Herzegovina "without affecting the rights of sovereignty of his Majesty the Sultan on those provinces." Though Bulgaria, by the Treaty of Berlin, is an "autonomous and tributary principality under the suzerainty of his Imperial Majesty the Sultan," Turkey did not consider her suzerainty to involve her in the war of 1885 between her vassal and Servia.

Attributes in international law.

A new and somewhat shadowy form of suzerainty is growing up in the "paramountcy" first enunciated (with the concurrence of Great Britain) by the President of the United States in 1823 (see Monroe Doctrine), asserted with a certain measure of success against Great Britain in 1896 (see Venezuela, also Arbitration), and proclaimed formally by the United States at The Hague conference in 1899 (see Peace Conference) as a condition of her signature of the Peace Convention. While the Spanish republics of Central and South America[1] are still recognized in

[1] Only Mexico was represented at the Peace Conference.

international law as sovereign states, they can only be said to fulfil the conditions of absolute independence subject to the limitations which the Monroe Doctrine has placed upon their treaty-making powers with Europe.[1]

"In constitutional law, the state," says a leading English authority, "is the power by which rights are created and maintained, by which the acts and forbearances necessary for their maintenance are habitually enforced" (Anson, *Law and Custom of the Constitution*, part i. p. 2). The definition is necessarily vague where, as in the British empire, the state has a very complex construction. In France, where it embraces a hierarchy of bodies and authorities culminating in the President of the republic, whose acts are the final form of a series of incomplete acts of the members of the hierarchy, it comes nearer to the theoretical meaning of the word as understood in international law. In Great Britain the sovereign power of the state is diffused among a number of authorities which have rights against each other and stand in independent relation towards the individual citizens. Actions can be brought by private citizens in the ordinary law courts against individual authorities, and there is no system of hierarchical responsibility which prevents a state official from being personally accountable for his administrative conduct. In Professor Dicey's admirable *Introduction to the Study of the Law of the Constitution*, this distinction between the French, or, as we should rather call it, Continental system of entire subordination of the organs to the state as a whole, and the less logical British system is dwelt upon. "Few things," he observes, "are more instructive than the examination of the actions which have been brought in Great Britain against officers for retaining ships about to proceed to sea. Under the Merchant Shipping Act, 1876, the Board are open to detain any ship which, from its unsafe and unseaworthy condition, is a serious danger to human life." "Most persons would suppose that the officials of the Board of Trade, so long as they—*bonâ fide* and without malice or corrupt motive—endeavour to carry out the provisions of the statute, would be safe from action at the hands of a shipowner. This, however, is not so. The Board and its officers have more than once been sued with success. They have never been accused of either malice or negligence, but the mere fact that the Board acts in an administrative capacity is not a protection to the Board; nor is mere obedience to the orders of the Board an answer to an action against its servants" (p. 324).

British and Continental conceptions.

In England, we may say, the notion of state, from the constitutional point of view, is still inchoate, but the play of international intercourse seems to be gradually leading to a clearer conception of the fact that an increasing national responsibility requires a corresponding increase in the power of co-ordinate state control. An instance of its absence is shown by the loose way in which the British Crown has granted governing powers to chartered companies (see Raid). This uncertainty applies as much to the United States as to Great Britain. In the Louisiana lynching riots, of which some Italian citizens were the victims, it was contended that the United States Government was not responsible, and that the responsibility fell upon the Government of Louisiana alone. This contention could not be pressed, and compensation was of course paid to Italy. But the subject is well known to have raised some apprehension as to the adequacy of the United States system to meet its centralized state responsibilities.

Another, and, in some respects, more dangerous feature of the inchoate conception of state responsibility is the growing apart, so to speak, of certain British dependencies. The British state, for international purposes, is the British empire; for domestic purposes it is the United Kingdom. Any limb of the former's huge body can have interests different from those of the United Kingdom, and involve its responsibility. A significant step towards co-ordination in the Continental sense—that is to say, towards the concentration of liability and control—was taken by the Australian colonies in the federation brought about by the Commonwealth Act of 1900. Under this Act the term state is applied to the federating colonies. Section 6 of the Act provides "The states" shall mean such of the colonies of New South Wales, New Zealand, Queensland, Tasmania, Victoria, West Australia, and South Australia, as for the time being are parts of the Commonwealth, and such colonies or territories as may be admitted into or established by the Commonwealth as states; and each of such parts of the Commonwealth shall be called "a state." "Original states" shall mean "such states as are parts of the Commonwealth at its establishment." Following out this distinction between the Commonwealth and the states, Articles 106 to 124 of the Commonwealth Constitution deal with the respective positions of the Commonwealth, the original states, and the new states. Article 109 in particular provides that "When a law of a state is inconsistent with a law of the Commonwealth, the latter shall prevail, and the former shall, to the extent of the inconsistency, be invalid," thus paving the way for the ultimate consolidation of the federal power.

Political science.

Much has been written on the "science" of the state, or, as we prefer to call it, "political science," and especially by the Germans, among whom the subject is dealt with as an independent branch of university education. Several German universities have a *Staatswissenschaftliche Facultät*, granting special degrees on the subject. In consequence of the great attention paid to the subject in Germany, her state polity is largely the work of her political writers. The result has not unnaturally tended to a system bearing some resemblance to that of the American Union, with this very important difference, however, that whereas in the United States the federal power is derived from the democratic forces of the individual states, in Germany it is derived from their aristocratic and absolutist forces. German political thinkers, in fact, have worked out *Staatsrecht* as a comparative study, in which arguments in favour of absolute government have received as much careful consideration as those in favour of democratic institutions, and the German state has developed upon lines based on the best theoretical arguments of these thinkers. There is,

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[1] Great Britain, in acceding to the arbitration imposed by President Cleveland, has, in the opinion of a number of American and Continental publicists, recognized the Monroe Doctrine. See Chrétien, *Principes*; De Beaumarchais, *La Doctrine de Monroe*; De Bustamente, *Le Canal de Panama et le Droit International*; De Pressensé, "La Doctrine de Monroe et le Conflit Anglo-Americain," *Revue des Deux Mondes*, an. 1896; also the writings of Ridgway, Scruggs, Sibley, and Tucker, and the *Annales de Jurisprudencia* (Columbia), June 1897 and following numbers. M. Pradier-Fodéré, Professor of International Law at Lyons University, and formerly professor of the University of Lima, observes that "En déclarant que la grande république Américaine considérerait comme dangereuse pour sa tranquillité et sa sécurité toute tentative de la part des puissances Européennes d'étendre leur système politique à *une partie quelconque* du continent Américain, il (le Président) s'est mêlé indirectement des affaires intérieures des républiques du Nouveau Monde, autres que les États Unis; il a fait de l'intervention par anticipation et au profit de l'Union; car, c'est d'intervenir que d'interdire aux autres gouvernements d'intervenir."

therefore, no anomaly in its practically absolutist Government working out the most democratic reforms as yet put into legislative form. It follows, however, that German theories are of little use in the consideration of the state problems with which British and American political thinkers have to deal. Anglo-Saxon institutions are following their independent development, and if the influence of foreign institutions is to be felt at all, it will probably be that of the clear logical detail and cohesion of French institutions.

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State Pensions. See OLD-AGE PENSIONS.

States of the Church, territories of Italy ruled over, down to 1860, by the Pope in his capacity as a secular sovereign. They are now comprised within the Italian provinces of Bologna, Ferrara, Forlì, Ravenna, Pesaro and Urbino, Ancona, Macerata, Ascoli-Piceno, Perugia, Rome, and Benevento.

Staunton, a city of Virginia, U.S.A. It is situated in 38° 09′ N., and 79° 04′ W., in the upper part of the Shenandoah Valley, in the western part of the state, at the intersection of the Chesapeake and Ohio and the Valley branch of the Baltimore and Ohio railways, at an altitude of 1366 feet. Though within the limits of Augusta county, it is not subject to county government. Population (1890), 6975; (1900), 7289, of whom 149 were foreign-born and 1828 negroes.

Stavanger, a seaport town of Norway, capital of county Stavanger, standing on the south of Bukken Fjord, just under 59° N. During the last decade of the 19th century Stavanger and its environs (Sannäs, &c.) made remarkably rapid progress as a manufacturing centre. The industries are, however, of a varied character, and embrace factories for woollens, soap, preserved foods (a speciality), butter and margarine, artificial manure, hardware, potteries, bricks and tiles, linens and cottons, furniture and wooden wares, worsted yarn, iodine from seaweed, shoes, lime, potato flour, &c.; also two shipbuilding yards and foundries, with a repairing slip (1899). Another important industry is the catching and curing of fish—herring, mackerel, sprats, cod, salmon, lobsters, anchovies. On Rennes Island in the fjord, over against the town, there exists a (Cheviot) sheep-breeding farm under Government auspices. Stavanger is the first port of call for tourist boats from Hull, Newcastle, Grangemouth, and other British ports. The mercantile fleet numbers about 375 vessels of 162,400 tons; while the total value of the trade increased from £350,000 in 1885 to £795,700 (£563,700 imports) in 1899. The imports consist principally of coal, salt, grain and flour, groceries, textiles, wood, and mineral oils. The most important export is fish—other items being seaweed, marble, preserved foods, butter and margarine, and infusorial earth. Down to 1895 Stavanger had a growing trade in the export of sheep to Leith. The port is entered by some 8000 vessels of a gross 325,000 tons annually, or, excluding those flying the Norwegian flag, by 270 vessels of 150,000 tons. Stavanger was the birthplace of Kjelland the novelist (1849). Population (1891), 23,899; (1900), 30,541.

Stavropol, a government of Russia, in northern Caucasia, with an area of 23,398 square miles. The climate is distinguished by rapid changes of temperature. The dry east winds are sometimes very strong in the spring and early summer, blowing the seeds out of the fields, and even destroying in a few days all existing vegetation. In July and August they last for several weeks in succession, and fill the air with dust. The average temperatures at Stavropol (altitude 2000 feet) are much lower than one might expect in that latitude; that for the year is 47° Fahr., that for January 24°, and that for August 68°. The rainfall is 28·2 inches, but other parts of the province are much worse off in this respect, the yearly rainfall being only from 11·1 to 21·5 inches. There is a great lack of forests, which are found only near Stavropol and along the courses of the main rivers. In the prairies, only bushes of tamarisk and a dwarf almond tree are found. Altogether, except in the hilly parts of the province, the flora and fauna of Stavropol differ to a great extent from the fauna and flora of other parts of the Caucasus. For both the animal and vegetable kingdoms resemble, on the one hand, those of Central Asia in such features as the presence among mammals and birds of the *Saiga tatarica*, L., the *Vulpes Corsac*, Pallas, and the *Melanocorypha tatarica*, Pall., and among plants of, firstly, the *Tamarix Pallasii*, the *Statice caspia*, and the *Stipa lessingiana* (all characteristic of the dry prairies beyond the Urals), and, secondly, of species of *Salsola*, *Salicornia*, *Sueda*, *Artemisia*, *Kochia*, and *Camphorosma* (all characteristic of the salted steppes of Asia); on the other hand, both flora and fauna have many features in common with the prairies of South Russia. As regards geology, the whole of the province is covered with Tertiary and post-Tertiary deposits. Lower Miocene, Middle-Mediterranean deposits, and Sarmatian clays, limestones and sandstones crop out over nearly one-half of the surface of the province, namely, in its higher portion, while the remainder is covered with loess and various fluviatile and lacustrine deposits. A narrow zone, which now represents a low plain almost devoid of vegetation, is covered with the so-called Caspian deposits.

The population is rapidly increasing, particularly from natural causes, and partly in consequence of immigration. In 1886 it was 702,635; in 1897, 876,298 (census population, domiciled only); and in 1898, 912,639, of whom 447,082 were women, and 51,324 lived in towns. The

average density of the population is only 39 per square mile, but in some districts it rises to 87. Russians form 90 per cent. of the population, Kalmyks 2 per cent., Turkomans 3 per cent., Nogais 4 per cent., the remainder being Armenians, Georgians, Germans, Poles, &c. More than four-fifths of the population (81 per cent.) are Russian peasants. The nomad population occupies, however, more than one-third of the territory. There are four ordinary districts, the centres of administration in which are—Stavropol (see below), Alexandrovsk (8708), Medvyezhinsk (4000), and Praskoveya (9297 in 1896), the chief town of the district of Novogrigorievsk; besides these the territory occupied by the nomads is divided into three districts (*pristavstvo*)—Bolshe-Derbetovskiy, Turkoman, and Achikulak. The standard of education is the average for Russia; in 1898 there were 578 schools, attended by 22,000 boys and 9000 girls. In 1897 the peasants owned 8,111,500 acres of land; private persons, 1,236,800 acres; the Imperial Government, 304,600 acres; and the Crown, 265,000 acres. Agriculture is most successful on the wide prairie lands, and in 1900 3,295,600 acres were under cereals. The average yield in 1895–99 was: rye, 419,500 cwt.; wheat, 7,254,000 cwt.; oats, 1,270,000 cwt.; barley, 2,001,000 cwt.—all cereals, 11,712,000 cwt.; also about 500,000 cwt. of potatoes. Melons, water-melons, and sunflowers are widely cultivated in the fields, and so is flax. Improved agricultural implements—reapers, sowing machines, steam- and horse-power threshing machines, &c.—are in general use. Nearly 9200 acres are under vineyards, which cover close upon 100 miles along the Kuma, and nearly 800,000 gallons of wine of an inferior quality are obtained annually. There were in 1898 199,470 horses, 760,690 horned cattle, 2,790,700 sheep, 8200 camels, and 102,000 pigs. These figures are much below those which were obtained from a census in 1896, the cause of the decrease being a very severe winter in 1898, when snowstorms destroyed in a few days more than 200,000 head of cattle. The factories are limited to flour-mills, oil-mills, distilleries, tanneries, and candle works, and few domestic industries are carried on in the villages. Considerable quantities of grain, flax, wool and hides are exported however, and the fairs are very animated. An interesting feature of the village life, in some parts of the province, is the communal cultivation of certain fields for the maintenance of reserve stores of grain. (P. A. K.)

Stavropol, the capital of the above government, 360 miles north-west of Tiflis, and 30 miles from the nearest railway station, standing at an altitude of 2000 feet. It has flour-mills and various small factories, employing a few hundred workers. Of educational institutions there are gymnasia for boys and girls, and several town schools and industrial schools, showing an aggregate of 5600 pupils. The town is well built, has several libraries and a people's palace, and is the seat of several scientific societies. Its population (mostly Russian) was 44,679 in 1897.

Stawell, borough, Victoria, Australia, in the county of Borung, 179 miles north-west of Melbourne. The quartz reefs of the gold district are worked at great depths, and large cyanide works are in operation. Wheat is extensively grown in the vicinity, and the soil is well adapted for vine-growing, which has been attempted with success. Population (1891), 5183; (1901), 5296.

Stawell, Sir William Foster (1815–1889), British colonial statesman, was the son of Jonas Stawell of Old Court, in the county of Cork, and of Anna, daughter of the Right Rev. William Foster, Bishop of Clogher. He was born on 27th June 1815, was educated at Trinity College, Dublin, studied law at King's Inn, Dublin, and Lincoln's Inn, and was called to the Irish bar in 1839. He practised in Ireland until 1842, and then making his home in Australia, was admitted to the Melbourne bar in 1843. He engaged extensively in pastoral pursuits, and had sheep stations at Natte Yallock, on the banks of the river Avoca, and in the neighbourhood of Lake Wallace, near the South Australian border. For many years he enjoyed the leading practice at the local bar, and when the Port Phillip district of New South Wales was separated from the parent colony, and entered upon an independent existence as the Colony of Victoria, Mr Stawell accepted the position of attorney-general, and became a member of the Executive and Legislative Councils. A few weeks after his appointment gold was discovered, and to Mr Stawell fell the arduous duties of creating a system of government which could cope adequately with the difficulties of the position. He had to establish a police force, frame regulations for the government of the gold-fields, appoint magistrates and officials of every grade, and protect life and property against the attacks of the hordes of adventurers, many of desperate character, who landed in Victoria, first from the neighbouring colonies, and later from Europe and America. It was very much owing to the firm administration of Mr Stawell that at a time when the Government was weak, and a large section of the new-comers impatient of control, lynch law was never resorted to. He had very little assistance for some time from any of his colleagues, and until the Executive Council was strengthened by the admission of Captain (afterwards Sir Andrew) Clarke and Mr H. C. E. Childers, Mr Stawell was the brains as well as the body of the administration. The success of his policy was upon the whole remarkable. In the Legislature he was sometimes opposed, and at other times assisted, by Mr (afterwards Sir John) O'Shanassy, who was the leader of the popular party, and between them they managed to pass a number of statutes which added greatly to the prosperity of the colony. Mr Stawell was indefatigable in the discharge of his duties, and extraordinary stories are told of the long journeys on horseback to visit distant outposts which he would take after being all day long in the Law Courts or the Council Chamber. Mr Stawell bore an active part in drafting the Constitution Act which gave to Victoria representative institutions and a responsible Ministry, instead of an executive, appointed and removable by the governor, and a legislature in which one-third of the members were chosen by the Crown. At the first general election after the new Constitution in 1856, Mr Stawell was returned as one of the members for Melbourne, and became the attorney-general of the first responsible Ministry. In 1857, on the resignation of the chief-justice, Sir William A'Beckett, he succeeded to the vacant post, and was created a knight-bachelor. He administered the Government of Victoria in 1873, 1875–76, and 1884. Sir William never left Australia from his arrival in 1843 till 1872, when he paid short visits to the neighbouring colonies and New Zealand, and 1873, when he returned to Europe on two years' leave of absence. He took a very deep interest in the proceedings of the Church of England, and was a member of the Synod. On his retirement from the bench in 1886 he was created K.C.M.G. He died at Naples in 1889. In 1856 he had married Mary Frances Elizabeth, only daughter of W. P. Greene, R.N. (G. C. L.)

Steam Engines. See ENGINES.

STEAM-SHIP LINES.

THE purpose of this article is not to trace the beginnings of steam navigation from an engineer's point of view, but to give some idea of the more important of the commercial undertakings which have been organized with the object of offering facilities to mails and passengers and higher class cargo. The shipping company is the outcome of the development of the steam-ship. In former days, when the packet ship was the mode of conveyance, there were combinations, such as the well-known Dramatic and Black Ball Lines, but the ships which were run in them were not necessarily owned by those who organized the services. The advent of the steam-ship changed all that. It was in the year 1815 that the first steam-ship began to ply between the British ports of Liverpool and Glasgow. In 1826 the *United Kingdom*, a "leviathan steam-ship," as she was considered at the time of her construction, was built for the London and Edinburgh trade, steam-ship facilities in the coasting trade being naturally of much greater relative importance in the days before railways. In the year 1823 the City of Dublin Steam Packet Company was inaugurated, though it was not incorporated till ten years later. The year 1824 saw the incorporation of the General Steam Navigation Company, which was intended not only to provide services in British waters, but also to develop trade with the Continent. The St George Steam Navigation Company and the British and Irish Steam Packet Company soon followed. The former of these was crushed in the keen competition which ensued, but it did a great work in the development of ocean travelling. Isolated voyages by vessels fitted with steam engines had been made by the *Savannah* from the United States in 1819, and by the first *Royal William* from Canada in 1833, and the desirability of seriously attacking the problem of ocean navigation was apparent to the minds of shipping men in the three great British ports of London, Liverpool, and Bristol. Three companies were almost simultaneously organized: the British and American Steam Navigation Company, which made the Thames its headquarters; the Atlantic Steam-ship Company of Liverpool; and the Great Western Steam-ship Company of Bristol. Each company set to work to build a wooden paddle steamer in its own port. The first to be launched was the *Great Western*, which took the water in the Avon on 19th July 1837. On 14th October following the *Liverpool* was launched by Messrs Humble, Milcrest, and Co., in the port from which she was named, and in May 1838 the Thames-built *British Queen* was successfully floated. The *Great Western* was the first to be made ready for sea.

But the rival ports were determined not to be deterred by delays in getting delivery of their specially built ships. The London Company chartered the *Sirius*, a 700-ton steam-ship from the St George Steam Packet Company, and despatched her from London on 28th March 1838. She was thus the first to put to sea. She eventually left Cork on 4th April, and reached New York on 22nd, after a passage of 17 days. The *Great Western* did not leave Bristol till 8th April, but she reached New York only a few hours after the *Sirius*. The Liverpool people, fired by the action of the other two ports, chartered the *Royal William* from the City of Dublin Steam Packet Company, and despatched her on the first steam voyage from the Mersey to Sandy Hook on 5th July in the same year. The *Liverpool* made her maiden voyage in the following October. But the *British Queen* did not make her initial attempt till 1st July 1839. Trouble overtook all three of these early Atlantic lines, and they soon ceased to exist.

Perhaps the most serious factor against them was the success of Mr Samuel Cunard in obtaining the Government contract for the conveyance of the mails from Liverpool to Halifax and Boston, with a very large subsidy. The Cunard Line was enabled and indeed, by the terms of its contract, obliged, to run a regular service with a fleet of four steamships identical in size, power, and accommodation. It thus offered conveyance at well-ascertained times, and by vessels of known speed. The other companies, with their small fleets of isolated ships and their irregular departures, could not continue the competition. The Atlantic Steamship Company of Liverpool found that the port could not then maintain two steam-ship lines, and the steam-ship *Liverpool*, with another somewhat similar vessel which they had built, fell into the hands of the P. and O. Company. The Great Western Steam-ship Company proceeded to build the *Great Britain*, an iron screw steam-ship, which in every way was before her time, and were swamped by financial difficulties, their *Great Western* being sold to the West India Royal Mail Company, to whom she became a very useful servant. The *Great Britain* eventually drifted into the Australian trade. The London Company put a second ship, the *President*, on their station. She was lost with all hands, no authentic information as to her end ever being obtained. Her mysterious fate settled the fortunes of her owners, and the *British Queen* was transferred to the Belgian flag. Steam navigation across the Atlantic was now an accomplished fact. But all the three pioneers had been borne down by the difficulties which attend the carrying out of new departures, even when the general principles are sound.

Constant improvement has been the watchword of the shipowner and the shipbuilder, and every decade has seen the ships of its predecessor become obsolete. Thus, to speak roughly, the 'fifties saw the iron screw replacing the wooden paddle steamer; the later 'sixties brought the compound engine, which effected so great an economy in fuel that the steam-ship, previously the conveyance of mails and passengers, began to compete with the sailing vessel in the carriage of cargo for long voyages; the 'seventies brought better accommodation for the passenger, with the midship saloon, improved state-rooms, and covered access to smoke rooms and ladies' cabins; the early 'eighties saw steel replacing iron as the material for shipbuilding, and before the close of that decade the introduction of the twin-screw rendered breakdowns at sea more remote than they had previously been, at the same time giving increased safety in another direction, from the fact that the duplication of machinery facilitated further subdivision of hulls. Now the masts of the huge liners in vogue were no longer useful for their primary purposes, and degenerated into mere signal poles, while the introduction of boat decks gave more shelter to the promenades of the passengers, and removed the navigators from the distractions of the social side. The provision of train-to-boat facilities at Liverpool and Southampton in the 'nineties did away with the inconveniences of the tender and the cab.

In the following pages some of the ships which first embodied these improvements are mentioned, a brief history of the principal lines is attempted, and reference is made to some of the milestones on the road of improvement. The tonnage and numbers of vessels in the fleets are, however, given in a table, as this is a point on which every month leaves its mark. At the present time the notable

features would seem to be the fact that increase of size in individual ships still continues, and that owing to the great cost of constructing and working such huge craft the tendency is towards centralizing trade, and especially passenger trade, in the hands of great companies. The movement towards amalgamation among these big companies is also an interesting development.

The Allan Line.—The story of the Allan Line is that of the enterprise of one family. Captain Alexander Allan, at the time of the Peninsular war, conveyed stores and cattle to Lisbon for Wellington's army. After 1815 he began to run his vessel between the Clyde and Canada, and as years went on he employed several vessels in the service. Till 1837 the ships ran from Greenock to Montreal, but in that year, after the Clyde was deepened, the ships went to Glasgow, as they have continued to do ever since. Captain Allan and his five sons devoted all their energies to the development of the Canadian trade, and for about forty years the line ran sailing ships only, which were greatly in request for the emigrant traffic. In 1852 the Canadian Government requested tenders for a weekly mail service between Great Britain and Canada. That of Sir Hugh Allan of Montreal, one of Captain Allan's sons, was accepted, and the Canadian mail line of steam-ships came into existence. From that time onwards the business has steadily increased, and the building of vessels to keep pace with modern demands has been proceeded with. From the time of the Crimean war down to the South African campaign the company's vessels have been employed as transports on occasions of national emergency. It may be noted that the Allan Line inaugurated steamers of the "spar-deck" type, *i.e.*, with a clear promenade deck above the main deck. This measure of safety was taken as a lesson to be derived from the disastrous foundering of the Australian steam-ship *London* in the Bay of Biscay in the year 1866. The company may claim, too, that their steam-ship *Buenos Ayrean*, built for them in the year 1879 by Messrs Denny of Dumbarton, was the first Atlantic steam-ship to be constructed of steel. As time went on the company's services were extended to various ports on the eastern shores of North America and in the river Plate; and London, as well as the two strongholds of Glasgow and Liverpool, was taken as a port of departure. In the course of its career it has absorbed the fleet of the old State Line of Glasgow and a great part of the fleet of the Royal Exchange Shipping Company, and of the Hill Line. Included in the latter fleet were the first twin-screw steamers constructed for a British North Atlantic line. The largest vessel in the fleet is the *Tunisian*, a twin-screw vessel of 10,376 tons, launched in January 1900; a sister ship, the *Bavarian*, carried as many as 2200 troops at once to the Cape. The principal ports served by the Allan Line are (in the United Kingdom) Glasgow, Londonderry, Belfast, Liverpool, and London; from these their vessels ply to many places in North and South America, including Quebec, Montreal, St Johns (Newfoundland), Halifax, St John (New Brunswick), Portland, Boston, New York, Philadelphia, Baltimore, Monte Video, Buenos Aires, and Rosario. The finest steamers of the company are run in the mail service from Liverpool to St Lawrence ports in summer, and to Halifax in the months when that river is closed.

American Line.—Though the American Line, as now constituted, is of comparatively modern origin, it is the successor of several much older organizations. Of these the oldest is the Inman Line last acquired by it. On 16th April 1850 an iron screw steam-ship of 1609 tons gross register left Glasgow on her maiden trip to New York. This was the beginning of the Inman Line. After a few voyages this ship was sold to Messrs Richardson, Spence and Company of Liverpool, and the sailings of the steam-ships were thenceforth for some years between Liverpool and Philadelphia. But in 1857 New York took the place of Philadelphia as a regular terminus. Messrs Inman had taken the management of the line in 1854, and a little later the fleet of another Glasgow and New York line was absorbed. In 1859 the regular call at Queenstown was commenced by this line, which may be said to have been responsible for two other innovations in transatlantic traffic. Before 1850 practically all the steam-ships crossing the ocean, with the famous exception of the *Great Britain*, were paddle-boats. After the advent of the Inman liners the screw began to be everywhere substituted for the paddle. In the second place, the Inman steamers were the first which regularly undertook the conveyance of third-class passengers, to the extinction of the old clipper vessels which had hitherto carried on the traffic. In 1867 the Inman Company's *City of Paris* (the first bearing the name) held the westward record with 8 days 4 hours, and in 1869 its *City of Brussels* came home in 7 days 22 hours 3 minutes. Till 1872 these records held good. The *City of Brussels* also had the distinction of being the first Atlantic mail steamer to be fitted with steam steering-gear. About 1875 Mr William Inman turned the concern into a limited company, and in 1886 the business was amalgamated with the International Company, and the vessels, though still flying the red ensign, became the property of a group of United States capitalists, who also acquired the old American Line which had been started in 1873 with four Philadelphia-built steamers. This company had been conducted under the auspices of the Pennsylvania Railroad. It plied between Liverpool and Philadelphia. A third constituent in the Inman and International Steam-ship Company was the Red Star Line, as the Société Anonyme Belge-Americaine was familiarly called. Its service was from Antwerp to New York. The whole was placed under the management of Messrs Richardson, Spence and Company, who thus after thirty-two years reassumed the direction of the old company. In 1887 the two ships *City of New York* and *City of Paris* were built on the Clyde for the company. At the time of their construction they were the largest vessels ever built, always excepting the unlucky *Great Eastern*. It stands to the credit of the *City of Paris* that in 1889 she was the first vessel to cross the Atlantic in less than six days. In these ships there was a great improvement in the whole arrangement of the water-tight compartments, more subdivisions being introduced. The *City of Paris* had the opportunity of demonstrating their value. In 1890 one of her engines was completely wrecked. The water flowed in and inundated the engine-rooms, yet her bulkheads kept her afloat until help came. The year 1893 was an important one in the history of the company, and indeed of the United States. The two vessels above mentioned were admitted to American registry by Congress, a stipulation being made that two new ships of at least equal tonnage and speed to the pair should be ordered by the company from American firms, and that they should be capable of being employed by the United States Government as auxiliary cruisers in case of war. The American flag was hoisted over the *New York* in 1893 by President Harrison, and in the same year the British headquarters of the company were transferred from Liverpool to Southampton. In 1894 the first American-built ocean liner of the new fleet was launched, and was named the *St Louis* by Mrs Cleveland, the wife of the then President of the United States. In 1898 the American Line had the distinction of supplying the navy of its country with cruisers for use in war. The *St Paul*, the only vessel of the four under contract in American waters at the time, was put under the command of

Captain Sigsbee, whose own battleship, the *Maine*, had been blown up in Havana harbour on 15th February. The other three ships were also put into commission, the *Paris* being temporarily renamed the *Yale*, and the *New York* the *Harvard*. Their exploits may be read in the annals of the war. Fitted up as swift cruisers they proved invaluable auxiliaries to the fleet, both as fighting vessels and in the pursuit and capture of blockade-runners. In 1902 with their twin-screw liner *Kensington* the American Line made the first experiments towards fitting Atlantic passenger steamers with appliances for the use of liquid fuel. The express fleet of the line consists of the four vessels, *St Louis* and *St Paul*, each of 11,600 tons, and a length of 554 feet; and the *New York* and *Philadelphia*, each of 10,800 tons and 560 feet length. Several still larger, but less speedy steam-ships, have recently been constructed for the intermediate services of the company. In addition to the weekly express service between Southampton and New York, the American Line runs boats between New York and Antwerp, Philadelphia, Queenstown, and Liverpool, and Philadelphia and Antwerp.

Austrian Lloyd Steam Navigation Company.—This company was started in 1837 at Trieste, where its headquarters are still situated. It commenced operations with seven small wooden paddle-boats for the voyage to Constantinople and the Levant. The whole commercial history of that region has since then been intimately bound up with that of the Austrian Lloyd. Trieste is not only the port whence the vessels of the company start, and to which they return, but also the place where most of them are constructed. The company has there its own dockyard, where it builds and engines most of the steamers of the fleet. This yard is fitted with a dry-dock, slip, and all the most modern shipbuilding appliances. The seven small paddle-steamers of 1837 have now grown to a fleet of 69 iron and steel steam-ships, with a gross tonnage of 186,000 tons. Some of the most important of the later ships were constructed in Great Britain. The actual ports served by the company are much too numerous to detail, but the whole eastern coast of the Adriatic and the Levant is visited by them with frequent services. These Adriatic, Mediterranean, and Levant ports have seven services in all, and three branch lines. There is a line to the west as far as Brazil, and a monthly mail service between Trieste, Brindisi, and Bombay. There is also a monthly ordinary service between Trieste, Bombay, China, and Japan, and a monthly branch in connexion with it between Colombo, Madras, and Calcutta. The latest development is towards the Cape of Good Hope down the east coast of Africa.

Bibby Line.—The name of Bibby has long been known and respected in the shipping world. The first undertaking of the family was the institution of a service from Liverpool to Mediterranean ports about the middle of last century. When Mr (subsequently Sir Edward) Harland took over the shipbuilding works at Belfast, which he afterwards made famous, Mr Bibby was one of his earliest customers. It was he who gave him practically *carte blanche* in the way of proportion for the new ships built for his service, and it was from the experience acquired and the success achieved with them that the "long ships," with which the White Star Line made its name, were first brought into the region of the practical. In this connexion it may be stated that Sir Edward Harland was born at Scarborough in 1831, his father being a medical practitioner. He learnt the science of shipbuilding in the yards of Messrs R. Stephenson and Company of Newcastle, and became first a draughtsman with Messrs J. and G. Thomson, and then manager in a Newcastle yard. In 1854 he went to Belfast, first as manager to Messrs Robert Hickson and Company. Then in 1858 he took over their yard. In 1859 he launched the *Venetian* for Mr Bibby, and in 1860 he took Mr G. W. Wolff into partnership. After a time Mr Bibby retired from the active pursuit of his business, and the line passed into the hands of one of his confidential managers—Mr Leyland. The name was soon changed, and continuing its prosperity, and advancing into the Atlantic trade, the company eventually, in the year 1900, absorbed the highly successful West India and Pacific Company, and became one of the big lines of the country. A good deal of tonnage was, however, subsequently taken over by its chairman, Mr J. E. Ellerman, for the purpose of developing another new company called after himself. And this line, in its turn, has since taken to itself others, notably the old-established City Line, plying from Glasgow as a headquarters to the East. But the Bibby family, though large shareholders in the White Star Line, could not remain without some active interest in seafaring matters. Hence a new Bibby Line was started. Its first vessel was the *Lancashire*, a single-screw steamer of 4244 tons gross register, built—as have been all this fleet—by Messrs Harland and Wolff. She came out in 1889. Her sister was a similar vessel. The company engaged in the trade between Liverpool and Rangoon, where they soon made a name and were put by Government on the same terms as the P. and O. in regard to the official recognition of their steamers as a permissible means of conveyance for officers. Five twin-screw steamers, each larger than the last, have followed the first pair, and the latest, the *Warwickshire*, is little short of 8000 tons gross. The service is maintained with three-weekly sailings, and there are reserve ships which have done useful work in the Government transport service.

British India Steam Navigation Company.—This line maintains, perhaps, a larger network of communications and serves a greater number of ports difficult of access than any in the world. The Persian Gulf, Burma, the Straits of Malacca, and the entire littoral of the East Indies, to say nothing of the east coast of Africa, are among the scenes of its enterprise. To its efforts is due in no small degree the development of Indian commerce with the ports of the neighbouring semi-barbarous countries. Though its ramifications now extend to the ports of northern Australia, the company had its origin in the Indian coasting trade. Its present designation is of comparatively recent origin, but its first operations date from 1855. A project for a mail service between Calcutta and Burma was then first set on foot by the East India Company. Early in the following year a company was formed, under the title of the Calcutta and Burma Steam Navigation Company. Two small steamers of 600 tons each were bought and despatched to India round the Cape in 1857, for a service between Calcutta, Akyab, Rangoon, and Moulmein, under a contract with the Government of India. At the outbreak of the Mutiny in 1857 the company rendered important service by bringing up to Ceylon from Calcutta the first detachment of European troops which came to the assistance of India from outside. In 1862 a most important step was taken, principally owing to the enlightened assistance rendered to the company by the Indian Government. An agreement was made between the company and the Government, by which the former agreed to convey troops and stores and to perform other services. Under this arrangement boats were to be despatched regularly from Calcutta to Rangoon, Moulmein, Akyab, and Singapore, and from Rangoon to the Andaman Islands. A service was also set on foot to the Persian Gulf, between Bombay and Karachi, and Madras and Rangoon. This gave an impulse to the business of the company, and entailed regular visits to ports which had hitherto been deemed unapproachable

for many months of the year. It also involved a great increase in the fleet. The company's connexions, too, have since 1866 embraced services to the Dutch West Indies. During the Abyssinian campaign of 1867 the company proved of the greatest assistance to the Government. The opening of the Suez Canal in 1869 produced an entire revolution in the shipping trade of India, and led to a great development of the company's fleet. The s.s. *India* with cargo was waiting at Suez when the canal was opened to traffic, and was the first steamer to arrive in London through the canal with an Indian cargo. In 1872 the company extended its operations to the east coast of Africa, and by an arrangement with the British Government began to run a service every four weeks between Aden and Zanzibar. Some interest attaches to the extension of the British India Company's service to Delagoa Bay. The coming importance of this trade was recognized and a service inaugurated to develop it. A loss amounting to no less than £40,000 per annum was, however, incurred, and the directors did not feel justified in continuing the attempt. The Germans, however, saw that the trade was worth buying, and the Imperial Government gave a new line under the German flag a subsidy, calculated on the amount lost by the British India Company, leaving its contractors, whilst probably insured against loss, to look to their own exertions in the development of the trade for any possibilities of profit. The German Line has proved a success as well to its shareholders as to German trade, and at a later date the British India Company again tried for the trade and entered into competition with it. The full record of this company's transport services would be a chronicle of British military operations during the second half of last century. But it may be mentioned that no less than 37 of its fleet were employed in the Chinese expedition, while 42 more were engaged in connexion with the South African war. The company's fleet comprises steam-ships of very various sizes, from a few hundred tons to several thousands. This of course is a necessity of the traffic, which compels visits to many out of the way ports which no vessels of large draught could approach. Upwards of one hundred ports are visited by the company's steamers. In all there are twenty-one lines with additional services. They may be classed roughly as those running to ports in (i.) India, Burma, and Straits Settlements; (ii.) Straits Settlements and Philippines; (iii.) East Coast of Africa; (iv.) Persian Gulf; (v.) Dutch East Indies and Queensland. Some of the services run from London, some from Indian ports, some are local. They are far too numerous to set out in detail, but this summary will indicate the magnitude and complexity of the company's operations.

Canadian-Australian Line and the Empress Line.—These two lines run in connexion with the Canadian-Pacific Railway—the Canadian-Australian Line from Vancouver to Sydney, and the Empress Line from Vancouver to Japan and China. The vessels of the first-named line were built in 1892. The fleet of the Canadian-Australian Line consists of three vessels, the *Aorangi*, *Warrimoo*, and *Miowera.* Of these the *Aorangi* is of 4250 tons, and the other two of 3500 tons each. The Empress Line has three twin-screw steam-ships—the *Empress of China*, *Empress of India*, and *Empress of Japan*—each of 6000 tons and 10,000 h.p. A fourth is under construction. They are built to the requirements of the British Admiralty, for they are all designed for use as armed cruisers in time of war, and are commanded by officers of the Royal Naval Reserve. Each line carries mails. The Canadian-Australian steamers run from Vancouver about every three weeks to Honolulu, Fiji, Brisbane, and Sydney. The Empress Line from Vancouver to Yokohama, Kobé, Nagasaki, Woosung, and Hong Kong, also run about every three weeks. These lines are of importance, not only as valuable factors in the development of the trade between the great British dependencies, but also because they afford a connexion between England and the most distant parts of the empire, by a route which can be traversed on British steamers, and a railway running across a British colony, without touching on foreign soil or traversing the possibly dangerous straits and narrow seas which are characteristic of the alternative route *viâ* the Mediterranean and Suez.

Castle Line (see also Union Line and Union-Castle Line).—The Castle Line began its career in 1872 with the *Iceland* and the *Gothland*, both vessels of about 1400 tons. At that time the charge for carrying letters to the Cape was about 1s. per half oz., and the contract time between England and the Cape thirty-seven days. The mail contracts were then in the hands of the Union Line exclusively, but in 1873 the House of Commons refused to ratify the extension of the contract signed with them by the Chancellor of the Exchequer, and their rights thus expired in 1876. Up to 1876 the Cape Parliament made an allowance to the Castle Line for the conveyance of letters, and when the postal contract was renewed in that year it was divided between the Union and the Castle Lines, an arrangement which was adhered to down to the time when the two lines united their fortunes. The scope of the company's energies has now been extended to all parts of South Africa. The line did great national service in carrying troops and stores to South Africa during the 1899–1902 and previous campaigns. By a resolution passed at a meeting of shareholders held on 13th February 1900 this company was amalgamated with the Union Line. The fleet had grown from two ships in 1876 to 20 ships in 1900, and from a total tonnage of 2800 to one of about 110,000 gross register.

City of Dublin Steam Packet Company.—Limitations of space forbid any detailed account of the various steamship services whose vessels traverse the waters of the narrow seas round Great Britain. It would be interesting to say something of the twin-screw fleet with which the London and North-Western Railway replaced the paddle vessels which formerly carried on its service between Holyhead and the North Wall, Dublin; of the comfortably fitted sleeping accommodation which the vessels of the service jointly owned by the North-Western and Lancashire and Yorkshire railways offer to travellers on the longer night crossing from Fleetwood to Belfast; of the Great Western Railway's service between Milford Haven and Waterford; of the same company's Channel Island fleet, which makes its headquarters at Weymouth; of the lines which, centring at Southampton, the South-Western Railway maintains with the Channel Islands and north-western French ports; of the cross-Channel services between Dover and Calais, and Folkestone and Boulogne; of the Newhaven and Dieppe fleet of the Brighton and West of France railways; of the excellent modern ships with which, starting from Harwich and plying to Belgian and Dutch ports, the unsubsidized Great Eastern Company holds its own against the State-aided paddle fleets under the Dutch and Belgian flags; and of the cross-Channel services of the Belfast Steamship Company and of the old-established Isle of Man Steam Packet Company. But it is obviously impossible to deal exhaustively with these, or with others which might perhaps fairly be named, and so we must content ourselves with a brief reference to the City of Dublin Steam Packet Company, oldest and most noteworthy of them all. This undertaking vies with the General Steam Navigation Company in the claim for precedence on account of seniority. The General Steam was undoubtedly the first

to receive incorporation in the year 1824, but the undertakings from which the City of Dublin Company sprang were at work in the years immediately prior to these dates. The facts, though they must have been well known to the general shipping public at the time, are now very difficult to trace. As far as appears, the firm of Bourne and Company—who fulfilled in Ireland functions for which the Messageries Imperiales in France were first formed—were large shareholders in two undertakings which made history in regard to the development of steam navigation. One of these companies was the Dublin and London Steam Packet Company, from which Messrs Wilcox and Anderson, the first managers of the P. and O., chartered the *Royal Tar*, the first steamer they despatched to the Peninsula, and the other was the City of Dublin Company, which originally occupied itself in the maintenance of a service of steam-ships between Dublin and Liverpool. It was this company's *Royal William* which had the distinction of opening the Liverpool service to New York. By absorption, too, this company represents the old St George Company, whose *Sirius* was the first steamer to sail from London towards New York. In the year 1838 the Admiralty, which in those days had the management of many of the mail services and continued for a time to keep the Irish day mails in its own hands, gave the City of Dublin Company the contract for the night Irish mails, which were thus despatched *viâ* Liverpool. The name of Laird is to this day closely associated with the fortunes of the company, and even at that time a Mr Laird, grandfather of the present partners in the shipbuilding firm, was a director of the City of Dublin Company. In the year 1848 the Government with four steamers endeavoured to run the day and night mails itself *viâ* Holyhead. But this arrangement did not work well, and two of its mail steamers were bought by the City of Dublin Company, while the two others were acquired by the Chester and Holyhead Railway. It is needless to follow the vicissitudes of the mail service, wavering as it did from the Admiralty to the Chester and Holyhead Railway, and then to the City of Dublin Company. Suffice it to say that in 1859 an arrangement was entered into whereby the City of Dublin Company undertook the conveyance of both day and night mails *viâ* Holyhead, and built four ships, called after the four Irish provinces, for the service. The performances of these four paddle ships, three of which were built by Messrs Laird, were remarkable indeed. The *Connaught* was the first vessel to do her 18 knots. The *Ulster* made the best passage of them all—doing the journey from Holyhead and Kingston in 3 hours 18 minutes. But the *Leinster* was only two minutes behind her, and the *Munster* only six minutes worse than the *Leinster*. Taking the performances of the whole four vessels over the first fourteen years of their existence, and considering the mean of 20,440 passages made as well in winter as in summer, the average time of passage was only 3 hours 56·1 minutes. The contract was renewed from time to time, that coming into operation on the 1st October 1883 being for an accelerated service. To enable this to be adequately performed, the last paddle ship of the fleet, the *Ireland*, was built by Messrs Laird, who also overhauled and improved the machinery of the older vessels, giving them new boilers adapted for the use of forced draught. In 1895 it was felt that the mode of carrying these important mails again needed revision, and in that year the House of Commons approved of a new contract, under which four new twin-screw vessels were to be built for the service. The work of design and construction was again undertaken by Messrs Laird, and in 1897 the new fleet assumed the duties, and indeed the names, of the vessels which had done such remarkable service during a period of about thirty-eight years. The contract time was now decreased by half an hour, and this meant naturally a very great increase in the speed of the vessels employed. The present ships are capable of a speed of about 24 knots—which is considerably in excess of that of any vessel as yet constructed for service on the Atlantic, and certainly of that of any other Channel steamers. They can thus maintain with regularity and ease the 20 to 21 knots which are sufficient for the purpose of their contract in ordinary circumstances. Besides the night and day services with the mails the company also maintains its old line between Liverpool and Dublin.

Collins Line.—Mention must not be omitted of the line which, although it had ceased by 1860, played a great part in the development of the passenger trade between Liverpool and New York. The American traveller has always been an important factor on the Atlantic, and in the sailing-ship days the American clippers had a great share of the better class of business. It was natural, therefore, that when the steam-ship was established in the trade the Americans should wish to have their share of the traffic. The Cunard Line soon after its start destroyed the opposition of the other existing British lines, and by 1850 was obtaining no less than £7, 10s. a ton for the cargo which it carried. There were thus more solid inducements than mere sentiment towards competition, and in 1850 Mr E. K. Collins started his line of steamers. Twenty voyages were to be made by it a year, and the subsidy payable by the American Government was to be $19,250 a voyage. It was found, however, before the ships were actually got to work that the cost both of building and running them would be higher than had been anticipated, and the Government accordingly raised its subsidy to $33,000 a trip, or £178,750 a year. Four wooden paddle steamers of about 3000 tons each were constructed in American yards, and these were soon put into the station. Their speed was good, and they accomplished faster passages than the Cunarders of their time. But the British company saw that its existence depended on the maintenance of its position, for the rate of freight promptly fell about 40 per cent. Accordingly the *Persia*, a beautifully-modelled iron paddle steamer, larger and faster than the American built vessels, was ordered and obtained from the yard of Messrs R. Napier and Sons. To this the Americans responded with the *Adriatic*, the largest wooden steamship ever constructed. But there were delays over her completion, and in spite of its enormous subsidy the Collins Line was tottering to its fall. Disasters overtook it. The *Arctic*, one of the four original steamers, was lost by collision with a French vessel named the *Vesta*, and unfortunately the casualty was attended with great loss of life. Another ship, the *Pacific*, was missing. These accidents do not appear to have been due to any want of care in the management of the line, but in conjunction with the heavy expenses which attended the working of the service they proved too much for the company, and the *Adriatic* only made one trip in the service, which was discontinued at the end of the year 1859. It had, however, left its mark in the improvements it wrung from the Cunard company, which had not only built the *Persia*, but had provided another larger and faster vessel named the *Scotia*; this, however, did not come out till after the competition had ceased.

Compagnie Générale Transatlantique.—An undertaking known as the Compagnie Générale Maritime was founded by the French in the year 1855, to free their mercantile marine from the reproach of marked inferiority to those of the British and United States in the North Atlantic

trade, where at that time the Collins and Cunard mail steamers were engaged in their historic struggle. It owed its inception to the brothers Émile and Isaac Pereire. Services were first organized from Rouen to Algeria, between Havre and Hamburg, and between Marseilles and Antwerp, with calls at Spanish and Portuguese ports. In 1861 the company was allowed to change its title to the more comprehensive one under which it now is known, and it then undertook its first contracts for the carriage of the French mails to the United States, the Antilles, and Mexico. Some of the earlier vessels employed in the New York service were very fine specimens of the naval architecture of their day. Among them may be instanced the great iron paddle steamer *Napoleon III.*, built in the year 1864 by Messrs Scott and Company of Greenock, who at that time constructed most of the more important vessels for this service. This vessel with her imperially titled sisters suffered a change of name in the early 'seventies, when several of them were lengthened and altered to screws. In the year 1881, again, there was a great movement towards the acceleration and improvement of the New York service, and a new fleet was begun with the single-screw steamship *La Normandie* launched at Barrow-in-Furness in 1883. Four larger vessels of much the same class followed, three of them being constructed in the owners' own yard at Penhoet. In 1890 the first twin-screw steamer of the line appeared in *La Touraine*, and proving a success, the British-built *L'Aquitaine* was purchased. A new postal contract was arranged in 1898, and under its terms it became necessary for the company to build still larger and faster vessels. Eventually four such ships required to be provided, but in 1902 only two—*La Savoie* and *La Lorraine*—had been put on the station. These vessels are of 22 knots' speed on trial, and are among the fastest on the Atlantic. The company maintains a weekly service to New York, as well as the lines to the Antilles and Mexico in the Atlantic. There are also communications with British and Algerian ports.

Cunard Line.—This is the premier steam-ship company in the highly competitive New York trade. It derives its name from Samuel Cunard of Halifax, Nova Scotia, an owner of sailing vessels trading from Boston and Newfoundland to Bermuda. He first conceived the idea of a regular despatch of royal mail steam-ships across the Atlantic, to take the place of the Government brigs, which often took six or seven weeks in the transport of mails. This idea he realized with the help of Mr George Burns of Glasgow and Mr David MacIver of Liverpool. On the 4th July 1840 the first Cunarder, the *Britannia*, started on her voyage across the Atlantic with sixty-three passengers, landing them at Boston in a fortnight, where they received an enthusiastic welcome from the inhabitants. It is said that Mr Cunard received 1873 invitations to dinner in twenty-four hours. Probably the advance in shipbuilding which has taken place since the time when the first Cunarder crossed the Atlantic is not to be measured by more striking contrast than that between the *Britannia* of 1840 and the *Ivernia* of 1900. The *Britannia* was a paddle steamer of 1154 tons, 207 feet length, 740 h.p.; and her average speed was 8·5 knots, and she carried at the utmost 115 passengers. The *Ivernia*, launched in September 1899, is a twin-screw steamer of 14,000 tons, 10,000 h.p., 600 feet length, and 16 knots' sea-speed. She can carry 2300 passengers, —200 first-class, 220 second, and 1900 third. She has four complete steel decks (lower, main, upper, and shelter), a steel orlop deck, extending from the boiler-room forward to the stem, and a bridge deck 280 feet long under the shelter deck. She can carry, compared with the *Britannia*, twenty times the number of passengers and fifty times the amount of cargo. The experiment of using the screw for the Atlantic service was made by the company with several cargo steamers in the early 'fifties, and, these being proved a success, the first Cunard screw steamer for the mail line made her debût in 1862. This was the *China*, and her advent marks the middle stage in the company's history. Since then the development in shipbuilding has advanced by leaps and bounds. The gross tonnage of the *China* was 2539, her i.h.p. 2250, and her average speed 13·9 knots. In 1870 the Cunard Company first fitted compound engines to their steam-ship *Batavia*, and in 1881 the *Servia*, the first steel vessel in the service, was the pioneer of the larger type which constitutes the present express fleet. The Cunard Line can boast that, though there have naturally been one or two losses of mail steamers in its long career of over sixty-three years, none of these have involved the lives of their passengers. The *Campania*, *Lucania*, *Umbria*, and *Etruria* are the express steamers at present maintaining the mail service. They run from Liverpool to New York every Saturday. The average speed of the two first-named boats is 21 to 22 knots, which they accomplish by means of engines of 30,000 h.p. The *Lucania* has accomplished the passage westwards in 5 days 7 hours and 23 minutes, making as much as 562 nautical miles in a single day's run. Since 1840 the Cunard Company has been under contract with the British Government for a mail service. At the present time the contract is for a weekly mail to the United States, *viâ* Liverpool and New York. The British Post Office, however, only pays its contractors for the weight of mails actually carried, and reserves the right to send specially addressed letters by foreign ships. The company's services also include a weekly passenger line to Boston, and frequent despatches to Mediterranean and Levant ports as well as a weekly steamer to Havre. In October 1902, as a result of the formation of the Morgan Shipping Trust, the British Government made a new arrangement with the Cunard Line, involving the loan at $2\frac{3}{4}$ per cent. of the capital for building two new fast steamers, besides a yearly subsidy of £150,000 for twenty years.

Elder, Dempster, and Company.—The remarkable progress of this company, and of the undertakings connected with it, is largely due to the activity of Sir Alfred Jones, the present head of the business. The oldest business under its management is the African Steam-ship Company, which was incorporated by royal charter in the year 1852 for the purpose of trading with West African ports. It received a subvention of £30,000 per annum for a monthly mail to the Gold Coast, and began its work with an unambitious little fleet of four 700-ton vessels. These were at first, however, equal to all the traffic which the trade could offer them. As time went on the number and size of the vessels employed was increased. In 1869 such progress had been made that it appeared worth while to start an opposition line under the name of the British and African Steam Navigation Company. This was at first a Glasgow venture, much in the same way as the old concern had made its headquarters in London. But Liverpool has long been the centre of the West African trade, and both companies practically transferred their business thither. In the year 1883 the British and African Company, which was the first of the two to fall under the management of Messrs Elder, Dempster, and Company, became a limited company, and not long afterwards the two rivals arrived at a working arrangement whereby their sailings—at that time about three times a fortnight—were worked into one another. The Canary Islands, where the West African steamers called on their

voyages, were then becoming known as a resort for tourists and invalids, and the issue of tickets available by either line was commenced for their convenience. The development of the cultivation of the banana for the English market was also begun to be encouraged by the two steam-ship companies. But it was in the month of August 1891 that the great movement by the Elder-Dempster Company was made public. It was then announced that the firm had assumed the management of the African Company, the quondam rival of the fleet they had themselves managed. The two concerns were, and are, continued as distinct organizations, but they naturally work very closely together. The African Company soon began to break fresh ground, building not only superior vessels for the improving West African service, but also constructing large cargo vessels for the general Atlantic trade. These were soon engaged in the trade between the Mersey and the St Lawrence on the one hand, and between Liverpool and the southern ports of the United States on the other. Meanwhile the development of the possibilities of West Africa and of the Canary Islands was not neglected. Various undertakings, not usually considered part of a shipowner's work, were inaugurated. These included a bank, founded in 1894, for the accommodation of West African traders, oil mills in Liverpool, where the palm kernels so largely consigned from the coast might be dealt with, and a hotel at Grand Canary for the convenience of the tourist; while, to ensure the disposal of the bananas which their companies brought to England, a fruit brokerage business was opened in Covent Garden. Having already, as has been seen, a footing in the Canadian trade, they began the restoration of the Atlantic trade to Bristol, by giving it a service of steam-ships to the St Lawrence, employing for the purpose vessels of as great size as their docks could accommodate. At the beginning of 1899 they further strengthened their connexion with the nearest British colony by the purchase, from the liquidator of the insolvent Canada Shipping Company, of the name, house-flag, and remains of the old Beaver Line. A new fleet for this service was at once put in hand, a fair representative of the ships being the twin-screw *Lake Erie*, a vessel of 7550 tons gross register, built in 1900 by Messrs Barclay, Curle, and Company of Glasgow, which did good work—in common with many other Elder-Dempster steamers—in the transport service during the Boer war. At the beginning of the 20th century the firm began trading with the West Indies. The distressed state of the planters, owing to the competition of bounty-fed beet sugar with their cane produce, had moved the Colonial Office to do something for their assistance, and a Royal Commission recommended the encouragement of fruit cultivation. Mr Chamberlain found that the existing lines were not provided either with the experience or the energy of the Elder-Dempster Company, and so, by arrangement with the Colonial Office, and in consideration of an annual subsidy of £40,000, the "Direct" service of fortnightly steam-ships was started with the sailing from Avonmouth of the then newly built *Port Morant* in February 1901. The four vessels built for this service run to Jamaica in about thirteen days, and after a four days' stay return with their contract consignment of not less than 20,000 bunches of bananas. A local steamer is engaged in connexion with them. The steam-ships of the new line have good passenger accommodation, and already two hotels have been acquired in Jamaica to provide accommodation for those who visit the West Indies under the new management. This provision for tourists is a novel feature, and one of the most comfortably fitted ships of the Beaver Line has been set aside for public yachting tours in various quarters of the globe. The increase, at once absolute and comparative, in the tonnage of the Elder-Dempster fleet has been very remarkable. It should be added for the sake of completeness that the vessels of the West African lines ply as well from Hamburg and other North Sea Continental ports as from Liverpool, while closely connected with the firm, though sailing its vessels under the Belgian flag, is the Compagnie Belge Maritime du Congo, which runs a service from Antwerp to West African ports.

General Steam Navigation Company.—This is the oldest existing line. Its first prospectus was issued in the year 1824, and in 1831 it received its charter of incorporation. Its business was at first confined to narrow limits. It commenced with the passenger trade from London to Margate, and its operations gradually extended to the British coastwise ports and the home trade ports on the Continent. In time the company introduced a regular steam service between Edinburgh and other east coast ports and London, Hamburg, Rotterdam, Antwerp, and Havre in the north of Europe. It gradually obtained a strong hold upon the passenger and fine goods trade to the Continent, holding the mail contracts between London and Hamburg, and London and Rotterdam. In the early 'seventies the pressure of foreign competition made itself severely felt, and in 1876 the increase of the American cattle trade told on the profits of the company; but the difficulty was met by obtaining parliamentary leave for an increase of capital, and the company has displayed new enterprise, especially in regard to its passenger facilities. It may claim to have been the pioneer in the promotion of steam-ship traffic between British home ports and the nearer ones of the Continent. The steam-ship *Giraffe*, built in 1836, brought over the first cargo of live cattle from Rotterdam to Blackwall in 1846. The company runs steamers from London to Edinburgh, Hull, and Yarmouth, and from London to Antwerp, Amsterdam, Bordeaux, Havre, Hamburg, Oporto, Ostend, Rotterdam, Charente, and the Mediterranean ports. Vessels are also run to some of the ports above named from Hull and Southampton. There is also a passenger service between Harwich and Hamburg, and excursion services in summer to the watering-places at the mouth of the Thames and on the Kentish coast.

Guion Line.—Soon after the discontinuance of the Collins Line the American Civil War broke out, and for a time the energies of the people of the United States were entirely distracted from the Atlantic. But, when peace was attained, the late Mr S. B. Guion, who had been a passenger agent to the Cunard Company, saw an opening for a new line of steamers, and, arranging to have the bulk of his capital from America, determined to inaugurate a line under the British flag. Six steam-ships were provided for the service, the first being an iron screw vessel named the *Manhattan*. The eastward mails were soon given to the line by the United States Government. In the early 'seventies Mr Guion realized the desirability of a high speed for this trade, and arranged for two vessels of peculiar design, which he believed would accomplish his object. These were the *Montana* and *Dakota*—ships of the then large size of 4321 tons—to be fitted with water-tube boilers. The steamers in question were constructed on the Tyne. Owing to the innovation in the boilers and the high steam pressures to be employed, the Board of Trade looked somewhat askance at them, and decided that before they could be allowed their passenger certificates they must be subjected to a long experimental cruise. The first of the two accordingly put to sea, and failed to sustain the test. The iron tubes of the boilers were "set in hundreds of tons of brickwork," and the unequal expansion of the materials caused serious leakages under

service conditions. Accordingly, without waiting for the report of the surveyors, the owner had the boilers removed and steam generators of the ordinary type substituted. These could not carry the steam pressures of the original designs, and accordingly the ships never attained the speed at which Mr Guion had aimed. After this set-back it was some years before he was enabled again to attempt the construction of a high speed vessel. In 1879, however, he succeeded in obtaining from the Fairfield yard the *Arizona*, the fastest vessel of her day, and found from his experience with her that his anticipations had been justified. She was followed at short intervals by the *Alaska* and *Oregon*, each more speedy than her predecessor. But the difficulties which he had gone through had crippled the finances of the line, and the *Oregon* had to be transferred to the Cunard Company. Then the fortunes of the line declined rapidly, and after a hopeless struggle the sailings were discontinued.

Hamburg-American Line.—The extraordinary progress of Hamburg as a seaport during the last thirty years of the 19th century may be held due in no small measure to the enterprise of this line, which now carries passengers not only to the two American continents, but also to the east of Asia and Africa. It was founded in May 1847. At that time, owing to the political disturbances throughout Germany, there was an enormous exodus of emigrants to the new world; of this the founders took advantage, and they started a regular service of sailing ships between Hamburg and New York. The first ship they owned was the *Deutschland*, of 700 tons, built on the Elbe. It is interesting to note that the present *Deutschland* is of 16,502 tons gross register, and is of twenty-three times the capacity of her predecessor. The first sailing took place in October 1848. In 1851 the company's fleet consisted of six vessels, with an aggregate of 4000 tons. In 1856 the first screw steamer in the company's service left Hamburg; this was the *Borussia*, a vessel constructed, as were her sisters for many years, on the Clyde. From this time, when the company abandoned sailing ships and took to steam, its prosperity may be said to have dated. It is strange to note that the two first steam-ships owned by it were chartered by the British and French Governments to convey troops to the Crimea. By 1867 the company had ceased to own any sailing ships. The enormous increase of the traffic is indicated by the fact that whilst in 1856 the sailings to New York took place every fortnight, in 1881 there were two a week, and later on three. The company had also by this time considerably extended its operations from the original passage between Hamburg and New York. After the war between France and Germany it started a line to the West Indies, and later to Baltimore, Boston, Montreal, and other ports in North America. In 1875 it absorbed the old Eagle Company of Hamburg, which had previously been its rival, and then began to run boats to Central and South America, and later to China, Japan, and the Straits Settlements. To-day the Hamburg American Line may claim to be the largest steam-ship company in the world. There are three services at present to New York—an express service and a passenger service, both run by twin-screw steamers, and also a service direct from Hamburg to New York by vessels carrying only one class of cabin passengers and third-class passengers. The ordinary passenger service is conducted by half-a-dozen ships all of over 12,000 tons. They call at Plymouth and Boulogne. The express service is run by the *Fürst Bismarck*, the *Columbia*, the *Auguste Victoria*, and the *Deutschland*, which call at Southampton on the outward and Plymouth on the homeward voyage. The *Deutschland*, which is the finest vessel of the fleet, was built at Stettin by the Vulcan Company. Her engines develop about 33,000 horse-power, and she was the first Atlantic liner to exceed a speed of 23 knots at sea. The Hamburg Company has extended its influence and enlarged its fleet by purchases from and absorptions of other fleets. Thus it has acquired vessels from the Carr Line and the Hansa Line of Hamburg, as well as from the Hamburg-South America and the Hamburg-Calcutta Companies. In conjunction with the Lloyd Line it took over the fleet of the Kinsing Line. In 1901, with a view to the feeding of its main lines, it acquired the Atlas Line of Liverpool—a company which had developed the trade between New York and the West Indies. It is impossible to set out in full detail the ports of call of the line. Starting from Hamburg, its boats run to New York, Portland, Baltimore, Boston, Philadelphia, Galveston, and New Orleans, and to Canadian ports. In Central and Southern America there are lines to Mexico, Venezuela, Brazil, Uruguay, and Argentina. Then there is that to Eastern Asia. From Stettin its boats run to New York, and from New York to the Mediterranean, Brazil, and Eastern Asia. From Genoa they run to La Plata direct. It is also to be observed that this company runs large steamers at intervals on pleasure trips to Norway, the Mediterranean, the West Indies, and the East. For these yachting excursions there has been specially built the twin-screw yacht *Prinzessin Victoria Luise*, a vessel of 4409 tons, which in many respects follows the design of the German Emperor's yacht *Hohenzollern*.

Japan Mail Steam-ship Company, Limited (*Nippon Yusen Kaisha*).—Nothing indicates in a more remarkable manner the entry of Japan on an equal footing into the life and activity of the civilized world than the extraordinarily rapid growth and development of this line of steam-ships, which now owns one of the principal fleets of the world, running to many of the chief ports in the four quarters of the globe. From an early period their insular frontiers made the Japanese a seafaring folk, but imperial policy for a long period shut them away from all intercourse with the rest of the world. It was not until about the year 1860 that the life of the West really touched Japan. In 1868 steam-ship communication was opened between Tôkyô and Osaka; in 1871 the Yubin Kisen Kaisha Steam-ship Company came into existence under the control of the Imperial Bureau of Communication; and in the same year a private company, called the Mitsubishi Kaisha, was founded. This may be said to have been the beginning of all modern maritime enterprises in Japan. In 1876 the Government company gave up the contest, and its fleet passed into the hands of the private company. In 1873 the capacities of this company had been tested in the military expedition to Formosa, when its organization had been found excellent, but its fleet insufficient. The Treasury now invited the company to buy up the Yokohama-Shanghai service of the Pacific Mail Steam-ship Company. In 1876 the company had a fleet of 42 vessels, including sailing ships. In 1882 the Government set on foot another rival line, the Kyodo Unya Kaisha, but it did not answer, and in 1885 the two were amalgamated into the present "Nippon Yusen Kaisha," or "Japan Mail Steam-ship Company." In the nine years which passed between this union and the outbreak of the war with China in 1894, the services between Japan and neighbouring countries were consolidated and extended, and the development of the cotton trade induced the Government to inaugurate a service between Japan and Bombay. During the war the vessels of the line were constantly used for the transport of troops, and many additional ships had to be acquired. As many as fifty were employed during the time that the war lasted, and they were nearly all officered and manned

by Japanese, while from first to last only one serious accident connected with their navigation occurred to any vessel of the fleet. The result of the war gave an enormous impulse to trade and navigation, and laws were passed giving special facilities for shipbuilding. The company determined to run vessels to America, Europe, and Australia. The capital was greatly increased, and orders were given for the construction of twelve twin-screw steamers of over 6000 tons each for the European line, and three of 3800 tons each for the Australian line. In 1899 the Japanese Diet resolved to grant subsidies to the company's European and American lines. All its lines therefore now, with few exceptions, run under the mail contract of the Japanese Government. There is a regular fortnightly service of twin-screw vessels between Yokohama, London, and Antwerp; a monthly service between Yokohama and Melbourne; also between Yokohama and Victoria (B.C.). There are lines to Bombay, Shanghai, Vladivostok, Newchang, Tientsin, and many local lines, touching at all the ports of the islands of Japan.

Royal Mail Steam Packet Company.—Soon after British-owned steam-ships began to run to America a company was formed by leading business men interested in the West Indies, to carry the mails from England to that part of the world. The charter of this company, to be known as the Royal Mail Steam Packet Company, was granted in 1839. The Government believed that the institution of a line carrying the mails regularly to British possessions in the West Indies was likely to prove of benefit to the empire, and granted it a large subsidy. The first contract with the Government was entered into in March 1841. No less than fourteen large paddle steamers capable of carrying the largest guns then used by the Royal Navy were at once ordered, and the service was opened with the *Thames* on 3rd January 1842, followed by other vessels in fortnightly succession. These steamers started from Falmouth and returned to Southampton, which was the company's headquarters, though it had no dock accommodation in those days. In 1846 the company began to carry the mails for places on the western coast of South America, the Pacific Steam Navigation Company receiving them at Panama. In January 1851 the company, by contract with the Government, inaugurated a monthly service to Brazil and the river Plate, and new steamers were built which greatly increased the rapidity of transit. This company was therefore the first to institute direct mail communication by steamer between Europe and the countries of South America, as it had also been with the West Indies. The company's boats were employed continuously during the Crimean war in the transport of troops. It is interesting to note that it was from one of the company's ships, the *Trent*, that Slidell and Mason, the commissioners of the Confederate States, were taken on their way to Europe by a United States man-of-war. In 1872 the service to Brazil and the river Plate was doubled. During 1898–99 the mileage run by the whole of the company's fleet, including cargo boats, was 1,198,000 miles. There is at present a contract between the company and the British Government for the transit of West Indian mails, for which £80,000 per annum is paid. The mails to Brazil and the river Plate are paid for by weight. The West India Line steamers leave Southampton for the West Indies every fortnight, and proceed direct to Barbados, thence to Jamaica and Colon, whence they proceed once in four weeks to Cartagena, Savanilla, and other local ports. From Barbados every fortnight boats on branch lines run (i.) to Demerara and Surinam; (ii.) to St Vincent, Grenada, Trinidad, and Tobago; (iii.) to St Lucien, Martinique, Dominica, Guadeloupe, Montserrat, Antigua, and St Thomas. The Brazil and River Plate Line comprises a fortnightly service of mail steamers to Pernambuco, Bahia, Rio, Monte Video, and Buenos Aires. There are also cargo services to the West Indies, and to the river Plate and intermediate ports. A branch service for collecting cargo from North Sea Continental ports for transhipment at Southampton has also been instituted.

Messageries Maritimes de France.—Originally known as the Messageries Imperiales, this company sprang from a land-transit undertaking. It received its first contract for the conveyance of over-sea mails from the French Government in the year 1851. It then extended its services to Italian, Greek, Egyptian, and Syrian ports. In the following year it included Salonica in its itinerary. The occurrence of the Crimean war gave an increase to its fleet and a stimulus to its operations. For it was not only given the task of maintaining mail communication with the French forces in the Black Sea, but was largely entrusted by the Government with the duty of transporting troops and stores to the seat of war. At that time it was a considerable purchaser of British tonnage. In 1857 it had the French mail contract to Algiers, as well as to the Danube and Black Sea ports, whilst in the same year a new mail contract for a service between Bordeaux and Brazil and the river Plate was granted to it. By this time it had, either afloat or under construction, a fleet of no less than fifty-four steamships of 80,875 tons. In 1861 further employment was found for its vessels in the conveyance of the mail to India and China. By the year 1875 its fleet embraced 175,000 tons of shipping, and also employed a large number of chartered sailing vessels. It was at that time the largest steam shipping company in the world. It had already ceased to employ British shipbuilders, and now constructed its own tonnage in its own yards. The extension of its services to Japan followed, and eventually it put forth branches which served Madagascar, Mauritius, and Zanzibar, as well as Australian ports and the French colony of New Caledonia. Some of the steamers employed in the mail services to the Far East and South are of a very fine character, especially the *Atlantique*, a twin-screw vessel launched in 1900. She is of 6700 tons gross register, and is fitted with Belleville boilers, as are no less than twelve of the finest vessels in the fleet. The first of these was the *Australien*, built in 1890, and the experience gathered from the running of these mail steamers with this type of boiler cannot have been discouraging, or the company would scarcely have continued to fit it to its vessels. Some idea of the extent of the operations of the fleet may be gathered from the statement that in 1901 its ships performed 486 voyages, traversing a total distance of 966,371 marine leagues, in respect of 405,810 of which no subvention from the Government was received.

Morgan Combination.—Under the head of the American Line it has been shown how a group of American capitalists acquired the Red Star, Inman, and American Lines, thus forming a body of shipping which embraced in the year 1901 about 167,000 tons of shipping tonnage, partly under the British and partly under the Belgian and American flags. Another company which drew its capital chiefly from the United States, though its vessels fly the red ensign, is the Atlantic Transport Company, registered under the British Limited Liability Acts in 1889. Its main service is between London and New York, and it is carried on by large and modern twin-screw steam-ships, several of which have been constructed by Messrs Harland and Wolff of Belfast. These vessels range up to nearly 14,000 tons gross register, and though they carry large quantities of cargo and of cattle on the eastward voyage, also accommodate a number of passengers in their saloons. Through the connexion of this undertaking with Messrs Harland and Wolff as builders of their vessels, those

American capitalists who are interested in the extension of United States interests on the North Atlantic were brought into connexion with Mr Pirrie, the managing director of this shipbuilding firm, and through him approach was made to the managers of the White Star Line in the year 1901. An offer for the purchase of this famous British line was put forward by the American syndicate, headed by Mr J. Pierpont Morgan, the well-known New York banker. The price suggested was expressed in terms of the earnings then made by the company's fleet, and it is not therefore possible to place it on record. But it is generally understood that it was about ten times the nominal value of the shares, though the amount was not all payable in cash. The managers of the White Star Company had not merely to consider what many experts believed to be a liberal offer. There was another factor in the situation present to their mind. The New York syndicate, besides having the control of the vessels of the American lines on the Atlantic, had secured the management of the trunk lines of railway between the great producing districts of the Western states of America and the eastern seaboard. They were thus in a position to give to shippers from the United States the convenience of transit by a through bill of lading to embrace both the railway journey and the ocean voyage. There was thus ground for the belief that if competition were allowed to ensue the British steam-ship companies—which from the nature of things could receive no corresponding support from the railways of the United Kingdom—might suffer very severely. The White Star Line accordingly threw in its lot with the American and Atlantic Transport Companies, and with the White Star Line went the Dominion Company—a line whose fine passenger vessels were constructed by Messrs Harland and Wolff, and whose management is largely influenced by the partners in that firm. The Dominion Line has services from Liverpool to Boston, Portland (Maine), and St Lawrence ports. The amount of tonnage involved by these additions to the Morgan combination was not great as compared with the total tonnage of the British empire, being as, say, 350,000 tons to 15,000,000 tons. Yet the lines affected were of so great repute that the movement counted for more than the mere figures expressed, while it was obvious that the considerations which led the managers of these companies to give their adhesion to the syndicate might influence in a similar way the directors of other British Atlantic companies. The Norddeutscher Lloyd and the Hamburg-American Companies were approached by Mr Morgan with a view to their entering into the scheme; but though a working agreement was arranged, the German lines decided to preserve their separate existence. The Morgan combination was eventually incorporated at the end of September 1902 in New Jersey as "The International Mercantile Marine Company," with a capital of 120,000,000 dollars; and an agreement was come to with the British Government, by which the British character of the British ships in it would be preserved.

Navigazione Generale Italiana.—The union of the Florio and Rubattino Lines in the year 1882 was the origin of this company. The Rubattino Line finally made Genoa its headquarters, while the Florio Line centred its business at Palermo, and had itself been largely strengthened by the absorption of the Trinacria Company of its own port. The coasting trade of Italy and Sicily, with services to various ports of the Mediterranean and Black Sea, occupies the great part of the company's fleet. But it also runs monthly lines from Genoa through the Suez Canal to Red Sea ports, and so to India and Hong Kong. Towards the western ocean it has a service maintained in conjunction with that of another Italian company, La Veloce, to Brazil and the river Plate, whereby weekly departures are made from Genoa. In February 1901 a new line was opened by the sailing of the Italian Generale Company's steam-ship *Liguria*—a new Italian-built vessel of upwards of 5000 tons register—for New York. The object of this line, which is being maintained by three steamers of the Generale Company, aided by a similar number from the fleet of La Veloce, sailing once a week from Genoa *viâ* Naples, is to attempt to retain in Italian hands some of the large traffic which is carried on from these ports regularly in the steamers of the Norddeutscher Lloyd, and in winter by those of the Hamburg-American Line.

New Zealand Shipping Company.—This company was established in 1872 for the purpose of maintaining a passenger and cargo service between London and New Zealand. This was before the days when sailing vessels could be used with commercial success in the long sea trade. At first it depended on chartered vessels, but gradually it acquired a fleet of fast clipper iron sailing ships which reduced the voyage to 90 days. These vessels took out a large number of Government emigrants between 1874 and 1882. In 1881 one of these ships inaugurated the frozen meat trade from New Zealand, thus opening up a business which has since grown to colossal proportions. The trade increased so rapidly that it was found impossible to conduct it by means of sailing ships, and in January 1883 the company despatched from London the chartered steam-ship *British King*, of 3559 tons. This vessel accomplished the voyage in 50 days, but it was found necessary to diminish the passage to 45 days out and 42 home. Five steamers were therefore built to fulfil the requirements of the trade. The first of these, the *Tongariro*, of 4163 tons, left England in October 1883. The company about this time received the contract of the New Zealand Government for a monthly mail service, with a guaranteed time of 45 days. The managers gradually eliminated all the sailing vessels from the fleet, and more recently replaced the original single-screw mail steamers with large modern twin-screws. In addition to passenger vessels the company owns several cargo boats, some of which are among the largest afloat. They will carry as many as 100,000 carcases of mutton, and a large quantity of dairy produce. The fleet consists of 15 steam-ships, of which several are over 7000 tons, the largest and most recent being of 8500 tons. The company's ships sail from London, calling at Plymouth, Teneriffe, Cape Town, Hobart, on the way out, and at Monte Video or Rio and Teneriffe on the return voyage. Communication with the different ports of New Zealand is carried out by the vessels of the Union Steamship Company of New Zealand, as well as to Australian ports.

Norddeutscher Lloyd.—The commanding position of this company among the great steam-ship lines of the world is a standing instance of success achieved after difficulties at first almost overwhelming. To the enterprise of certain citizens in the old commercial city of Bremen this large business owes its existence. The originator was Herr H. H. Meier, who brought into line the various shipping interests of Bremen, and induced them to amalgamate into one company. The associations thus brought together were the Weser Haute Steam-ship Company, the Unter Weser and Ober Weser Steam Tug Companies, and the Ober Weser Universal Shipping Insurance Association. The statutes of the new company were approved by the senate of Bremen on 18th February 1857. The original capital was 4,000,000 thalers, but soon after the formation of the new company great depression set in, owing to the commercial crisis in North America. More than 2500 shareholders in the Lloyd forfeited their shares, but the directors were not dismayed, and had the loyal support of their fellow-

citizens. Four big ocean steamers were constructed for the American line and three for the English, and large docks for repairs were established at Bremerhaven. The first voyage was made in June 1858, when the *Bremen* started for New York, carrying many steerage passengers, but only one in the saloon. The second ship, the *Hudson*, was shortly afterwards burned while lying in harbour. At the end of the first year both lines showed a loss. At the end of the second year matters improved, the English cattle trade especially showing great progress. But the company still commanded little confidence, for the Darmstadt Bank parted with 1,000,000 thalers' worth of shares at a loss of 75 per cent. These the directors themselves took over. But the American Civil War now came to deal another severe blow at the Lloyd, just when its prospects were growing brighter, and till 1864 no dividend greater than 2½ per cent was paid to the shareholders. After the termination of the war the trade with the United States grew enormously, and the English traffic also revived in a most unexpected way. One result was the foundation of rival lines, which, however, were unable to maintain effective competition, and succumbed. In 1868 a new line was opened. Bremen's staple of commerce is tobacco, and the directors determined to bring their port into direct communication with the tobacco-producing areas in the States; so in that year they inaugurated their line to Baltimore. In the following year a line was started to New Orleans, another great centre of the tobacco and cotton trade. It was necessary to construct three special liners for that service, as the ordinary ships could not pass the bar of the Mississippi. In 1869 a line to Central America and the West Indies was set on foot, and new steamers were ordered to run on it. With the outbreak of the war of 1870 the company naturally had anxious times, as the French fleet blockaded the German coasts; but its boats often ran the blockade with success. Soon after the war the West Indian service, proving unprofitable, was given up. In 1875 a new line of steamers to Brazil and Argentina was started. This was separated into two distinct services in 1878. In 1880 the approach of the great struggle for supremacy on the Atlantic made itself felt, and the company began to prepare for the contest, and ordered the construction of the *Elbe*, the first of its express line of steamers. She commenced running in 1881, and was quickly followed by others. Between 1881 and 1888 an entirely new fleet was placed on the New York line. In 1886 the Australian and East Asian Lines were founded in accordance with a contract with the Imperial Government. This included a monthly service to China, with branch service to Japan, and a monthly service to Australia, with a branch line to the Samoan and Tonga Islands. From that time onwards the story of the Norddeutscher Lloyd has been one of increased prosperity, keeping pace with wider developments of its activity. The company's fleet includes the two large and fast steam-ships *Kaiser Wilhelm der Grosse* of 14,349 tons and 27,000 i.h.p., and *Kronprinz Wilhelm* of 14,800 tons and 33,000 i.h.p., both built by the Vulcan company at Stettin, while a still larger and more powerful vessel, the *Kaiser Wilhelm der Zweite*, will follow from the same yard. The company runs many lines from its headquarters at Bremen; among them are those to New York—a line of express steamers and a line of ordinary mail steamers, all calling at Southampton or Cherbourg; to Baltimore direct; to Galveston direct—there are no first-class passengers by this line; to Brazil; to the river Plate, calling at principal ports on the way. There are also lines of imperial mail steamers between Bremen and eastern Asia, and Bremen and Australia, and a freight line to East Asia, which runs in connexion with the Hamburg-American Line. In pursuance of the German policy of securing the feeders to maintain traffic, the Norddeutscher Lloyd purchased the ships and business of the Kinsing Line and of the Scottish Oriental Company, when it began seriously to develop its Eastern trade. Feeling, in common with all large steam-ship companies, the difficulty of providing efficient personnel for its constantly expanding fleet, and believing in the necessity for seamen of experience in masted ships, the Lloyd has provided itself with a sea-going training ship.

Ocean Steam-ship Company.—The Ocean Steam-ship Company is the successor of older steam-ship enterprises, mainly under the same management and ownership. These began in 1852 with the coasting trade, and extended in following years to French ports, and in 1855 to the West Indies. The last-named line attained some moderate importance, comprising seven vessels; it was sold in 1863, and eventually became the West India and Pacific Steamship Company, which in its turn was absorbed by the Leyland Line in 1900. The managers thereupon, seeking other trades, decided on attempting that to China, and the company under its present title was registered as unlimited in 1875. Up to this date low-pressure jet-condensing engines were alone used, burning perhaps 5 to 5½ ℔ of coal per indicated horse-power per hour. This rate of consumption would have been fatal to the scheme, since vessels could not have carried any cargo in addition to the coal necessary for so long a voyage as that *viâ* the Cape, the Suez Canal not being opened till 1870. A small vessel, the *Cleator*, of which the exact speed and consumption with the old type of engine was well known, was therefore experimentally fitted with new machinery of the compound high-pressure (70 ℔), surface-condensing type. The result of the experiment was that her consumption was reduced to about 3 or 3½ ℔. per i.h.p. per hour, and this warranted the construction of the *Agamemnon*, *Ajax*, and *Achilles*, all 309 feet long, 38 feet 6 inches broad, 28 feet 6 inches deep, fully rigged as barques, with screws outside their rudders. These rigs were subsequently altered to that of barquentines, but the relative positions of the screws and rudders were retained till they were disposed of in 1899. In these vessels the consumption was further reduced to about 2½ ℔, which allowed margin for a reasonable cargo. The *Agamemnon* sailed from Liverpool in 1866: the itinerary being Mauritius, Penang, Singapore, Hong Kong, and Shanghai, and, with similar calls, back to London. The cargoes in those days were mainly manufactured goods outwards, and tea homewards. The average speed was perhaps 9¾ knots, and the consumption about 21½ tons of Welsh coal per day. These and succeeding steamers were at that date the only vessels carrying high-pressure steam on long voyages, and they traded regularly round the Cape, being the only line that did so. When the Suez Canal was opened in 1870 they changed the route. The trade from the United Kingdom to China has since steadily grown, and increasingly large cargoes are also procurable homewards from the Far East, in spite of the successful competition of Indian and Ceylon teas. In 1891 a service was begun from Amsterdam and Liverpool to Java, and this is maintained about once a fortnight, finding employment for about ten of the smaller ships. The vessels in this trade, which is principally between Holland and her eastern possessions, fly the Dutch flag. A limited number of passengers were formerly carried between England and the East, but the ships now take cargo only to and from Europe, though Mahommedan pilgrims are conveyed in considerable numbers to and from Jeddah, the port for Mecca. The ships generally load at Glasgow, and occasionally at other west coast ports. They usually carry the greater part of the cargo from

Liverpool, the most important element being fine goods (manufactured cottons, &c.) from Lancashire and Yorkshire. Abroad the regular service has been extended to the principal Japan ports—Nagasaki, Kobé, and Yokohama. The following local services have their headquarters at Singapore:—(1) Singapore to West Australian ports, including Fremantle. These steamers carry passengers, and bring large quantities of wool and pearl shell from Australia to Singapore for transhipment to the main line steamers bound for London. (2) Singapore to Deli (Sumatra). Three small steamers bring tobacco from Deli for transhipment to Europe. (3) Singapore and Penang to China. The great emigration of Chinese coolies to the British colony of the Straits Settlements keeps several steamers regularly employed. The company is colloquially known in the shipping world as the "Blue Funnel" Line, and is also often referred to by the name of Mr Alfred Holt, who has been closely identified with it throughout its history. In 1902 the Ocean Company absorbed its younger rival, the China Mutual Steam Navigation Company, with a fleet of thirteen vessels of 106,870 tons, and shortly afterwards re-registered itself under the Limited Liability Act.

Orient Line.—The Orient Line of steamers between London and Australia took up the work of the Orient Line of clipper packets, which, in the days of sailing ships, used to ply between London and Adelaide. In April 1877 it was announced that "the Orient Line would sail the under-mentioned steam-ships of the Pacific Steam Navigation Company to Australia," and that connexion between the two organizations has been continued and strengthened till in 1901 the name of Orient Line was changed to that of Orient-Pacific. In June of 1877 the *Lusitania* was despatched from London to Adelaide, Melbourne, and Sydney, *viâ* the Cape of Good Hope. Other sailings followed at about two-monthly intervals. In the following year the present line came into existence. It was formed by the joint efforts of Messrs Anderson, Anderson and Co., and F. Green and Co., who are the managers of the line. When the service was begun it was intended to be run monthly, but the increase of traffic soon demonstrated that fortnightly sailings would be successful. This extension was determined on in 1880, the year following that in which the *Orient*, the first ship specially built for the company's trade, commenced work. Since 1888 the Orient Company has carried the mails to Australia by contract with the English Post Office once a fortnight. These despatches, alternating with those of the P. and O., give Australia a weekly mail. Several twin-screw steamers have been built for this service by both the Orient and the Pacific Companies. It was the Orient liner *Ophir* which took the place of a Royal Yacht for the Imperial tour of the Prince and Princess of Wales in 1901. The steamers of the Orient Line call regularly at Plymouth, Gibraltar, Marseilles, Naples, Port Said, Suez, Colombo, Fremantle, Adelaide, Melbourne, and Sydney.

Pacific Steam Navigation Company.—This was the pioneer of the steam-trade along the western coast of South America; subsequently its operations were extended to Europe, and finally, in conjunction with the Orient Steam Navigation Company, it established the Orient Line to Australia. It obtained a charter early in the year 1840, and soon sent out from England two steam-vessels, the *Chili* and *Peru*. These were paddle-boats of 710 tons and 198 feet in length. They ran along the coast from Valparaiso to Panama. The early struggles of this company are noteworthy as showing how difficulties, apparently insuperable, may be overcome, and even turned to essential advantage. The great obstacle to the success of these steamers was the difficulty of obtaining supplies of fuel, and in the first five years of its existence no less than £72,000 was lost, the whole capital of the company being but £94,000. But the difficulties were overcome, and all that remained in the mind of the managers was a strong feeling of the importance of economy in coal consumption. Accordingly, in conjunction with the Fairfield firm of Randolph, Elder and Company, they turned their attention in this direction, and were sending out vessels fitted with compound engines some ten or a dozen years before the Atlantic companies adopted them. In 1867, under pressure from the Chilian Government, the company sought and obtained powers to extend its operations, and in the same year the *Pacific* of 1630 tons was constructed. She left Valparaiso for Liverpool in May 1868, the first of the new mail line. In 1870 the voyage was extended, Callao, 11,000 miles from Liverpool, being made the terminal port, and the sailings were increased from one to three a month. In 1873 a weekly service between Liverpool and Callao was instituted, and by 1874 there was a fleet of 54 steamers, with an aggregate of 120,000 tons, in commission. Owing, however, to a great decrease in the South American trade the service was reduced to a fortnightly one. Several of the company's steamers now run in the service of the Orient Line. In January 1893 the company inaugurated a monthly cargo service to the Brazils, river Plate, and the West Coast. This service has been extended to Glasgow. Many ports are served. The principal are La Pallice, La Rochelle, Corunna, Carril, Vigo, Lisbon, St Vincent, Pernambuco, Bahia, Rio de Janeiro, Monte Video, Buenos Aires, Punta Arenas, and the ports of the western coast of South America, Valparaiso, and Callao.

Peninsular and Oriental.—The story of the P. and O. Company may be divided into two eras—the first reaching from its foundation to the opening of the Suez Canal; the second from that date to the present day. During almost the whole of its career the company has acted as the agent of the British Government in the conveyance of its mails, first to Mediterranean ports, and afterwards to Egypt, India, and the Far East. From time to time the Government has made efforts to procure some other means for transmitting its mails, but on every occasion it has found it advisable to return to the P. and O. In 1835 Messrs Willcox and Anderson, a firm of London merchants, began to run steamers to the principal ports of the Peninsula. Their vessels observed greater regularity than the sailing-ships then employed to carry the mails, and the first mail contract was entered into on 22nd August 1837. This was awarded to them after another company, which was unable to fulfil its obligations, had been engaged for the work. Messrs Willcox and Anderson had shortly before, in concert with Captain Bourne, R.N., founded the Peninsular Company. This contract arranged for a monthly service between Falmouth and Vigo, Oporto, Lisbon, and Gibraltar. About two years later another step was taken. Hitherto the mails to Egypt and India had been conveyed by the Peninsular Company to Gibraltar, by an Admiralty packet from Gibraltar to Malta, by another Admiralty vessel from Malta to Alexandria, and from Alexandria to Bombay by one of the East India Company's steamers. It was resolved to substitute for this unsatisfactory mode of conveyance a direct system of carriage by one line of steamers from London to Alexandria. The Peninsular Company again secured the contract, which was put up to public competition, and built two steamers of 1600 tons for the purpose, this being a large tonnage for those days. The annual subsidy was fixed at £34,000, by which the Government saved £10,000 of the amount formerly expended on their own inefficient means of transport. The company then, by a

charter of incorporation, dated December 1840, assumed the name by which it has ever since been known—The Peninsular and Oriental Company. The charter was granted only on the onerous condition that steam communication with India should be established within two years. The first steamer, the *Hindostan*, was despatched to India *viâ* the Cape of Good Hope on 26th September 1842. She was one of a small fleet destined to ply between Calcutta, Madras, Ceylon, Aden, and Suez. It was an adventurous undertaking, for the East India Company promised no definite subsidy, only a small premium on a certain number of voyages.

The obvious advantages of a direct conveyance of mails between Suez and Bombay by a regular sufficient service were becoming evident, and the P. and O. Company offered to effect this at a great saving on the existing system; but, for some reason or other, the East India Company showed the greatest reluctance to allow the control of this route to pass out of their hands, in which, in fact, it remained until 1854. Fortunately for the P. and O. Company the Government decided to establish regular monthly steam communication between England and Ceylon, Madras, and Calcutta, and also from Ceylon, eastward to Singapore and Hong Kong. Only the P. and O. could at that time have contemplated undertaking such a service. In 1844 the contract was signed, and by it the company was to receive a subvention of £160,000. The Indian portion of the service opened on 1st January 1845, and during that year the extension to China was effected, and nine new steamers were put on the stocks. The organization of the overland route was due to the P. and O. Company, which brought it into regular working in order to convey its passengers from Alexandria to Suez. It was a picturesque but uncomfortable passage by canal-boat and steamer to Cairo, then by a two-wheeled omnibus for ninety miles across the desert to Suez. Even the coal for the boats at Suez had to be transported in this fashion, which was cheaper than sending it by sailing vessel round the Cape. The construction of a railway across the Isthmus in 1859 greatly simplified the transit. It may be noted that the company had to establish coaling stations between Suez and the Far East, and also depôts of provisions, a business of no less magnitude than that of the steam service itself. In 1852 the first mail service to Australia was undertaken by the company, and the same contract included an arrangement for a fortnightly service to India and China, though a service running once every two months *viâ* Singapore and Sydney was thought sufficient for the requirements of Australia. The year 1854 saw the abolition of the East India Company's service to Bombay, the P. and O. taking its place. This arrangement saved the country £80,000 per annum. The Crimean war made large demands on the company's resources for the conveyance of troops, and the Australian service was for a time interrupted. By 1859 the company was in possession of all the lines of steam communication between England and the East. In 1864 the service to Australia was increased to one sailing a month, and in 1868 the Bombay mail left weekly. About the same time the fourth India and China contract was entered into, and at the end of 1869 the opening of the Suez Canal led to a serious crisis in the company's affairs; and also after these difficulties had been surmounted, to a complete revolution in its methods. The opening of the canal led to a prolonged controversy with the Post Office, which, with true official perversity, would not allow the company to use the canal for the conveyance of its mails. A serious falling-off of the company's revenue was the result, as the competition of the canal steamers was killing its trade. At length in 1874 a new arrangement was made by which the mails were to be carried through the canal, the subsidy granted to the company being at the same time reduced. Under these conditions, however, it was now able to construct vessels capable of competing successfully with its rivals. A prolonged dispute between Victoria and New South Wales for a long time prevented the Australian service from being as efficient as it might have been. Sydney insisted on the Pacific route being adopted. In consequence of this controversy the Australian headquarters of the company were for some time fixed at Melbourne, and it was not till 1888 that a general contract was entered into with the Postmaster-General, acting at last for all the Australian colonies as well as for the Imperial Government. This stipulated for an accelerated service—the India, China, and Australian mails being all worked from Aden in connexion with the steamer which conveyed them from Brindisi. There was for long a service between Venice, Brindisi, and Egypt, and a mail contract with the Italian Government; but this came to an end in March 1900.

The company's first ship, the *William Fawcett*, built in 1829, had a gross tonnage of 206 and 60 h.p. Down to 1851 the vessels of the fleet were all constructed with paddles; after that date the screw took their place, though for the Marseilles to Malta express service certain famous fast paddle steamers were subsequently constructed. A later interesting development was the abandonment of Brindisi as a port of call for the Ocean mail steamers, which reverted to Marseilles, whence they run across to Port Said direct. The mails leaving London every Friday night are despatched from Brindisi in specially-designed twin-screw vessels, which land them at Port Said little more than 96 hours after their despatch from London. On this service the *Osiris* and *Isis* are employed, and they have the distinction of being the only vessels in the mercantile marine which cross the seas with mails and passengers only. The company is under contract with the British Government for the conveyance of mails to India, China, and Australia. Its services are as follow:—India: Brindisi to Bombay, weekly. China: Brindisi to Shanghai, fortnightly. Australia: Brindisi to Sydney, fortnightly. Apart from the mail services, the company runs independent lines to Malta, Colombo, and Calcutta; also between Bombay, Colombo, Singapore, Hong Kong, and Shanghai; and between Hong Kong, Nagasaki, Hiogo, and Yokohama. There is likewise a direct fortnightly service of through steamers to China and Japan at special rates. As illustrating the advances made in rapidity of mail services in twenty-five years, the following table is interesting:—

	Miles by Land and Sea.	Days occupied.	
		1873.	1900.
London to Bombay.	5,459	23	14
„ to Shanghai.	9,834	45	32
		(Monthly.)	(Fortnightly.)
„ to Melbourne..	10,773	48	31

Russian Volunteer Fleet.—Though of comparatively recent origin—it only sprang into being during the stress of the Russo-Turkish war of 1878—this organization is important and in some respects unique. Its existence is due to the patriotism of certain Russian nobles who were anxious to aid their country in its struggle, and it thus began its career somewhat hurriedly, though under Imperial auspices. Owing to the need for immediate tonnage, its managers, in the first instance, purchased a few somewhat obsolete German liners, and one or two of the

earlier vessels constructed for the British Castle Line. But even with these ships it did useful service in the transport needed for the military operations then proceeding. The Imperial Government granted the company certain very exceptional facilities, including what amounts to a practical monopoly of the trade between Odessa and Vladivostok. Its vessels maintain the important service between these two ports, and thus form the link between European Russia and the ports on the Pacific coast of Siberia. They have the duty of taking out the troops and stores which are constantly being sent to the Far East, and they bring back, not only time-expired men, but also large quantities of such valuable freight as tea. Their profits are great, but they have been very largely applied to the improvement and extension of the fleet. At the conclusion of the Russo-Turkish war steamers specially suited for the peculiarities of the trade were ordered in British yards, and these, built for great speed, and fitted with twin-screws, are essentially designed for use as possible auxiliaries to the Imperial navy in case of maritime war. Some of the later of these ships have water tube boilers. Already some 17 vessels (of which six are of 20 knots' speed) have been placed in service, all being fitted to carry guns, which are kept in store for them in their terminal ports, and being officered from the Imperial Navy. So far the trade of this company has been confined to voyages between Russian and Siberian ports. But in 1902 there was a movement towards extending the operations of these ships to the North Atlantic, it being thought that they might find a useful opening in the trade between Italian and United States ports.

Shaw, Savill, and Albion Company.—The amalgamation of the business of Messrs Shaw, Savill and Company of London and of the Albion Shipping Company of Glasgow brought this company into its present form at the close of the year 1882. At that time the amalgamating firms owned a large fleet of sailing ships, and traded chiefly between this country and New Zealand. Soon after the amalgamation the company began to acquire steam-ships, which gradually supplanted their sailing vessels. The Shaw, Savill, and Albion Company were among the first in the frozen meat trade, and their vessels are fitted to carry large numbers of carcases. With this company the White Star Line of Liverpool became associated in the year 1884, and five of their ships now run in the fleet of the Shaw, Savill, and Albion Company. At the present time the combined fleet comprises 13 steam-ships, of which the largest are three sister ships of 12,500 tons each. The total tonnage of the steam-fleet is about 72,000. There is also a fleet of sailing vessels, 10 in number, the total tonnage of which is 11,544. The route to New Zealand is by the Cape of Good Hope on the outward voyage, returning by Cape Horn, thus going completely round the globe every voyage. After leaving London the steamers call at Plymouth, Teneriffe, Cape Town, Hobart, and Wellington; returning from New Zealand, the ports touched are Rio (sometimes Montevideo), Teneriffe, Plymouth, London. The *Arawa*, which came out in 1884, made the outward voyage in 38 days, and the run home in 35 days 4 hours steaming time; she thus made the circuit of the world in 73 days 4 hours net time.

Union Steamship Company (see Castle Line).—This company first came into existence in 1853 under the name of the Union Steam Collier Company, with a capital of £60,000. At its commencement it possessed a fleet of five small steamers with an aggregate of only 2337 tons. But by the time these boats were built the Crimean war was being actively carried on, and it was thought advisable to employ them for other purposes than those for which they were originally intended. They ran for a time between Southampton, Constantinople, and Smyrna; but the transport service proved more remunerative, and they were used for the conveyance of troops. At the close of the war the company was registered under the Limited Liability Act by its present name. It was then determined to run the vessels between Southampton and Brazil with cargo, but this did not prove profitable, and in 1857 a notable change took place in the status of the company, for in that year it took its place among the great ocean mail companies of England. In that year a contract was completed with the Government for a monthly mail service for five years to the Cape of Good Hope at an annual subsidy of £30,000. The *Dane* was the first boat to leave Southampton with the mails on 15th September. In 1858 the subsidy was increased in order that the Company's ships might call at St Helena and Ascension for mails on the homeward voyage. When the first contract expired the company secured another for five years. A service between the Cape and Natal, under a temporary arrangement, was inaugurated in 1862, and a seven years' mail service contract with the Natal Government was concluded in 1865. In 1873 the House of Commons refused to ratify a contract which the Government had entered into with the company for an extended mail service; the company, however, carried out its intention to extend its service to Zanzibar. But in October 1876 a new mail contract with the Cape of Good Hope Government was entered into for a fortnightly service between Plymouth and Table Bay, the length of voyage not to exceed twenty-six days. During the Zulu war this company rendered considerable services to Great Britain. In 1878 three ships were employed, and after Isandula they conveyed reinforcements, the *Pretoria* being the only mail steamer to carry an entire regiment, the 91st Highlanders. It was on this company's s.s. *Danube* that the Prince Imperial sailed, whilst the old s.s. *German* took out the Empress Eugénie when she went to visit the scene of his death. The direct service with the Cape, Natal, and Zanzibar was in 1881 discontinued, and in February of that year operations were extended to the Continent, a service from Hamburg was commenced, running every twenty-eight days, which for a time proved highly successful. A branch service to Antwerp, begun in 1882, was discontinued for a time, but subsequently resumed. At the time of the Penjdeh scare in 1885, when hostilities were threatening with Russia, two of this company's steam-ships, the *Moor* and the *Mexican*, were selected to act as armed cruisers for the defence of South Africa. The former was the only merchant vessel on which the pennant was actually hoisted. In 1889 the company's Continental traffic increased so that it not only resumed the despatch of through steamers from Hamburg, but made calls at Rotterdam. This service afterwards became fortnightly, calls being made at Rotterdam, Antwerp, and Hamburg. New contracts with the colonial governments were made in 1888, and in the same year Southampton took the place of Plymouth as the outward mail port, while in 1889 the homeward mails were landed at Southampton in place of Plymouth. In 1889, by the construction of the *Scot*, the company acquired a much larger vessel than any they had hitherto employed; in 1895 Messrs Harland and Wolff successfully accomplished the task of lengthening this ship by cutting her in two amidships and adding 54 feet to her length and 1000 tons to her tonnage. In 1893 the company entered upon its new policy of building a large number of practically sister ships for its intermediate trade. All were built by Messrs Harland and Wolff, and fitted with twin-screws. The series included ten vessels, commencing with the *Gaul* of 4745 tons, and ending with the *Galician* of 6757 tons launched in 1900. Meanwhile from the same yard the

mail steamers *Norman*, *Briton*, and *Saxon* were added to the fleet. The last-named, which came out in 1899, is a vessel of 12,385 tons, with a length of 570 feet. By a resolution passed at a meeting of shareholders held on 13th February 1900, this company was amalgamated with the Castle Line, and thus ceased its separate existence. At the time of its absorption its fleet consisted of 20 vessels, of which 9 were over 6000 tons.

Union-Castle Line.—The early developments of this company must be sought under the head of the Union and Castle Lines, from whose amalgamation it sprang. Public convenience has, in some directions at least, been served by the union. Previously, though practically all the steamers made their final departure from Southampton, the Union Line only made its headquarters at that port, the Castle liners coming round from London. After amalgamation, the mail boats—to which cargo is not of so much importance—did not come to the Thames at all, the increase in their size and the neglect of the improvement of the river and of the docks by the authorities making it undesirable that they should do so. The cargo (intermediate) boats, on the other hand, all load in London, and many of them, before their final departure from the Thames, visit Hamburg, Antwerp, and Rotterdam, for the purpose of picking up cargo. On these North Sea trips passengers are carried, and facilities are given for their accommodation on board during the calls at the various ports. The new company carries out the contracts of its two constituents and thus despatches every Saturday a mail steamer from Southampton *viâ* Madeira to the Cape and Natal. An hour or so before the sailing of the mail boat an intermediate steamer departs from the same port. Her places of call are Teneriffe or Las Palmas for certain, and possibly also Ascension and St Helena. These vessels serve the East Coast ports of Algoa Bay and East London as well as Natal. Some of them also go to Delagoa Bay. Those which do so proceed farther, going on alternate voyages thence to Beira on the mainland, and also to the island of Mauritius. Besides the two weekly vessels, however, there are despatches of extra mid-weekly intermediate steamers, and these extra sailings have recently tended to become more frequent. The company's attention has for some time been directed to the trade between the United States and South Africa, and within two years after amalgamation eight new steamships were constructed with a view to the development of the trade between Cape ports and New York. Nor did the union of the two companies stop the improvement of the general fleet. The 10,000-ton twin-screw mail steamers *Kinfauns Castle* and *Kildonan Castle* were delivered to the Castle Company from the Fairfield yard prior to the amalgamation. Messrs Harland and Wolff had the *Saxon*, 2000 tons larger than these ships, well in hand at the time. But the *Walmer Castle*, the largest of all and a still later addition to the fleet, embodies as far as possible the practice which from experience commended itself to both the old companies. Further important mail steamers were in 1902 under construction. In spite of the strain put on the resources of the company by the heavy work entailed by the South African war, both on the vessels employed in their regular service and on those especially taken up for Government transport duty, it was found possible already to discard two of their older vessels.

White Star Line.—Though perhaps chiefly known in the New York trade, the White Star flag was first hoisted in the middle of last century over a fleet of clippers which sailed to Australia. In 1867 Mr Thomas Henry Ismay took it over, and two years later the great revolution in the constitution of the company took place. In was in 1869 that Mr Ismay formed the Oceanic Steam Navigation Company to run a line of steamers between Liverpool and New York. Immediately on its formation the company entered into arrangements with Messrs Harland and Wolff of Belfast for the construction of a fleet of high-class passenger ships, and it is worthy of notice that the terms upon which Messrs Harland and Wolff built the White Star ships were peculiar. No definite price was agreed upon, but the actual cost plus a percentage for builder's profit was charged. The first *Oceanic*, pioneer steam-ship of the line, was launched on 27th August 1870, and sailed for New York on 2nd March 1871. Her advent opened a new era in Atlantic travel. She introduced the midship saloon, which extended the whole width of the ship, thus giving increased light and improved ventilation, and reducing to a minimum the sensation of the vessel's motion. The arrangement thus introduced is now almost universally adopted in the construction of ocean liners. The *Oceanic* was also narrower in proportion to her length than the vessels previously designed for the transatlantic mail service. In 1877 the *Britannic* reduced the passage to 7 days 10 hours and 50 minutes, excelling by three hours the best previous Atlantic passage. After the year 1888 the company ceased to build single-screw steamers, all later vessels having been constructed on the twin-screw system, of which the superiority had been clearly demonstrated. About this time also the owners of the line became responsible for an important advance in steam-ship construction which was afterwards imitated by merchant ships of all the great maritime Powers. The *Teutonic* and *Majestic*, introduced in 1889 and 1890, were the first merchant ships constructed with a view to their use as possible auxiliaries to the Royal Navy. The former was present, armed with eight quick-firing guns, at the naval inspection by the German Emperor in 1889. With the launch of the second *Oceanic* in January 1899 the company's record was still further enhanced. This gigantic ship, built by Messrs Harland and Wolff, is of 17,247 tons and 28,000 h.p., her length over all being 705 feet. She has accommodation for 350 saloon, 250 intermediate, and 1000 steerage passengers, besides a crew of 450. She also is an armed cruiser, as are the *Majestic* and the *Teutonic*, both close upon 10,000 tons. The White Star Line was from 1877 regularly employed under contract with the British Government to carry the American mails from Liverpool and Queenstown to New York. Besides this weekly mail and passenger service, a fleet of twin-screw cargo vessels maintained a subsidiary service between Liverpool and New York. These vessels were especially designed for the conveyance of cattle and horses. The company's s.s. *Celtic*, a vessel of 20,880 tons, gross register, when launched (in 1901) the largest vessel afloat, was usually employed in this trade, but she also on occasion carried the mails. A slightly larger sister, the *Cedric*, was provided for the same work in 1902. After 1883 several steam-ships of the line were employed in the Shaw, Savill, and Albion service between London and New Zealand. Three of the company's ships ran in the line of the Occidental and Oriental Company between San Francisco and Yokohama and Hong Kong. The company inaugurated a service to Australia from Liverpool in 1899. Five ships ran in it (calling at Cape Town) to Albany, Adelaide, Melbourne, and Sydney. The ports visited by their vessels in New Zealand will be found detailed under Shaw, Savill, and Albion Company. In 1902 the absorption of the White Star fleet and management in the Morgan Shipping Combine (*q.v.*) was arranged.

Wilson Line.—Thomas Wilson, Sons and Company is at

the present time the largest private ship-owning company in the world. This line traces its origin as far back as 1835. It was founded by Mr. Thomas Wilson in conjunction with Messrs Hudson and Beckington, and on the retirement of the two last-named gentlemen it acquired its present title. Early in the 'forties the firm was running three steam-ships to Gothenburg, and was engaged largely in the iron trade, importing large quantities of Swedish and Russian iron, and running a regular line of sailing boats to Swedish ports. It also despatched a regular service to Dunkirk. Steam-ships gradually superseded the sailing vessels, and new steamers year by year were placed on the Scandinavian service. About this time the firm secured the mail contract between England and Sweden, which it still holds. After the Crimean war it started the St Petersburg, Stettin, and Riga trade. During the Franco-German war the trade to Stettin had to be suspended; and as a set-off the service to Trieste was inaugurated, which has developed into an independent Adriatic and Sicilian service. The Norwegian trade was then improved by the despatch of steam-ships to Bergen, Stavanger, and Trondhjem, and subsequently a service of large steamers began running to Constantinople and the Black Sea. After the opening of the Suez Canal the trade to India, which has since assumed such considerable proportions, was inaugurated. In 1875 the firm launched out into a more hardy enterprise, by commencing to run steamers to America. Its boats in 1902 ran to New York regularly from Hull and the Tyne ports. The original Calcutta trade was discontinued when the New York line was started, but in 1883 a service was established between Hull and Bombay. In 1891 the firm became a private limited company, and in 1894 took over the coasting trade between Hull and Newcastle. The company employs a number of large and swift ships in the Norwegian passenger traffic, which in the summer season now reaches very considerable proportions. It has frequent services of passenger and cargo vessels to the ports of northern Europe, carrying passengers in the season as far north as the North Cape. Of course the winter season necessitates considerable variation of summer services to Baltic ports. There are also boats leaving Grimsby, Manchester, and Liverpool regularly for Scandinavian and Baltic ports; weekly services to Ghent, Liverpool, and Newcastle; and services to Mediterranean and Black Sea ports. Besides the New York line there are ocean services to Boston, to New Orleans, and the river Plate. There is also a weekly service to and from London and Boston in conjunction with the Furness-Leyland Line.

Comparison of the Gross Tonnage of the Fleets of Various Important Steamship Companies in 1901 and 1891.[1]

Company.	Flag.	1901.			1891.		
		Vessels.	Tons.	Numerical Order.	Numerical Order.	Vessels.	Tons.
Hamburg-American	German	202	541,085	1	9	42	126,795
Norddeutscher Lloyd	,,	111	454,936	2	4	70	198,723
Elder, Dempster, and Company[2]	British	120	382,560	3	25	48	55,256
British India S. N. Company	,,	120	378,770	4	1	100	234,654
Peninsular and Oriental Company	,,	58	313,343	5	3	49	199,911
Messageries Maritimes	French	62	246,277	6	2	63	202,801
F. Leyland and Company[3]	British	55	242,781	7	23	23	60,511
Union-Castle Line[4]	,,	41	222,613	8	...	...	...
Nippon Yusen Kaisha	Japanese	69	218,361	9	28	52	42,058
White Star Line	British	25	212,403	10	17	16	84,902
General S. N. Company of Italy[5]	Italian	102	205,104	11	6	106	164,052
Wilson Line	British	89	189,818	12	7	73	132,889
Compagnie Générale Transatlantique	French	59	183,243	13	5	66	174,600
Austrian Lloyd	Austrian	68	169,436	14	10	76	124,435
American Line[6]	American	25	167,105	15	...	...	...
Ocean S. S. Company	British	41	165,143	16	11	44	109,000
Clan Line	,,	46	164,487	17	18	29	76,300
Hansa Line	German	57	157,037	18	26	26	50,413
Allan Line	British	36	152,367	19	13	31	106,346
Lamport and Holt	,,	47	149,712	20	12	54	106,648
Harrison Line	,,	31	146,625	21	22	27	61,643
Pacific S.N. Company	,,	42	138,754	22	15	36	97,793
Anchor Line	,,	41	132,540	23	8	44	127,065
Maclay and MacIntyre	,,	51	126,917	24	30	19	26,928
Cunard Line	,,	26	126,332	25	16	22	85,104
Atlantic Transport Company	,,	17	123,593	26	32	6	18,111
Dominion Line	,,	13	105,430	27	29	8	28,696
Johnston Line	,,	24	100,460	28	24	22	58,621
R. Ropner	,,	36	100,426	29	21	34	62,717
Cia Transatlantica	Spanish	23	88,453	30	14	36	101,214
J. Westoll	British	38	88,306	31	27	31	48,298
Royal Mail S. P. Company	,,	28	88,205	32	19	25	73,364
Bucknall Brothers	,,	23	83,207	33	...	...	...
Chargeurs Réunis	French	26	81,149	34	20	30	70,173
Volunteer Fleet	Russian	16	80,424	35	31	8	23,845

Conclusion.—The scope of this article will not allow of any detailed reference to many of the important foreign lines which in a complete history should be mentioned. The Hansa Company of Bremen; the Chargeurs Réunis of Havre; the Nederland American Line, which has recently added to the fleet several fine twin-screw liners, built at

[1] This table is based on that contained in a paper on "Shipping Subsidies," by B. W. Ginsburg, published in the *Journal of the Royal Statistical Society*, September 1901.

[2] Messrs Elder, Dempster, and Company now control the fleets of the African British and African and Imperial Steamship Companies, as well as that of the Beaver Line.

[3] The Leyland Line was formerly the Leyland Line and West India and Pacific Steam Navigation Company.

[4] Formerly the Union Line and the Castle Line. In 1891 the Union Line had 23 steamers of 55,576 tons, and the Castle Line 19 steamers of 57,934 tons.

[5] Formerly known as the Florio-Rubattino Line.

[6] In 1891 the old American Line had 3 steamers of 10,166 tons; the Inman Line 6 steamers of 41,276 tons; the International Line 4 steamers of 12,112 tons; and the Red Star Line 9 steamers of 39,609 tons. The present American Line comprises all these fleets.

the Belfast yard; the Compania Transatlantica of Barcelona, which performed so great a feat in the transport of troops from Barcelona to Cuba in the latter days of Spain's dominion over that island; the Pacific Mail Company of the United States; and many others might be noticed. A whole article might be devoted to the work of the lines on the North American inland waters, while there are several other English companies which might well claim attention, both from the magnitude of their operations and the extent to which they have developed types of ships suitable for the peculiarities of the trades in which their vessels are engaged. The Clan Line, for example, has largely adopted the turret-decked ship, which is the design of Messrs W. Doxford and Company of Sunderland. This type of ship is intended to carry large cargoes on a small registered tonnage and a light draught, without paying for it by a sacrifice of weatherly qualities. The same object is aimed at by the design of the trunk steamers built by Messrs Ropner of Stockton. Then there are the tank steamers constructed for the carriage of oil in bulk. The largest fleet of such vessels is the Shell Line of Messrs Samuel and Company. Several of these ships are adapted not only for the carriage of oil, but also for its consumption in their furnaces in place of coal. We have already referred to some of the vessels fitted with refrigerating apparatus for the carriage of dead meat, and to the cargo steamers of the Atlantic companies, which are supplied with conveniences for carrying valuable racehorses and cattle. The experience of many years has enabled the owners of some of these lines to exhibit a wonderfully low record of loss, the percentage of deaths at sea to numbers carried being small beyond the dreams of, say, the 'seventies. A tenth of 1 per cent. over a somewhat extended period is not an unprecedented average.

The foregoing table shows something of the recent growths of companies, and at the same time records some of the amalgamations which have been so frequent. It should be explained that the table does not pretend to be exhaustive. The fleets embraced in it are not necessarily all those whose tonnage reaches above the lower limit shown. The figures, too, are subject to certain reservations. The count was not necessarily taken by the various companies at the same period of each year. Some of the figures given may include numbers and tonnages of tugs and tenders, while others may exclude them. Again, some of the companies may have returned in their fleets the vessels which they had under construction, whilst others may not have counted them. But none of these considerations can much affect the general significance of the figures shown. The growth in the average size of individual ships is as marked as that of the aggregate tonnage of the companies.

AUTHORITIES.—The following books throw much light on the history of the leading steam-ship lines:—*History of Merchant Shipping*, by W. S. LINDSAY. London, Sampson Low and Co.—*La navig. comm. au XIX Siècle.* Paris, 1901.—A. J. MAGINNIS. *The Atlantic Ferry*, 3rd edition. London, Whittaker and Co.—E. R. JONES. *The Shipping World Year-Book.*—T. RHODES. *Steam-ship Guide.* London.—Also see a comprehensive article on this subject in the *Quarterly Review* for January 1900. Perhaps the fullest information is, as a rule, to be obtained from the handbooks issued by the companies themselves. (B. W. G.; W. B. DU.)

Stedman, Edmund Clarence (1833–——), American poet and critic, was born at Hartford, Connecticut, 8th October 1833. He studied two years at Yale College; became a journalist in New York, especially on the staffs of the *Tribune* and *World*, which latter paper he served as field correspondent during the first years of the Civil War; and was a broker in Wall Street from 1864 to 1899. His first book, *Poems, Lyric and Idyllic*, appeared in 1860, followed by successive volumes of similar character, and by collected editions of his verse in 1873 and 1884. His longer poems are *Alice of Monmouth: an Idyl of the Great War* (1864); *The Blameless Prince* (1869), an allegory of good deeds, supposed to have been remotely suggested by the life of Prince Albert; and an elaborate commemorative ode on Hawthorne, read before the Harvard Phi Beta Kappa Society in 1877. An idyllic atmosphere is the prevalent characteristic of his longer pieces, while the lyric tone is never absent from his songs, ballads, and poems of reflection or fancy. As an editor he put forth a volume of *Cameos* from Landor (with T. B. Aldrich, 1874); a large *Library of* (selections from) *American Literature* (with Ellen M. Hutchinson, 11 vols., 1888–90); a *Victorian Anthology* (1895); and an *American Anthology* (1900); the two last-named volumes being ancillary to a detailed and comprehensive critical study in prose of the whole body of English poetry from 1837, and of American poetry of the 19th century. This study appeared in separate chapters in *Scribner's Monthly* or the *Century Magazine*, and was re-issued, with enlargements, in the volumes entitled *Victorian Poets* (1875; continued to the Jubilee year in the edition of 1887), and *Poets of America* (1885), the two works forming the most symmetrical body of literary criticism yet published in the United States. Their value is increased by the treatise on *The Nature and Elements of Poetry* (1892)—originally delivered in the form of lectures at Johns Hopkins University—a work of great critical insight as well as technical knowledge.

Steele, a town of Prussia, in the Rhine province, on the Ruhr, 4 miles by rail east of Essen. Here, as early as 938, the Emperor Otto I. held a diet of the empire. It has coal mines, iron and steel works, and makes fireproof bricks. Population (1885), 6237; (1900), 12,243.

Steelton, a borough of Dauphin county, Pennsylvania, U.S.A. It is on the river Susquehanna, and on the Pennsylvania and the Philadelphia and Reading railways, south-east of the centre of the state, at an altitude of 306 feet. It contains the works of the Pennsylvania Steel Company, including blast-furnaces, rolling-mills, and bridge manufactories, besides other industrial concerns. It was chartered as a borough in 1880. Population (1880), 2447; (1890), 9250; (1900), 12,086, of whom 2300 were foreign-born and 1508 negroes.

Steeple-chasing. See HORSE-RACING.

Stefanie, BASSO NAEBOR, or CHUWAHA, a lake of East Africa, lying in 37° E., between 4° 25′ and 5° N. lat., and measuring some 40 miles by 15. It is the southernmost and lowest (1880 feet) of a series of lakes which seem to lie in a north-easterly continuation of the great East African rift valley, although this loses its well defined character in about 3° N. The character of the lake varies greatly according to the amount of water brought down by its principal feeder, the Sagan or Galana Amara, which enters at its north end, being there a fairly rapid stream 50 yards wide and 3½ feet deep. According to Dr Donaldson Smith, this river is partly fed by the next lake in the series, Abaya or Chamo (3460 feet), which in turn receives the waters of a larger lake—Abai, Pagade, or Regina Margherita—through the river Walo, across a plain only 2 miles wide. All the lakes of the series are shut in by high mountains, those surrounding Lake Pagade, together with the islands with which its surface is broken, being clothed with luxuriant vegetation. The chief feeder of Pagade rises in 7° 30′ W., beyond which are several smaller lakes unconnected with the more southerly system.

Lake Stefanie was discovered by Count Teleki in 1889, and has since, with others of the series, been explored by Donaldson Smith, Bottego, Wellby, and others. Harrison in 1899 found the lake quite dried up, and two years later Count Wickenburg found water only in the northern part.

See *Geographical Journal*, September 1896, September and December 1900, September 1901.—VANNUTELLI and CITERNI. *L'Omo*. Milan, 1899.

Stellar Photometry. See PHOTOMETRY, STELLAR.

Stellenbosch, a town of Cape Colony, a few miles south of Paarl and east of Cape Town, with which places it is connected by rail. It lies in a pleasant upland valley on the Atlantic slope of the coast range, and is, next to the capital, the oldest settlement in the colony. The Fransche Hoek, or French Quarter, in the neighbouring amphitheatre of hills, still indicates the district where most of the Huguenot refugees established themselves towards the close of the 17th century. Stellenbosch is a busy agricultural centre, with a population of over 5000 in 1890. In the early days of the Boer war (1899–1902) Stellenbosch was one of the British military bases, and was used as a "remount" camp; and in consequence of officers being sent back to it when they had not distinguished themselves at the front, the expression "to be Stellenbosched" came into general use; so much so, that in similar cases officers were spoken of as "Stellenbosched" even if they were sent to some other place altogether.

Stendal, a town of Prussia, in the province of Saxony, 70 miles west of Berlin by rail. The cathedral was restored in 1893, and now shelters the natural history and archæological collections of the Museum of the Alt-Mark. Population (1885), 16,184; (1900), 22,081.

Stephan, Heinrich von (1831–1897), German statesman, was born at Stolp, in Pomerania, on 7th January 1831. From his earliest years he showed that talent for languages to which he owed so much of his success in life, and before he went to school had acquired a considerable knowledge of Italian, Spanish, and English. He was educated at the grammar school of his native town, and at the age of sixteen entered the service of the Prussian Post Office. His promotion was rapid; he was transferred to East Prussia, and thence to Cologne. Here he added to his salary by writing dramatic criticism, and here he obtained his first acquaintance with the system, or rather lack of system, which with its complication of charges made all international postal correspondence so expensive and uncertain—a system which he was in later years to revolutionize. After passing the examinations which admitted him to the higher branches of the service, he was transferred to Frankfort-on-the-Oder, and in 1856 to Berlin. Many different stories are told of the manner in which his exceptional knowledge of European languages was brought to the knowledge of the Postmaster-General, who at once saw that capacity and attainments of the kind could best be used at headquarters. During the next few years he was entrusted with very important duties; he was chosen as Prussian representative when a postal treaty was arranged with Spain and Portugal. In 1864 he was given the task of reorganizing the postal service in the conquered duchies of Schleswig-Holstein, and in 1866 it fell to his lot to extend the Prussian system to the newly annexed provinces; he had to take over and replace the system by which for three hundred years the family of Thurn and Taxis had conducted the postal service of central Germany. He also found time to write works on the history of postal matters, viz., a *History of the Prussian Post Office* (1859), and articles on the means of communication in ancient and mediæval times, which appeared in *Raumer's Historisches Taschenbuch* (1868). He was one of the invited guests at the opening of the Suez Canal, and in 1872 published a work on modern Egypt. In 1870, at the early age of thirty-nine, he was made Postmaster-General of the North German Confederation, and in the next year of the newly founded Empire; in 1878, at the general reorganization of the Imperial administration (see article GERMANY) the Post Office was made a separate department, and his title was altered to that of Secretary of State. His great powers of organization were at once shown in the arrangement of the admirable *Feld Post*, which during the war with France maintained communication with the army in the field. In eight months 89 millions of letters, 2½ million post-cards, and £10,000,000 in money passed through the department, and it was his boast that letters were delivered to and collected from the soldiers with almost unfailing regularity, sometimes even on the field of battle. In this way he began what was the great work of his life, that of making the Post Office in the truest sense of the word popular, and henceforth he was unremittingly occupied in devising and adopting new contrivances for the convenience and use of the people. The introduction of post-cards was his first innovation. In this he had been anticipated by Austria, but the idea was his own, and had been adopted by the Austrians in consequence of a suggestion made by him at a postal conference in 1865. The development of the parcel post and of the system of money orders was his next work, and in this he was so successful that in 1883 the German Post Office dealt with 79 million parcels, while in all the other countries of the world together only 52 million went through the post. While in this and other ways he extended the use of the Post Office at home, he gained a wider celebrity in being the chief promoter of the International Postal Union. He presided at the first conference, which met at Bern in 1874. The alacrity of his intelligence and his enthusiasm for the institution over which he presided were shown by the readiness with which he applied or took over all new inventions which might be of public service, such as telegraphs, telephones, and pneumatic tubes. His pride in the Post Office showed itself in the immediate interest which he took in the design and plan of the new offices which were erected in all parts of Germany; it was always his ambition that the post office in each town should be the most conspicuous and the handsomest of public buildings, even at the sacrifice of economy. He warmly supported Bismarck in his policy of extending and promoting national industry and foreign trade, and arranged the subsidies by which a direct postal service was established between Germany and China and Australia. His national feeling also showed itself in the support which he gave to the movement for purifying the German language of foreign words—but he did not always succeed in avoiding the exaggeration verging on the ridiculous into which this movement so easily degenerates. While he stood aloof from ordinary party politics, he was a frequent speaker in the Reichstag on the affairs of his own department, and was a member of the Bundesrath. Though never on terms of intimate friendship with Bismarck (difference of habits arising from the different spheres in which their youth had been passed would have made this impossible), his mastery in his own department won for him the appreciation of the Chancellor, and he was allowed more independence than most of the officials. By the power of working out broad and

general principles in detail and idealizing the routine work of administration he may fairly be placed among the great administrators by whom (far more than by statesmen and politicians) the Prussian State has been built up, and he was singularly fortunate in that his life fell at a time when by perfecting the administration of the newly founded Imperial Post he took no small part in strengthening the national idea and binding together the German nation. In 1897 blood-poisoning, arising from a wound in the foot, made amputation of the leg necessary, and he died from the effects of the operation.

See E. Knickeberg, *H. v. Stephan*, Berlin, 1897.

(J. W. He.)

Stephen, Sir James Fitzjames, Bart. (1829–1894), English lawyer, judge, and publicist, was born in London on the 3rd of March 1829, the third child and second son of Sir James Stephen, for many years permanent under-secretary in the Colonial Office. Fitzjames Stephen was for three years (1842–45) at Eton, and afterwards for two years at King's College, London. In October 1847 he entered at Trinity College, Cambridge. Notwithstanding exceptional vigour of mind and body, he did not attain any of the usual scholastic or athletic distinctions. The only studies then seriously prosecuted in the university course were mathematics and classics. Neither of these attracted him in their academical forms, nor did he care for competitive sport. But his Cambridge time was fruitful in other ways. He was already acquainted with Sir Henry Maine (*q.v.*), six years his senior, and then newly appointed to the chair of civil law. This acquaintance now ripened into a perfect friendship, which was continued in both private and public life with the happiest results, and ended only with Maine's death in 1888. No two men's intellectual tempers ever presented a stronger contrast. As Stephen himself said, it took them a long time to know when they really agreed. Maine was subtle, swift, and far-reaching; Stephen was massive, downright, indefatigable, and sincere even to unnecessary frankness. Their qualities were an almost exact complement of one another, but neither of them would take opinions on trust, or acquiesce in commonplace methods of avoiding difficulties; and it might have been said of either of them without exaggeration that, if all his technical and professional acquirements could be taken away, a born man of letters would be left. By Maine's introduction Stephen became a member of the Cambridge society known as the Apostles, in form not very different from many other essay societies, in substance a body with an unformulated but most individual tradition of open-mindedness and absolute mutual tolerance in all matters of opinion. Perhaps the golden age of the society was a few years before Stephen's election, but it still contained a remarkable group of men who afterwards became eminent in such different ways as, for instance, Clerk-Maxwell and Sir William Harcourt. Stephen formed friendships with some of its members, resident or occasionally revisiting Cambridge, which were as permanent, though in few cases so little subject to external interruption as his intimacy with Maine. Probably the Apostles did much to correct the formalism inevitably incident to the Evangelical traditions of the first Sir James Stephen's household.

After leaving Cambridge, Fitzjames Stephen, having practically to choose between the Church and the Bar, decided for the bar. He was called in 1854, after the usual haphazard preparation which then was (and still practically is) considered in this country alone, and even in this country for one kind of learning alone, a sufficient introduction to the duties of a learned profession. His own estimate of his strictly professional success, written down in later years, was that in spite of such training as he could get, rather than because of it, he became a moderately successful advocate and a rather distinguished judge. As to the former branch of the statement, it is correct, but ambiguous to those who do not know the facts. Stephen's work was always distinguished in quality, though his amount of business was never great in quantity. After his return from India and before he became a judge he had what is called a good practice, but still not a large one. In his earlier years at the bar he was attracted, like many other able young lawyers, by the stop-gap of journalism. It was no common journalism, however, that enlisted Stephen as a contributor to the *Saturday Review* when it was founded in 1855. He was in company with Maine, Sir William Harcourt, G. S. Venables (a writer of first-rate quality, who never set his name to anything), Bowen, Freeman, Mr Goldwin Smith, and others whose names have since become well known. Strangely enough, the first and the last books published by Stephen were selections from his papers in the *Saturday Review* (*Essays by a Barrister*, 1862, anonymous; *Horæ Sabbaticæ*, 1892). These volumes embodied the results of his studies among publicists and theologians, chiefly English, from the 17th century onwards. They never professed to be more than the occasional products of an amateur's leisure, but they were of greater value when they were first published than is easily recognized at this day by a generation familiar with the resources of later criticism.

For exactly three years (1858–61) Stephen served as secretary to a royal commission on popular education, which was more fortunate than most commissions in having prompt effect given to its conclusions. In 1859 he was appointed recorder of Newark. In 1863 he published his *General View of the Criminal Law of England* (not altogether superseded by the second edition of 1890, which was practically a new book). This was really the first attempt that had been made since Blackstone to explain the principles of English law and justice in a literary form, and it had a thoroughly deserved success. All this time Stephen kept up a great deal of miscellaneous writing, and the foundation of the *Pall Mall Gazette* in 1865 gave him a new opening. He was one of the principal contributors for some years, and an occasional one till he became a judge. He "seemed perfectly insensible to the labour," though he put far more individual conviction into his articles than most leader-writers do, or probably ought to do. So far he was a literary lawyer, possibly with chances (diminished by his vehement dislike for party politics) of regular professional advancement, possibly not free from the temptation to turn wholly to literature. The decisive point of his career was in the summer of 1869, when he accepted the post of Legal Member of Council in India. Fitzjames Stephen's friend Maine was his immediate predecessor in this office. Guided by Maine's comprehensive genius, the Government of India had entered on a period of systematic legislation which was to last about twenty years. The materials for considerable parts of this plan had been left by Maine in a more or less forward condition. Stephen had the task of working them into their definite shape and conducting the Bills through the Legislative Council. This he did with wonderful energy, with efficiency and workmanship adequate to the purpose, if sometimes rough according to English notions, and so as to leave his own individual mark in many places. The Native Marriages Act of 1872 was the result of deep consideration on both Maine's and Stephen's part. The Contract Act had been framed in England by a learned commission (apparently not having much special Indian information, or not much regarding that which it had), and the draft was materially altered in Stephen's hands

before, also in 1872, it became law. The Evidence Act of the same year was entirely Stephen's own. It not only consolidated the rules of judicial proof, but endeavoured to connect them by legislative authority with a logical theory of probability set forth in the Act itself. This part of the Act has been criticized both as to the principle (which, indeed, seems open to much doubt) and as to the success of the draftsman in applying it. At any rate it is characteristic of Stephen's anxiety never to shirk a difficulty. To some extent the Contract Act may be charged with similar over-ambition; but its more practical defects are evidently due to the acceptance by the original framers of unsatisfactory statements which, coming to India with a show of authority, naturally escaped minute criticism amid the varied business of the Legislative Department. If the success of the later Anglo-Indian Codes has not been quite so complete as that of the Penal Code, they have on the whole done excellent service, and they are at least as good as any European codification prior to the very recent achievements of scientific lawyers in Italy and Germany. Besides the special work of legislation, Stephen had to attend to the current administrative business of his department, often heavy enough to occupy the whole of an ordinary able man's attention, and he took his full share in the general deliberations of the Viceroy's Council. His last official act was the publication of a minute on the administration of justice which pointed the way to reforms not yet fully realized, and is still a most valuable manual of information for every one who wishes to understand the judicial system of British India. When one considers this amount of performance, it seems hardly credible that it was compressed into half of a member of Council's usual term of office. Stephen, mainly for family reasons, came home in the spring of 1872. During the voyage he made a pastime of meditating and writing a series of articles, which took the form of his book entitled *Liberty, Equality, Fraternity* (1873, 1874)—a protest against J. S. Mill's neo-utilitarianism which was really in the nature of an appeal from the new to the old utilitarians, if any such were left, or perhaps rather to Hobbes, but was too individual to be systematic, and made no serious attempt at reconstruction. Soon after his return Stephen became a member of the Athenæum Club under the rule empowering the committee to elect a certain number of distinguished persons without ballot.

Indian experience had supplied Stephen with the motive for his next line of activity, which future historians of the common law may well regard as his most eminent title to remembrance. The Government of India had been driven by the conditions of the Indian judicial system to recast a considerable part of the English law which had been informally imported. Criminal law, procedure, and a good deal of commercial law, had been or were being put in a shape intelligible to civilian magistrates, and fairly within the comprehension of any intelligent man who would give a moderate amount of pains to mastering the text of the new codes. The rational substance of the law had been preserved, while the disorder and the excessive technicalities were removed. Why should not the same procedure be as practicable and profitable in England? It was Bentham's ideal of codification, to be put in practice with the knowledge of actual business and legal habits, the lack of which had made Bentham's plans unworkable. For the next half-dozen years Fitzjames Stephen was an ardent missionary in this cause. The mission failed for the time, as to the specific undertakings in which Stephen made his experiments, but it had a large indirect success which has not yet been adequately recognized. Stephen published, by way of private exposition, digests in code form of the law of evidence and the criminal law. There were transient hopes of an Evidence Act being brought before Parliament, and in 1878 the digest of criminal law became a ministerial Bill. This was referred to a very strong judicial commission, with the addition of Stephen himself: the revised Bill was introduced in 1879 and 1880. It dealt with procedure as well as substantive law, and provided for a court of criminal appeal (after several years of judicial experience, Stephen changed his mind as to the wisdom of this). However, no substantial progress was made. In 1883 the part relating to procedure was brought in separately, and went to the Grand Committee on Law, who found that there was not time to deal with it satisfactorily in the course of the session. Nothing has been done with either part of the draft code since. The historical materials which Stephen had long been collecting took permanent shape the same year (1883) in the *History of the Criminal Law of England*, which, though not free from inequalities and traces of haste, must long remain the standard work on the subject. A projected digest of the law of contract (which would have been much fuller than the Indian Code) fell through for want of time. Thus, none of Stephen's own plans of English codification took effect. Nevertheless they bore fruit indirectly. Younger men dealt with other chapters of the law in the systematic form of the Anglo-Indian Codes; a digest of the law of partnership by the present writer, and one of the law of negotiable instruments by Mr Chalmers, who some time afterwards filled the post of Legal Member of Council in India, became the foundation of the Bills of Exchange Act of 1882 and the Partnership Act of 1890. Lord Herschell passed a Sale of Goods Act on similar lines, also drafted by Mr Chalmers, in 1893; and it is understood that the law of insurance has been codified in the Parliamentary counsel's office, and only awaits the time when the legislature can pay attention to it. A Marine Insurance Bill was in fact prepared by Mr Chalmers, under Lord Herschell's directions, in 1894, and has several times been brought into the House of Lords. Nothing really stands in the way of a practically complete code of maritime and commercial law for the United Kingdom but the difficulty of finding time in the House of Commons for non-contentious legislation which, however useful to the commonwealth, is devoid of partisan interest; and whenever this is achieved, the result will in substance be largely due to Sir James Stephen's efforts. Meanwhile, in addition to his other occupations, Stephen was an active member of the Metaphysical Society (see KNOWLES), and he carried on an intimate correspondence with Lord Lytton, then Viceroy of India, during the critical period of the second Afghan war. In connexion with the Metaphysical Society and otherwise, Fitzjames Stephen took an active interest in many topics of current controversy. This led him to produce a great number of occasional articles, of which a list may be found at the end of Sir Leslie Stephen's *Life*. The matters dealt with covered a wide field, from modern history and politics, with a predilection for India, to philosophy, but the prevailing mood, if one name must be assigned to it, was theologico-political. All these writings were forcible expositions of serious and thoroughly definite views, and therefore effective at the time and valuable even to those who least agreed with them. As to the philosophical part of them, the grounds of discussion were shifting then, and have continued to shift rapidly. Much of Stephen's vigorous polemic has already incurred the natural fate of becoming as obsolete as the arguments against which it was directed. Pure metaphysical speculation, as an intellectual exercise, had little attraction for him; and, though he

was fully capable of impartial historical criticism, he seldom applied it outside the history of law.

In 1877 Stephen was made a Knight Commander of the Star of India, and in 1878 he received the honorary degree of D.C.L. at Oxford. Early in 1879 he was appointed a judge of the Queen's Bench Division. He held that office a little more than eleven years. The combination of mature intellectual patience and critical subtlety which marked the great masters of the common law was not his, and it cannot be said that he made any considerable addition to the substance of legal ideas. His mind was framed for legislation rather than for systematic interpretation and development. Therefore he can hardly be called a great judge, but he was a thoroughly just and efficient one; and if none of his judgments became landmarks of the law, very few of them were wrong. Especially in criminal jurisdiction, he was invariably anxious that moral as well as legal justice should be done. He found time, in 1885, to produce a book on the trial of Nuncomar, for the purpose of rehabilitating Sir Elijah Impey's memory against the attack made on him in Macaulay's essay on Warren Hastings, which for most English readers is the first and last source of information on the whole matter. Mr G. W. Forrest's later research in the archives of the Government of India has tended to confirm the judicial protest, at any rate as regards Macaulay's grosser charges.

The one thing of which Stephen was least capable—among things possible to a good man and a good citizen—was sparing himself. He had one or two warnings which a less energetic man would have taken more seriously. In the spring of 1891 his health broke down, the chief symptom being sudden lapses of memory of which he was himself quite unconscious. In obedience to medical advice, which he took as soon as his attention was called to the matter, he resigned his judgeship in April, and was created a baronet. He lived in retirement till his death on 11th March 1894, having filled a not very long life with a surprising amount of work, of which a large proportion was of permanent value. Perhaps the most individual part of Stephen's character was his absolute sincerity. He would not allow himself even innocent dissimulation; and this gave to those who knew him but slightly an impression of hardness, which was entirely contrary to his real nature. Sir James Stephen married Mary Richenda Cunningham in 1855. On his death his eldest son, Herbert, succeeded to the baronetcy. A second son of brilliant literary promise, James Kenneth Stephen (1859–1892), died in his father's lifetime: his principal literary achievements consisted of two small volumes of verse—*Lapsus Calami* and *Quo Musa Tendis*, the former of which went through five editions in a very short time. The third son, Mr H. L. Stephen, was appointed in 1901 judge of the High Court at Calcutta.

See LESLIE STEPHEN. *Life of Sir James Fitzjames Stephen* (London, 1895), with bibliographical appendix, a model biography; same author's article in the *Dict. Nat. Biog.*. See also Sir C. P. ILBERT, "Sir James Stephen as a Legislator," *Law Quart. Rev.*, x. 222.

(F. PO.)

Stephen, Sir Leslie (1832– ——), English biographer and literary critic, grandson of James Stephen (1758–1832), Master in Chancery, a friend of Wilberforce, and author of a book called *Slavery Delineated*, and son of Sir James Stephen (1789–1859), Colonial Under-Secretary for many years, and author of *Essays on Ecclesiastical Biography*, was born at Kensington Gore on 28th November 1832. At his father's house he saw a good deal of the Abolitionists and other members of the Clapham Sect, and the Macaulays, James Spedding, Sir Henry Taylor, and Nassau Senior were intimate friends of his family. After education at Eton, King's College, London, and Trinity Hall, Cambridge, where he graduated B.A. 1854, M.A. 1857, Mr Stephen remained for several years a fellow and tutor of his college. He has recounted the experiences of a resident fellow at that period in a delightful chapter in his *Life of Fawcett* as well as in some less formal *Sketches from Cambridge: By a Don* (1865). These sketches were reprinted from the *Pall Mall Gazette*, to the proprietor of which, George Smith, he had been introduced by his brother, (Sir) James Fitzjames Stephen. It was at Smith's house at Hampstead that Stephen met his first wife, Harriet Marion (died 1875), daughter of W. M. Thackeray. While still a fellow he had taken holy orders, which he relinquished immediately upon the passing of the Clerical Disabilities Act in February 1870. In the meantime he settled in London, and wrote largely, not only for the *Pall Mall Gazette*, but also for *Fraser*, *Macmillan*, the *Fortnightly*, and other periodicals. He was already known as an ardent mountaineer, as a contributor to *Peaks, Passes, and Glaciers* (1862), and as one of the earliest presidents of the Alpine Club, when in 1871, as a vindication in some sort of the mountaineering mania, and as a commemoration of his own first ascents of the Schreckhorn and Rothhorn, he published his fascinating *Playground of Europe* (republished with additions 1894). In the same year he was appointed editor of the *Cornhill Magazine*, the reputation of which he maintained by enlisting such men as R. L. Stevenson, Thomas Hardy, W. E. Norris, Henry James, and James Payn among his contributors. During the eleven years of his editorship, in addition to three delightful volumes of critical studies, reprinted mainly from the *Cornhill* under the title of *Hours in a Library* (1874, 1876, and 1879), and some *Essays on Freethinking and Plain Speaking*, which include the very striking "A Bad Five Minutes in the Alps" (reprinted from *Fraser* and the *Fortnightly* in 1873), he made two valuable contributions to philosophical history and theory, *The History of English Thought in the Eighteenth Century* (1876 and 1881) and *The Science of Ethics* (1882); the second of these was extensively adopted as a text-book on the subject. The first was generally recognized as an important addition to philosophical literature, and led immediately to Mr Stephen's election at the Athenæum Club in 1877. In the autumn of 1882 he abandoned the direction of the *Cornhill* to James Payn, having accepted the more responsible duty of editor of the *Dictionary of National Biography*, for the first planning and conception of which he was largely responsible. The first volume of the *Dictionary* was published in January 1885, and twenty quarterly volumes followed under Mr Stephen's sole editorship. Five volumes were then published under the joint-editorship of Mr Stephen and of Mr Sidney Lee, whom he had appointed as his assistant in March 1883. Early in 1891, after eight and a half years' service, Mr Stephen, whose health had been somewhat impaired by the labour inseparable from the direction of such an undertaking, resigned the responsibility to his coadjutor. Fortunately for the success of the work, re-established health enabled him to remain a contributor to the *Dictionary*. Among his lives are those of Addison, Bolingbroke, Burns, Charlotte Brontë, Byron, Carlyle, Marlborough, Coleridge, Defoe, Dickens, Dryden, Fielding, George Eliot, Gibbon, Goldsmith, Hobbes, Hume, Johnson, Landor, Locke, Macaulay, the two Mills, Milton, Pope, Scott, Swift, Adam Smith, Thackeray, Warburton, Wordsworth, and Young. Most of these are characterized by felicitous phrases, by frequent flashes of insight (especially of the sardonic order), and by the good fortune which attends a consummate artist in

his special craft. His particular style of treatment is more appropriate, perhaps, to the self-complacent worthies of the 18th century than to quietists such as Law and Wordsworth; but where space demands that a character should be inscribed upon a cherry-stone, Stephen seldom if ever failed to rise to the occasion. For the "English Men of Letters" series he wrote lives of Swift, Pope, and Johnson—the last well described as "the peerless model of short biographies"—and subsequently of George Eliot. During his tenure of the editorship of the *Dictionary* he was appointed first Clark Lecturer at Cambridge (1883), and lectured upon his favourite period—Berkeley, Mandeville, Warburton, and Hume; a few years later, upon one of several visits to his intimate friends and old correspondents, C. E. Norton and J. Russell Lowell, he was granted a Doctor's degree by Harvard University. After Lowell's death in 1891 Mr Stephen was mainly instrumental in having a memorial window placed in Westminster Abbey. In 1885 he brought out his standard *Life of Fawcett*, in 1893 his *Agnostic's Apology and other Essays*, and in 1895 the *Life* of his brother, Sir James Fitzjames Stephen, which, less essayistic in manner than the *Life of Fawcett*, contains his most finished biographical work. In the same year, in succession to Lord Tennyson, Mr Stephen was elected president of the London Library, and was shortly afterwards appointed a trustee of the National Portrait Gallery. Some of his experiences as an editor were embodied in *Studies of a Biographer*, issued in 1898, while in 1900 appeared an important work which he had long had in preparation in continuation of his *English Thought in the Eighteenth Century*, entitled *The English Utilitarians*, being full-length studies of Bentham and the two Mills. As a thinker Leslie Stephen showed himself consistently a follower of Hume, Bentham, the Mills, and G. H. Lewes, but he accepted the older utilitarianism only as modified by the application of Darwinian principles, upon lines to some extent indicated by Mr Herbert Spencer (see ETHICS). The negative character of his teaching, his anti-sacerdotal bias, his continual attitude of irony, and even the very subtlety of his thought, have co-operated to retard the recognition of his value as in many respects the first of living English critics. For blowing the froth off the flagon of extravagant or inflated eulogy he certainly met no equal in his generation. Voluminous as his work is, it is never dull. While making self-deprecation a fine art, and perpetually laughing in his sleeve at the literary bias and the literary foible, he fulfilled with exceptional conscience the literary duty of never writing below his best. Besides being a member of the Metaphysical Society, he was for some years president of the Ethical Society (many of his addresses to which were published as *Social Rights and Duties* in 1896). In addition to his separate works, he superintended a large number of editions, among them Clifford's *Essays* (1879), Fielding (1882), Richardson (1883), Payn's *Backwater of Life* (1899), and J. R. Green's *Letters* (1901). In 1896 he wrote a memoir of his friend James Dykes Campbell for the second edition of Campbell's *Coleridge*, and in 1897 he contributed a preface to the English translation of *The Early Life of Wordsworth*, by M. Legouis. His name was included in the Coronation honours list of June 1902, when he was made K.C.B.

Stepniak, Sergius (1852–1895), whose real name was SERGIUS MICHAELOVITCH KRAVCHINSKI, was one of the most widely known among the Russian exiles who aroused the sympathy of England for the advocates of Russian freedom. He was born in South Russia, of parents who belonged to a noble family. He received a liberal education, and, when he left school, became an officer in the artillery; but his sympathy with the peasants, among whom he had lived during his boyhood in the country, developed in him at first democratic and, later, revolutionary opinions. Together with a few other men of birth and education, he began secretly to sow the sentiments of democracy among the peasants. His teaching did not long remain a secret, and in 1874 he was arrested. He succeeded in making his escape—possibly he was permitted to escape on account of his youth—and immediately began a more vigorous campaign against autocracy. It was not only on logical grounds that he strove to bring about reform. His sympathetic nature was even more influenced by indignation against the brutal methods adopted towards prisoners, especially political prisoners, and by the stern measures which the Government of the Tsar felt compelled to adopt in order to repress the revolutionary movement. His indignation, in fact, carried him into accord for a time with those who advocated what was called the Terrorist policy. This, of course, was the policy which aimed at attaining by violence and assassination ends for which it seemed hopeless to work upon peaceful lines. In consequence he exposed himself to danger by remaining in Russia, and in 1880 he was obliged to leave the country. He settled for a short time in Switzerland, then a favourite resort of revolutionary leaders, and after a few years came to London. He was already known in England by his book, *Underground Russia*, which had been published in London in 1882. It gave a vivid and striking picture of the agitation which was going on under the surface of Russian life, and it had a great success. He followed it up with a number of other works on the condition of the Russian peasantry, on Nihilism, and on the conditions of life in his country which he was so anxious to see altered. His mind gradually turned from belief in the efficacy of violent measures to the acceptance of constitutional methods; and in his last book, *King Stork and King Log*, he spoke with approval of the efforts of politicians on the Liberal side to effect, by argument and peaceful agitation, a change in the attitude of the Russian Government towards various reforms. Stepniak constantly wrote and lectured, both in Great Britain and the United States, in support of his views, and his energy, added to the interest of his personality, won him many friends. He was chiefly identified with the Socialists in England and the Social Democratic parties on the Continent; but he was regarded by men of all opinions as an agitator whose motives had always been pure and disinterested. Stepniak was killed by a railway engine at a level crossing at Bedford Park, Chiswick, where he resided, on 23rd December 1895. Before his cremation at Woking on 28th December, funeral speeches were made at Waterloo Station by well-known men of different nationalities who were in sympathy with his aims, including Mr William Morris, Prince Kropotkin, and Mr John Burns. (H. H. F.)

Steppes, GENERAL-GOVERNORSHIP OF, a portion of Russian Central Asia which includes both what was formerly known as the Kirghiz Steppe and the region around Omsk which was formerly part of Western Siberia. It consists of four provinces—Akmolinsk, Semipalatinsk, Turgai, and Uralsk—and is bounded by the provinces of Samara and Astrakhan and the Caspian Sea on the W.; the Transcaspian territory, Lake Aral, and Syr-dariinsk (Russian Turkestan) on the S.; Semiryechensk, Lake Balkhash, the Chinese province of Chuguchak, and Tomsk on the SE. and E.; and Tobolsk and Ufa on the N. The Tarbagatai mountains rise along the Chinese frontier, and send their spurs into Russian

territory; the parallel chains of the southern Urals cover portions of the province of Uralsk; and the Mugojar Hills separate the Steppe rivers from the tributaries of the Caspian Sea. The remainder of the territory consists of plains rising nowhere more than a few hundred feet above sea-level, and sinking below it as they approach the Caspian. The territory is watered by the Emba and the upper courses of the Ural, the Ishim, the Tobol, and the Irtysh, also by a number of Steppe rivers—Irghiz, Turgai, Sary-su, Nura, &c., which are lost in the Steppes or in lakes which frequently dry up. The soil is very fertile in the north, in the Ob-Irtysh basin, but becomes less and less so towards the south, where sandy deserts make their appearance. The climate is very hot in summer and cold in winter, and extremely dry, the average temperature at Omsk for the year being 32·5° Fahr., for January −2°, for July 67°; at Semipalatinsk (altitude 228 feet) the averages are: for the year 37°, for January 0°, for July 72°; at Uralsk (altitude 367 feet) for the year 39°, for January 8°, for July 67°. Yearly rainfall 10·6 inches. Farther east the yearly rainfall is even still smaller, being only 8·8 inches at Akmolinsk and 6·9 inches at Irghiz. The following table shows the area and population of the several provinces:—

Provinces.	Area, Square Miles.	Population, 1897.	Density.
Akmolinsk	229,609	678,957	3
Semipalatinsk	184,631	685,197	4
Turgai	176,219	453,123	3
Uralsk	139,168	644,001	4
Lake Aral	26,166	...	...
General-Governorship of the Steppes	755,793	2,461,278	3

The capital of the territory is at Omsk (37,470 inhabitants). The other towns are Uralsk (36,597 inhabitants), Akmolinsk (9557), Semipalatinsk (26,353), and Irghiz (1536). For further particulars see under the separate provinces. (P. A. K.)

Sterling, a city of Whiteside county, Illinois, U.S.A. It is on the river Rock, at the intersection of branches of the Chicago and North-Western and the Chicago, Burlington, and Quincy railways, in the north-western part of the state, at an altitude of 648 feet. It has varied manufactures, among which perhaps agricultural implements are the most important. Population (1890), 5824; (1900), 6309, of whom 815 were foreign-born.

Sterlitamak, a district town of Russia, in the government and 82 miles south of the town of Ufa, on the left bank of the river Byelaya, and on the highway to Orenburg. It dates only from 1766, but in 1897 its population was 15,538 (partly Tatars), and it is rapidly growing. The surrounding country is very fertile, and it is a centre for trade in cattle, horses, hides, and furs imported from the Kirghiz Steppes. It is also an entrepôt for salt raised at Iletsk.

Sternberg, a manufacturing town in the north of Moravia, Austria, 48 miles north-east of Brünn, one of the principal centres of the Moravian textile industry. Population (1890), 15,395; (1900), 15,195, almost exclusively German and Catholic. In addition to the staple textile industry, there is now a tobacco and a tile factory.

Stettin, a seaport town of Prussia, capital of the province of Pomerania, on the left bank of the Oder, a few miles above its entrance into the Stettiner Haff. It is the chief port of Prussia, one of the principal shipbuilding centres in Germany, and a place of very considerable industry. It is, further, the headquarters of the 2nd German Army Corps, but no longer a fortress, the fortifications having been demolished in 1873. The foremost place in its chief industry, shipbuilding, is taken by the Vulcan yard, which makes warships for the German and other navies; also locomotives, stationary engines, and boilers. The business was started in 1851, and now employs nearly 6500 men, the works extending over 68 acres and the covered workshops over 646,000 square feet. In 1897 a floating dock was fitted up capable of holding vessels of 12,000 tons. Next in importance to shipbuilding comes the making of ready-made clothing, giving employment to about 6500 men and the same number of women and girls. Then follow the manufacture of cement, sewing-machines and cycles, sugar, fireproof bricks, flour, chemicals, candles and soap, spirits and beer, and oil-cake —all on a large scale; and to these have been added iron-smelting works. Most of these mills and factories are situated in the suburbs—Grabow, Bredow, Pomerensdorf, &c. The sea-borne commerce of Stettin is scarcely of less importance than her industry. On an average the port is cleared by some 4500 vessels of 1,400,000 tons annually (4530 vessels of 1,465,116 tons in 1900). A further impulse to the trade was given by the opening in 1898 of a free harbour to the east of the Lastadie suburb on the east bank of the Oder, which embraces a total area of 150 acres and a quayage length of 14,270 feet. The construction of this new harbour, of which only one basin (37½ acres) was finished in 1900, with the necessary accompaniment of cranes, dock sheds, storehouses, &c., and the deepening of the river Oder from Stettin to the Haff to 24 feet (see further under SWINEMÜNDE), had up to 1899 cost £1,530,000. With the view of still further increasing the commercial importance of Stettin, it is proposed to construct a ship canal giving the town direct communication with Berlin. The mercantile fleet of this port numbered 128 vessels of 58,275 tons in 1900. Modern public buildings include the Roman Catholic church (1890), the Luther church (1893), and the St Gertrude church (1896); also a fine monumental fountain (1898) in front of the town hall. The church of St James's was restored in 1897. The town also possesses a technical school (1898) for architects and builders, and an equestrian statue of the Emperor William I. Population (1890), 116,228; (1895), 140,724; (1900), 210,680.

Steubenville, a city of Ohio, U.S.A., capital of Jefferson county. It is situated in 40° 25′ N., and 88° 41′ W., on the river Ohio, in the eastern part of the state, at an altitude of 662 feet. It is regularly laid out on a bench in the bottom lands of the river, above the reach of floods. It has a water-supply pumped from the river, is well sewered, and is paved with brick. It has three railways—the Pennsylvania; the Pittsburg, Cincinnati, Chicago, and St Louis; and the Wheeling and Lake Erie. Steubenville is in a region of coal and natural gas, and has extensive manufactures of iron and glass. It contains furnaces, rolling-mills, nail factories, foundries, &c. Population (1890), 13,394; (1900), 14,349, of whom 1815 were foreign-born and 736 negroes.

Stevens, Alfred (1828– ——), Belgian painter, was born in Brussels, 11th May 1828. His father, an old officer in the service of William I., king of the Netherlands, was passionately fond of pictures, and readily allowed his son to draw in the studio of François Navez, director of the Brussels Academy. In 1844 Stevens went to Paris and worked under the instruction of Camille Roqueplan, a friend of his father's; he also attended the classes at the École

"LA BÊTE À BON-DIEU." BY A. STEVENS.

Musée de Bruxelles. (From a Photograph by Ghilain-Atteuille, Brussels.)

des Beaux Arts, where Ingres was then professor. In 1849 he painted at Brussels his first picture, "A Soldier in Trouble," and in the same year went back to Paris, where he definitely settled, and exhibited in the Salons. He then painted "Ash-Wednesday Morning," "Burghers and Country People finding at Daybreak the Body of a Murdered Gentleman," "An Artist in Despair," and "The Love of Gold." In 1855 he exhibited at the Antwerp Salon a little picture called "At Home," which showed the painter's bent towards depicting ladies of fashion. At the Great Exhibition in Paris, 1855, his contributions were remarkable, but in 1857 he returned to graceful female subjects, and his path thenceforth was clear before him. At the Great Exhibition of 1867 he was seen in a brilliant variety of works in the manner he had made his own, sending eighteen exquisite paintings; among them were the "Lady in Pink" (in the Brussels Gallery), "Consolation," "Every Good Fortune," "Miss Fauvette," "Ophelia," and "India in Paris." At the Paris International Exhibitions of 1878 and 1889, and at the Historical Exhibition of Belgian Art, Brussels, 1880, he exhibited "The Four Seasons" (in the Palace at Brussels), "The Parisian Sphinx," "The Japanese Mask," "The Japanese Robe," and "The Lady Bird" (Brussels Gallery, see Plate). "Alfred Stevens is one of the race of great painters," wrote Camille Lemonnier, "and like them he takes immense pains with the execution of his work." The example of his finished technique was salutary, not merely to his brethren in Belgium, but to many foreign painters who received encouragement from the study of his method. . The brother of Alfred Stevens, Joseph Stevens, was a great painter of dogs and dog life.

See J. DU JARDIN. *L'Art Flamand.*—CAMILLE LEMONNIER. *Histoire des Beaux Arts en Belgique*

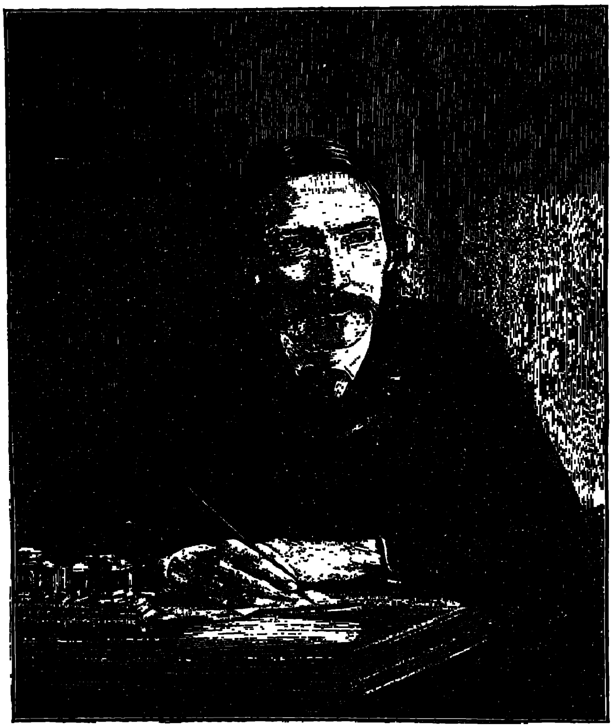
Stevenson, Adlai Ewing (1835- ——), Vice-President of the United States, 1893–97, was born in Kentucky in 1835. At the age of seventeen he removed to Bloomington, Ill. After a college education he was admitted to the bar in 1857. A Democrat in politics, he was elected to Congress in 1875, and again in 1879. In President Cleveland's first administration he was first assistant postmaster-general, and he removed so many postmasters for party reasons that "Adlai's Axe" became a subject of journalistic jest. He led the Illinois delegation in the Democratic Convention of 1892, and after the nomination of Cleveland for the Presidency, Mr Stevenson, as representative of the Western and bimetallist wing of the party, was named for the second place. After serving his term as Vice-President, President McKinley appointed him a member of the commission to promote the cause of international bimetallism. In 1900 the Democratic National Convention nominated him for Vice-President with Mr Bryan, but the ticket met with an overwhelming defeat.

Stevenson, Robert Lewis Balfour (1850–1894), British poet, essayist, and novelist, was the only child of Thomas Stevenson, civil engineer, and his wife, Margaret Isabella Balfour. He was born at 8 Howard Place, Edinburgh, on the 13th of November 1850. He suffered from infancy from great fragility of health, and nearly died in 1858 of gastric fever, which left much constitutional weakness behind it. From the age of six he showed a disposition to write. He went to school, mainly in Edinburgh, from 1858 to 1867, but his ill-health prevented his learning much, and his teachers, as his mother afterwards said, "liked talking to him better than teaching him." He often accompanied his father on his official visits to the lighthouses of the Scottish coast, and on longer journeys, thus early accustoming himself to travel. As his health improved, it was hoped that he would be able to adopt the family profession of civil engineering, and in 1868 he went to Anstruther and then to Wick as a pupil engineer. In 1871 he had so far advanced as to receive the silver medal of the Edinburgh Society of Arts for a paper suggesting improvements in lighthouse apparatus. But long before this he had started as an author. His earliest publication, the anonymous pamphlet of *The Pentland Rising*, had appeared in 1866, and *The Charity Bazaar*, a trifle in which his future manner is happily displayed, in 1868. From about the age of eighteen he dropped his baptismal names of Lewis Balfour and called himself Robert Louis, but was mostly known to his relatives and intimate friends as "Louis." Although he greatly enjoyed the outdoor business of the engineer's life, it strained his physical endurance too much, and in 1871 was reluctantly exchanged for study at the Edinburgh bar, to which he was called in 1875. In 1873 he first met Mr Sidney Colvin, who was to prove the closest of his friends, and at last the loyal and admirable editor of his works and his correspondence; and to this time are attributed several of the most valuable friendships of Stevenson's life.

He was now labouring, with extreme assiduity, to ground himself in the forms and habits of literary style. In 1875 appeared, anonymously, his *Appeal to the Clergy of the Church of Scotland*, and in that year he made the first of many visits to the forest of Fontainebleau. Meanwhile at Mentone in the winter of 1873–74 he had grown in mind under the shadow of extreme physical weakness, and in the following spring began to contribute essays of high originality to one or two periodicals, of which the *Cornhill*, then edited by Sir Leslie Stephen, was at first the most important. In 1875 Stevenson passed for the bar, as has been said; but he made no attempt to practise, and the next years were spent in wanderings in France, Germany, and Scotland. Records of these journeys, and of the innocent adventures which they encouraged, were given to the world as *An Inland Voyage* in 1878, and as *Travels with a Donkey* in 1879. During these four years Stevenson's health, which was always bettered by life out of doors, gave him little trouble. It was now recognized that he was to be an author, and he contributed many essays, tales, and fantasies to various journals and magazines. At Fontainebleau in 1876 Stevenson had met Mrs Osbourne, the lady who afterwards became his wife; she returned to her home in California in 1878, and in August of the following year, alarmed at news of her health, Stevenson hurriedly crossed the Atlantic. He travelled, from lack of means, as a steerage passenger and then as an emigrant, and in December, after hardships which seriously affected his health, he arrived in San Francisco. In May 1880 he married, and moved to the desolate mining-camp which he has described in *The Silverado Squatters*. As Mr Colvin has well said, these months in the west of America were spent "under a heavy combined strain of personal anxiety and literary effort." Some of his most poignant and most enchanting letters were written during this romantic period of his life. In the autumn of 1880 he returned to Scotland, with his wife and stepson, who were received at once into the Edinburgh household of his parents. But the condition of his health continued to be very alarming, and they went almost immediately to Davos, where he remained until the spring of 1881. In this year was published *Virginibus Puerisque*, the earliest collection of Stevenson's essays. He spent the summer months in Scotland, writing articles, poems, and above all his first romance, *The Sea-Cook*, afterwards known as *Treasure Island*; but he was driven back to Davos in October. In 1882 appeared *Familiar Studies of Men and Books* and *New Arabian Nights*. His two winters at Davos had

done him some good, but his summers in Scotland invariably undid the benefit. He therefore determined to reside wholly in the south of Europe, and in the autumn of 1882 he settled near Marseilles. This did not suit him, but from March 1883 to July 1884 he was at home at a charming house called La Solitude, above Hyères; this was in many ways to be the happiest station in the painful and hurrying pilgrimage of Stevenson's life. *The Silverado Squatters* was published in 1883, and also the more important *Treasure Island*, which made Stevenson for the first time a popular writer. He planned a vast amount of work, but his schemes were all frustrated in January 1884 by the most serious illness from which he had yet suffered. He was just pulled through, but the attack was followed by long prostration and incapacity for work, and by continued relapses. In July he was brought back to England, and from this time until August 1887 Stevenson's home was at Bournemouth. In 1885 he published, after long indecision, his volume of poems, *A Child's Garden*, an inferior story, *The Body Snatcher*, and that admirable romance, *Prince Otto*, in which the peculiar quality of Stevenson's style was displayed at its highest. Early in 1886 he struck the public taste with precision in his wild symbolic tale of *The Strange Case of Dr Jekyll and Mr Hyde*. In the summer of the same year he published *Kidnapped*, which had been written at Bournemouth.

This, however, was a period of great physical prostration, so that 1886 and 1887 were, perforce, among the least productive years of Stevenson's life. In the early months of 1887 Stevenson was particularly ill, and he was further prostrated by being summoned in May to the deathbed of his father, who had just returned to Edinburgh from the south. He printed privately as a pamphlet, in June 1887, a brief and touching sketch of his father. In July he published his volume of lyrical poems called *Underwoods*. The ties which bound him to England were now severed, and his health was broken to such a discouraging degree that he determined to remove to another hemisphere. Accordingly, having disposed of Skerryvore, his house at Bournemouth, he sailed from London, with his wife, mother, and stepson, for New York on the 21st of August 1887. He never set foot in Europe again. His memoir of his friend Professor Fleeming Jenkin was published soon after his departure. After resting at Newport, he went for the winter to be under the care of a physician at Saranac Lake in the Adirondacks for the winter. Here he was very quiet, and steadily active with his pen, writing both the greater part of *The Master of Ballantrae* and many of his finest later essays. He had undertaken, for a regular payment greatly in excess of anything which he had hitherto received, to contribute a monthly essay to *Scribner's Magazine*, and these essays, twelve in number, were published continuously throughout the year 1888. Early in that year was begun *The Wrong Box*, a farcical romance in which Mr Lloyd Osbourne participated; Stevenson also began a romance about the Indian Mutiny, which he abandoned. His attitude about this time to life and experience is reflected in *Pulvis et Umbra*, one of the noblest of all his essays. In April 1888 he was at the coast of New Jersey for some weeks, and in June started for San Francisco, where he had ordered a schooner, the *Casco*, to be ready to receive him. On the 28th of the month he started, as Mr Colvin has said, "on what was only intended to be a pleasure excursion . . . but turned into a voluntary exile prolonged until the hour of his death": he never again left the waters of the Pacific. The *Casco* proceeded first to the Marquesas, and south and east to Tahiti, passing before Christmas northwards to Honolulu, where Stevenson spent six months, and finished *The Master of Ballantrae* and *The Wrong Box*. It was during this time that he paid his famous visit to the leper settlement at Molokai. In 1889, "on a certain bright June day," the Stevensons sailed for the Gilbert Islands, and after six months' cruising found themselves at Samoa, where he landed for the first time about Christmas Day 1889. On this occasion, however, though strongly drawn to the beautiful island, he stayed not longer than six weeks, and proceeded to Sydney, where, early in 1890, he published, in a blaze of righteous anger, his *Letter to Dr Hyde* in vindication of the memory of Father Damien and his work among the lepers of the Pacific. At Sydney he was very ill again: it was now obvious that his only chance of health lay within the tropics. For nearly the whole of the year 1890 the Stevensons were cruising through unfamiliar archipelagos on board a little trading steamer, the *Janet Nicoll*. Meanwhile his volume of *Ballads* was published in London.



ROBERT LOUIS STEVENSON.
(From a photograph by Bartlett F. Kenney, Boston, Mass.)

The last four years of his unquiet life were spent at Samoa, in circumstances of such health and vigour as he had never previously enjoyed, and in surroundings singularly picturesque. It was in November 1890 that he made his abode at Vailima, where he took a small barrack of a wooden box 600 feet above the sea, and began to build himself a large house close by. His character developed unanticipated strength on the practical side; he became a vigorous employer of labour, an active planter, above all a powerful and benignant island chieftain. He gathered by degrees around him "a kind of feudal clan of servants and retainers," and he plunged, with more generous ardour than coolness of judgment, into the troubled politics of the country. He took up the cause of the deposed king Mataafa with extreme ardour, and he wrote a book, *A Footnote to History* (1892), in the endeavour to win over British sympathy to his native friends. In the autumn of this year he received a visit at Vailima from the Countess of Jersey, in company with whom, and some others, he wrote the burlesque extravagance

in prose and verse, called *An Object of Pity*, privately printed in 1893 at Sydney. Whenever the cultivation of his estate and the vigorous championship of his Samoan retainers gave him the leisure, Stevenson was during these years almost wholly occupied in writing romances of Scottish life. *The Wrecker*, an adventurous tale of American life, which mainly belonged to an earlier time, was finally published in 1892; and towards the close of that very eventful and busy year he began *The Justice Clerk*, afterwards *Weir of Hermiston*. A portion of the old record of emigrant experiences in 1879, long suppressed for private reasons, also appeared in book form in 1892. In 1893 Stevenson published the important Scottish romance of *Catriona* and the four tales illustrative of Pacific Ocean character, *Island Nights' Entertainments*. But in 1893 the uniform good fortune which had attended the Stevensons since their settlement in Samoa began to be disturbed. The whole family at Vailima became ill, and the final subjugation of his *protégé* Mataafa, and the destruction of his party in Samoan politics, deeply distressed and discouraged Stevenson. In the autumn of that year he went for a change of scene to the Sandwich Islands, but was taken ill there, and was only too glad to return to Samoa. In 1894 he was greatly cheered by the plan, suggested by friends in England and carried out by them with the greatest energy, of the noble collection of his works in twenty-eight volumes, since known as the Edinburgh edition. In September 1894 was published *The Ebb Tide*, the latest of his books which he saw through the press. Of Stevenson's daily avocations, and of the temper of his mind through these years of romantic exile, a clear idea may be obtained by the posthumous *Vailima Letters*, edited by Mr Colvin in 1895. Through 1894 he was engaged in composing two romances, neither of which he lived to complete. He was dictating *Weir of Hermiston*, apparently in his usual health, on the day he died. This was the 3rd of December 1894; he was gaily talking on the verandah of his house at Vailima, when he had a stroke of apoplexy, from which he never recovered consciousness, and passed away painlessly in the course of the evening. His body was carried next day by sixty sturdy Samoans, who acknowledged Stevenson as their chief, to the summit of the precipitous peak of Vaea, where he had wished to be buried, and where they left him to rest for ever with the Pacific Ocean at his feet.

The charm of the personal character of Stevenson and the romantic vicissitudes of his life are so predominant in the minds of all who knew him, or lived within earshot of his legend, that they make the ultimate position which he will take in the history of English literature somewhat difficult to decide. That he was the most attractive figure of a man of letters in his generation is admitted; and the acknowledged fascination of his character was deepened, and was extended over an extremely wide circle of readers, by the publication in 1899 of his *Letters*, which have subdued even those who were rebellious to the entertainment of his books. It is therefore from the point of view of its "charm" that the genius of Stevenson must be approached, and in this respect there was between himself and his books, his manners and his style, his practice and his theory, a very unusual harmony. Very few authors of so high a class have been so consistent, or have made their conduct so close a reflection of their philosophy. This unity of the man in his work makes it difficult, for one who knew him, to be sure that one rightly gauges the purely literary significance of the latter. There are some living who still hear in every page of Stevenson the voice of the man himself, and see in every turn of his language his flashing smile. So far, however, as it is possible to disengage one's self from this captivation, it may be said that the mingling of distinct and original vision with a singularly conscientious handling of the English language, in the sincere and wholesome self-consciousness of the strenuous artist, seems to be the central feature of Stevenson as a writer by profession. He was always assiduously graceful, always desiring to present his idea, his image, his rhapsody, in as persuasive a light as possible, and, particularly, with as much harmony as possible. He had mastered his manner and, as one may say, learned his trade, in the exercise of criticism and the reflective parts of literature, before he surrendered himself to that powerful creative impulse which had long been tempting him, so that when, in mature life, he essayed the portraiture of invented character, he came to it unhampered by any imperfection of language. This distinguished mastery of style, and love of it for its own sake within the bounds of good sense and literary decorum, gave him a pre-eminence among the story-tellers of his time. No doubt it is still by his romances that Stevenson keeps the wider circle of his readers. But many hold that his letters and essays are finer contributions to pure literature, and that on these exquisite mixtures of wisdom, pathos, melody, and humour his fame is likely to be ultimately based. In verse he had a touch far less sure than in prose. Here we find less evidence of sedulous workmanship, yet not unfrequently a piercing sweetness, a depth of emotion, a sincere and spontaneous loveableness, which are irresistibly touching and inspiring.

The personal appearance of Stevenson has often been described: he was tall, extremely thin, dark-haired, restless, compelling attention with the lustre of his wonderful brown eyes. In the existing portraits of him those who never saw him are apt to discover a strangeness which seems to them sinister or even affected. This is a consequence of the false stability of portraiture, since in life the unceasing movement of light in the eyes, the mobility of the mouth, and the sympathy and sweetness which radiated from all the features, precluded the faintest notion of want of sincerity. Whatever may be the ultimate order of reputation among his various books, or whatever posterity may ultimately see fit to ordain as regards the popularity of any of them, it is difficult to believe that the time will ever come in which Stevenson will not be remembered as the most beloved of the writers of that age which he did so much to cheer and stimulate by his example. (E. G.)

Stevens Point, a city of Wisconsin, U.S.A., capital of Portage county. It is situated in 44° 31′ N., and 89° 33′ W., on the river Wisconsin, and on the Wisconsin Central and the Green Bay and Western railways, in the central part of the state, at an altitude of 1089 feet. Situated on the border of the pine timber region, it has large lumber interests, which are aided by ample water-power in the river. It has many saw and shingle mills, railway repair shops, and flour mills. Population (1880), 4449; (1890), 7896; (1900), 9524, of whom 2205 were foreign-born.

Stevenston, a town of Ayrshire, Scotland, about a mile from the coast, 29 miles south-west of Glasgow by rail. There are coal mines, four iron-works—one is among the largest in Scotland—and in the sandhills along the coast large explosives works. Population (1891), 4263; (1901), 6797.

Stewart, Balfour (1828–1887), Scottish physicist, was born in Edinburgh on the 1st of November 1828, and was educated at the university of that city. The son of a tea merchant, he was intended for a mercantile career, and for some time was actually engaged in business in

Leith and in Australia, but the attractions of physical science ultimately became too strong for him. Returning to his studies at Edinburgh, he became assistant to Forbes in 1856, and his association with that physicist had an important share in determining the course of his scientific life. Forbes was especially interested in questions of heat, meteorology, and terrestrial magnetism, and it was to these that Stewart also mainly devoted himself. Radiant heat first claimed his attention, and by 1858 he completed his first investigations into the subject. These yielded a remarkable extension of Prévost's "Law of Exchanges," and enabled him to establish the fact that radiation is not a surface phenomenon, but takes place throughout the interior of the radiating body, and that the radiative and absorptive powers of a substance must be equal, not only for the radiation as a whole, but also for every constituent of it. In recognition of this work he received in 1868 the Rumford medal of the Royal Society, into which he had been elected six years before. Of other papers in which he dealt with this and kindred branches of physics may be mentioned "Observations with a Rigid Spectroscope," "Heating of a Disc by Rapid Motion in Vacuo," "Thermal Equilibrium in an Enclosure containing Matter in Visible Motion," and "Internal Radiation in Uniaxal Crystals." In 1859 he was appointed director of Kew Observatory, and there naturally became interested in problems of meteorology and terrestrial magnetism. In 1870, the year in which he was very seriously injured in a railway accident, he was elected professor of physics at Owens College, Manchester, and retained that chair until his death, which happened near Drogheda, in Ireland, on the 19th of December 1887. In addition to papers communicated to learned societies, he was the author of several successful text-books of science, and also of the article on "Terrestrial Magnetism" in the ninth edition of this Encyclopædia. In conjunction with Professor Tait he wrote *The Unseen Universe*, at first published anonymously, which was intended to combat the common notion of the incompatibility of science and religion.

Stewart, Sir Donald Martin (1824–1900), British field-marshal, son of Robert Stewart of Forres, Elginshire, was born at Mount Pleasant, near Forres, on the 1st March 1824. Educated at schools at Findhorn, Dufftown, and Elgin, and at Aberdeen University, he entered the Bengal army in 1840, and served in 1854 and 1855 in the frontier expeditions against the Mohmands, and Aka and Bari-Khels (medal and clasp). In the Indian Mutiny in 1857 Stewart, after his famous ride from Agra to Delhi with despatches, served on the staff at the siege and capture of Delhi and of Lucknow, and afterwards through the campaign in Rohilkhand (medal and two clasps, and brevet-major and lieutenant-colonel). For nine years he was assistant and deputy-adjutant-general of the Bengal army, commanded the Bengal brigade in the Abyssinian expedition in 1867 (medal and C.B.), and became a major-general in 1868. He reorganized the penal settlement of the Andaman Islands, where he was commandant when Lord Mayo was assassinated, and, after holding the Lahore command, was promoted lieutenant-general in 1877, and commanded the Kandahar field force in the Afghan war in 1878 (K.C.B. and thanks of Parliament). In 1880 he made his difficult and memorable march from Kandahar to Kabul, fighting the victorious battles of Ahmed Khel and Urzu on the way, and held supreme military and civil command in northern Afghanistan. On hearing of the Maiwand disaster, he despatched Sir Frederick Roberts with a division on his celebrated march from Kabul to Kandahar, and himself led the rest of the army back to India by the Khaibar Pass (medal with clasp, G.C.B., C.I.E., baronetcy, and thanks of Parliament). Promoted general in 1881, he was for five years commander-in-chief in India, and afterwards member of Council of the Secretary of State for India until his death. He was made G.C.S.I. in 1885, promoted to be field-marshal in 1894, and appointed governor of Chelsea Hospital in 1895. He died at Algiers on 26th March 1900. (R. H. V.)

Stewart, Sir Herbert (1843–1885), British soldier, eldest son of the Rev. Edward Stewart, was born 30th June 1843 at Sparsholt, Hampshire. He was educated at Winchester and entered the army in 1863. He went out to India, and was aide-de-camp to Major-General Beatson, commanding the Allahabad division, until November 1870. It was during an outbreak of cholera in the summer of that year that Stewart gained the commendation of Lord Napier, the Commander-in-chief, by his judgment and promptitude, and he was then employed in the quartermaster-general's department, and engaged in explorations on the north-western frontier until 1873, when he returned to England. In 1878 he was sent out to South Africa. From February to May 1880 he was military secretary to Lord Wolseley. As chief staff officer under Colley he was present at Majuba Hill, 27th February 1881, where he was made prisoner by a Boer patrol and detained until the end of March. In August 1882 he was placed in command of a cavalry division in Egypt. After Tel-el-Kebir, 13th September 1882, he headed a brilliant advance upon Cairo, and took possession of the town and citadel. Again, in January 1884 he was sent to Suakin in command of the cavalry under Sir Gerald Graham, and took part as brigadier in the actions from El Teb to the advance on Tamanib. His services were recognized by the honour of K.C.B., and he was assistant adjutant and quartermaster-general in the south-eastern district in England from April to September 1884. He then joined the expedition for the relief of Khartum, and in December, when news from Gordon decided Lord Wolseley to send a column across the desert of Metemmeh, Major-General Stewart was entrusted with the command. He was appointed brigadier on 24th November, and reached Korti on 15th December. A fortnight later he reached Jakdul with the camel corps, and, after some unavoidable delay, set out for Metemmeh on the 14th January 1885. On the 16th he found the enemy in force near the wells of Abu Klea, and brilliantly repulsed their fierce charge on the following morning. Leaving the wounded under guard at Abu Klea, the column again moved forward on the 18th through bushy country towards Metemmeh, 23 miles off. Meanwhile the enemy continued their attacks, and on the morning of the 19th Stewart was wounded and obliged to hand over the command to Sir Charles Wilson. He lingered for nearly a month, and died on the way back from Khartum to Korti on 16th February, and was buried near the wells of Gakdul. In the telegram reporting his death Lord Wolseley summed up his character and career in the words, "No braver soldier or more brilliant leader of men ever wore the Queen's uniform." (G. F. B.)

Steyn, Martinus Theunis (1857- ——), last President of the Orange Free State, was born at Winburg on 2nd October 1857. His father was a waggonmaker, an able man, who attained the position of a member of the Executive Council. His mother, a woman of decided character, was the daughter of one of the leaders of the Great Trek of 1836. Their son was educated at the Grey College at Bloemfontein, and at the age of sixteen became manager of a farm belonging to his father. But he was

not content with the prospect of a farmer's life, and soon obtained permission to study law in Europe. He was a student first in Holland and later in England at the Inner Temple, and was called to the English bar in November 1882. After his return to South Africa he practised as a barrister at Bloemfontein, and made such rapid progress in his profession that in his thirty-second year he was appointed State Attorney of the Orange Free State. A few months afterwards he became second puisne judge, and in 1893 first puisne judge of the High Court. His decisions won him a reputation for ability and sound judgment, and in 1895, upon the resignation of Mr Reitz, Steyn's position had become strong enough to make him a candidate for the Presidency. He had married, soon after he returned from England, a daughter of the Rev. Colin Fraser, a clergyman of the Dutch Reformed Church. His wife's uncle, Mr J. G. Fraser, was chairman of the Free State Volksraad, and he now became Mr Steyn's principal opponent in the Presidential election. Mr Fraser's sympathies were distinctly British; he advocated an alliance between the Free State and Great Britain. Mr Steyn was the candidate of the Dutch party. In 1895 this party was in the ascendant. At the preliminary ballot Mr Steyn received forty-one votes to Mr Fraser's twenty, Sir Henry de Villiers, Chief Justice of Cape Colony, finding ten supporters, and Mr Hofmeyr, leader of the Dutch party at the Cape, five. The final voting early in 1896 resulted in a decisive victory for Mr Steyn. If there had been any doubt about his success, the Jameson Raid would certainly have turned the scale in his favour. He had been placed in power by the advocates of a Dutch South Africa, and he immediately began to cultivate closer relations with the Transvaal. There already existed between the two republics a defensive alliance, which bound each state to assist the other in the event of an unjust attack being made upon either. Early in 1898 a treaty of closer union was concluded. At the same time steps were taken to strengthen the armaments of the Orange Free State. Yet the sympathies of the Free State burghers were by no means unanimous on the Transvaal side. It may have been the knowledge of this fact, or it may have been a genuine desire for the maintenance of peace, that led President Steyn to propose a conference at Bloemfontein in May 1899 between President Kruger and Sir Alfred (afterwards Lord) Milner, the British High Commissioner. This conference failed to bring about any agreement between Great Britain and the Transvaal; but even after its failure the attitude which the Orange Free State would take up in the event of war was by no means certain. During the summer of 1899 the two Presidents were in close touch. When it became clear that war could not be avoided, President Steyn made an effort to throw upon Great Britain the responsibility for the calling to arms of the Free State burghers. He urged the British Government to stop the movements of its troops and to explain its proposals for a settlement, which he professed himself anxious to promote. At last, on 11th October, the day which the Transvaal Government had named as the latest on which they could accept an answer to its ultimatum, Steyn telegraphed to Sir Alfred Milner that "the high-handed and unjustifiable conduct" of the British Government had determined the Free State to throw in its lot with the Transvaal. Thus the two republics began the war fighting side by side. The early successes of the Boers in Cape Colony enabled President Steyn, who had not in the first instance taken the field himself, to issue proclamations annexing portions of British territory to his own republic. But the tide of war soon turned. After the surrender of Cronje's force at Paardeberg on 27th February 1900 Bloemfontein was at the mercy of Lord Roberts. It was occupied on 13th March, by which date the President had already taken flight. The annexation of the Orange Free State—now the Orange River Colony—followed on 28th May. During the whole after course of the war Steyn wandered about South Africa, carrying on a semblance of government, and on occasion actually taking charge of military operations. More than once he narrowly escaped capture. He was regarded as one of the most irreconcilable of the Boer leaders, and in August 1901 he justified this view by declaring, with Botha and De Wet, that he intended to carry on the war as long as possible. He took part, however, in the preliminary peace negotiations at Klerksdorp in April 1902, but was prevented by illness from signing the instrument of surrender at Pretoria on 31st May. At that date he was stated to be suffering from locomotor ataxy, brought on in all probability by his constant exertions and the nervous strain to which he had been subjected by the war. He sailed for Europe in July, and took up his residence in Holland.

Steyr, or Steier, an industrial town in Upper Austria, on the river Enns, 18 miles S.S.E. of Linz. Population (1890), 21,499; (1900), 17,592, chiefly German and Catholic (estimated to have 5 per cent. Czech and 1 per cent. Protestants and Jews). In addition to its important iron and steel industry, there is a paper manufactory, together with cotton-printing, dyeing, bell-founding, and brewing industries. The well-known small-arms factory now produces bicycles, electrical plant, &c., in addition to its staple products.

Stillman, William James (1828–1901), American painter, journalist, consul, and for many years a special correspondent of *The Times*, was born at Schenectady, New York state, on 1st June 1828. Both his parents were rather remarkable people of Puritan leanings. The religion in which the boy was brought up was of a repressive character. It tended to a morbid anxiety of soul rather than to joy and spiritual peace. But it continued to influence Stillman all through his life. He went through various developments of belief, but never lost his firm trust in the help and guidance of a beneficent Ruler of the Universe. He was sent to school in New York, and graduated at Union College, Schenectady. His desire was to be a painter. His family opposed the wish, but he managed to overcome their opposition, and early in 1850 came to England. He made the acquaintance of Ruskin; was introduced to Turner, for whose works he had unbounded admiration; and fell so much under the influence of Rossetti and Millais, that on his return home he speedily became known as the "American Pre-Raphaelite." He did not stay at home long. In 1851 Kossuth, the Hungarian patriot, made a tour through the United States. Stillman was one of the young people who were most deeply impressed by his oratory. He at once offered his services to the cause of Hungarian liberation, and before long his offer was accepted. He was invited to go to Hungary to dig up the Crown jewels, which had been buried secretly during the insurrection of 1848–49. But the fellow-conspirator whom he was to meet at Budapest could not be found. Kossuth had planned the errand in a characteristically casual way, and Stillman returned without the Crown jewels, glad enough to have escaped the active Austrian police. While he was awaiting a projected rising in Milan, Stillman studied art in Paris, and then, since the rising did not take place, he returned to the United States and once more devoted himself to

landscape painting. He found time not only to play a considerable part in the spiritualist movement, but also to start a journal, called *The Crayon*, in New York. It numbered Lowell among its contributors, and when it failed for want of funds, Stillman went to live near Lowell at Cambridge, Mass. Here he had also for neighbours Emerson, Longfellow, Agassiz, and other famous writers. He induced many of them to join the Adirondack Club, which used to make expeditions into the mountains. One such expedition has its record in a poem by Emerson. In this particular excursion Longfellow refused to take part. He was still doubting when he heard that Emerson intended to take a gun. "Then," he said at once, "somebody will be shot," and hesitated no longer. Stillman passed several years at Cambridge in quiet satisfaction with his surroundings, but a fit of restlessness started him off once more to England. He began to paint in London, renewed his friendship with Ruskin, and went with him to Switzerland to paint and draw in the Alps. Here Stillman worked so assiduously that his eyesight was affected. This did not prevent him, however, from undertaking the responsibilities of marriage. He was in Normandy with his wife, a daughter of Dr David Mack of Cambridge, Mass., when the American Civil War broke out. He made more than one attempt to serve in the Northern ranks, but his health was too weak. "We have not seen the enemy yet," said a colonel, to whom he offered himself as a volunteer, "but we have buried all the men like you already." His country, however, found employment for his services in another direction. In 1861 he was appointed United States consul in Rome. A dispute with his Government soon led to resignation, but shortly afterwards (in 1865) he was appointed to Crete, where he immediately became an avowed champion of the Christians in the island and of Cretan independence. He was naturally regarded with hostility both by the Mussulman population and by the Turkish authorities, and in September 1868 he found the strain upon his nerves too great to be borne any longer. He resigned and went to Athens, where his first wife died. In 1871 he married again in England, his second wife being a daughter of Mr Spartali, Greek consul-general in London. He had now given up painting and was following the career of a writer for newspapers and magazines. When the insurrection of 1875 broke out in Herzegovina he went there as a volunteer correspondent of *The Times*. His letters from the Balkans aroused so much interest that the British Government was induced to lend its countenance to Montenegrin aspirations. The Turks tried to blacken his character, but without success. Mr Gladstone, who had been inclined to put faith in their fables, was soon convinced of their untruth, and offered Mr Stillman a handsome apology. When the war ended in 1877 Stillman passed some months in Italy before he was appointed correspondent of *The Times* in Athens. In 1886 he became representative of that journal both in Italy and in Greece, with permanent residence in Rome. From 1890 until 1898 he was correspondent for Italy alone. He was a severe critic of Italian statesmen, and embroiled himself at various times with various politicians, from Crispi downwards. After his retirement he lived in Surrey, still keeping up a keen interest in all the subjects that had claimed his energies during his long and interesting life. He died on 6th July 1901. Stillman left a number of books, recording the different phases of his active career and discussing the questions in art and life that had chiefly occupied his mind. His autobiography was published shortly before his death.

(H. H. F.)

Stillwater, a city of Minnesota, U.S.A., capital of Washington county, near the head of St Croix Lake, at an altitude of 694 feet. It has three railways—the Chicago and North-Western; the Chicago, Milwaukee, and St Paul; and the Chicago, St Paul, Minneapolis, and Omaha, which, with boats on the river, which is navigable to this point, give it a large trade. The industries are chiefly connected with the lumber trade and manufactures. It has many large saw, planing, and shingle mills. It contains also flour mills and grain elevators, waggon factories and agricultural implement works. Population (1890), 11,260; (1900), 12,318, of whom 4021 were foreign-born.

Stirling, a royal and parliamentary burgh (Stirling group), important railway centre, and county town of Stirlingshire, Scotland, overlooking the Forth, 36 miles W.N.W. of Edinburgh, and 30 miles N.N.E. of Glasgow by rail. A steamer runs from Leith (45 miles), but the navigation of the river between Alloa and Stirling is almost wholly dependent on the tide. The famous "links of the Forth" occur between the towns named, and make the distance between them almost twice what it is by land. At Causewayhead, about 1½ mile from Stirling, rises the Abbey Craig, an outlying spur of the Ochils, upon the summit of which stands the Wallace Monument, which serves as a landmark for many miles around. Trams connect Stirling and Bridge of Allan. Tweed is no longer manufactured, but industrial features include furniture factories, a cooperage, and large rubber works. The water-supply has been supplemented and electric light introduced. A new post office and free library have been built. The High School has an organized science and art school attached. Population (1891), 16,776; (1901), 18,403.

Stirlingshire, a midland county of Scotland, bounded on the N. by Perth, on the N.E. by Clackmannan and the Firth of Forth, on the S.E. by Linlithgowshire, on the S. by Lanarkshire and a detached portion of Dumbartonshire, and on the S.W. and S. by Dumbartonshire.

Area and Population.—In 1891 the parish of Stirling was placed wholly in Stirling, and Alva transferred to Clackmannan; Logie was placed wholly in Stirling, Lecropt wholly in Perth, and Kippen wholly in Stirling. The area is 296,928 acres, or about 466 square miles. The population was, in 1891, 125,608; in 1891, on the above area, 118,021; and in 1901 it was 142,338, of whom 72,697 were males and 69,641 females. On the area given above, the number of persons to the square mile in 1901 was 305, and the number of acres to the person 2·8. The following table gives particulars of births, deaths, and marriages:—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimacy.
1880	2076	701	4008	6·9
1890	2386	770	3790	6·31
1899	2359	1010	4445	5·1

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	37·87	33·57	32·06	34·42	34·52
Death-rate . .	19·62	18·23	20·18	18·58	18·32
Marriage-rate .	6·62	6·35	6·51	6·99	7·84

In 1891 there were 1794 Gaelic-speaking persons in the county, and 408 foreigners. Valuation in 1889–90, £557,037; 1899–1900, £623,748.

Administration.—The county returns a member to Parliament. Stirling (18,403) is a royal and parliamentary burgh of the Stirling group, Falkirk (29,271) is a parliamentary burgh (Falkirk group), Kilsyth (7331) is a police burgh and burgh of barony, and Bridge of Allan (3240), Denny and Dunipace (5158), and Grangemouth

(7968) are police burghs. Alva and Milngavie were cut off from the county in 1891. Five other towns have more than 2000 inhabitants, and six more over 1000. There are 23 civil parishes, and the number of paupers and dependents in September 1899 was 2821. Stirlingshire forms a sheriffdom with Dumbarton and Clackmannan, and there are two resident sheriffs-substitute, one at Stirling and one at Falkirk.

Education.—Twenty-six school boards manage 78 schools, which had an average attendance of 21,591 in 1898–99, and 12 voluntary schools (8 Roman Catholic and 2 Episcopal) had 1565. There are 2 secondary schools, one at Stirling and the other at Falkirk, and each of these places has a science and art school, while 20 public schools in the county earned grants in 1898 for giving higher education. The county council does little or nothing for technical education, but Stirling and Kilsyth town councils subsidize science and art and manual instruction classes, and Denny and Dunipace supports a mining instruction class.

Agriculture.—The percentage of cultivated area in 1898 was 39·9. Oats are the staple crop, the barley acreage is about a third of that under oats, and some 2000 acres are under wheat. Of the 1545 holdings in 1895 the average size was 77 acres. The percentage under 5 acres was 14·95, between 5 and 50 acres 33·01, and over 50 acres 52·04. The number of farms between 50 and 100 acres was 370, between 100 and 300, 393, between 300 and 500, 35, and over 500 acres, 6. The following table gives the principal acreages at intervals of five years from 1885:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	115,058	29,031	8708	28,206	47,702	1400
1890	119,138	27,324	8434	36,531	45,106	1630
1895	118,794	26,780	8732	32,671	49,362	1111
1899	118,676	25,819	8071	31,541	52,017	1087

The following table gives particulars of the live-stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf	Sheep.	Pigs.
1885	4541	31,275	10,956	115,766	1975
1890	4635	31,106	11,074	120,531	2188
1895	5173	32,889	11,744	128,734	2677
1899	4772	33,902	12,181	122,584	2096

At the census of 1891 the number of persons returned as being engaged in agriculture was 3983 men and 774 women. There were 14,920 acres under wood in 1895, of which 593 had been planted since 1881.

Industries and Trade.—Coal-mining is the staple industry. The following table shows the output of minerals in 1890 and 1899:—

Year.	Coal.		Iron Ore.		Sandstone.		Fire-clay.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	1,498,085	£586,549	38,233	£22,910	..	..	54,440	£9,551
1899	2,269,992	£880,551	3,012	£1,129	52,376	£12,707	79,992	£11,099

There were also obtained in 1899, 19,518 tons of limestone valued at £3904, and 2288 tons of oil-shale valued at £572. Falkirk is the headquarters of the light founding industry, which developed largely during the last quarter of the 19th century; chemical works, woollen manufacture, calico-printing and bleaching are also important. The industrial population numbered, in 1891, 26,244 men and 5664 women, of whom 13,191 men and 237 women were engaged in the working of minerals, and 1666 men and 1862 women in textiles. About 30 miles were added to the railway mileage of the county during the period 1875–1900.

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(W. WA)

Stockbridge, a town of Berkshire county, Massachusetts, U.S.A. It comprises an area of 24 square miles of picturesque valley and hill country, situated in the western part of the state. The principal village bears the same name as the town, and is situated on the river Housatonic, and on a branch of the New York, New Haven, and Hartford Railroad. Stockbridge is well known as a place of summer resort for New York people, whose country houses are scattered through it. Population (1880), 2357; (1890), 2132; (1900), 2081.

Stockerau, a market town in the government district of Korneuburg, Lower Austria, situated on an arm of the Danube and on the North-Western Railway, about 16 miles from Vienna. It is one of the largest of the Austrian corn-markets, and has a considerable trade in timber. Soap, candles, perfumery, felt goods, &c., are manufactured. Population (1890), with incorporated village of Grafendorf, 8393; (1900), 10,213.

Stockholm, the capital of Sweden, beautifully situated, in part on a cluster of islands, between the eastern extremity of Lake Mälar and the Saltsjö, an inlet of the Baltic (40 miles long, thickly studded with rocky, wooded islands), in 59° 20′ 34″ N. and 18° 3′ 32″ E. Stockholm is traversed from south to north by the main railway line from Malmo to the north and west of Sweden, which has a commodious and handsome station on the Wasagatan. With this are linked three local lines. There is also a well-arranged tramway system. Since 1875 the city has grown with much rapidity, the expansion being greatest on the northern outskirts, that is, beyond Norrmalm. But the population has since 1895 increased faster than the city has expanded, and the want of houses, more particularly smaller houses at moderate rentals, became very acute in 1897, and continued to be so on to 1902. Population (1880), 168,775; (1890), 246,454; (1900), 300,624. The death-rate diminished from 25·7 per 1000 for the quinquennial period 1876–80 to 19·5 in 1891–95. On the island of the Holy Spirit (Helgeandsholm) there are new Houses of Parliament and premises for the Bank of Sweden. On Riddarholm there were built, in 1887–90, fine archives offices; and in the yard of the palace of nobility (Riddarhunt) a statue to the Swedish chancellor, Axel Oxenstjerna, by Börjeson, was unveiled (1890). In front of the church of St Nicholas' there was unveiled, in 1898, a statue to Olaus Petri, the reformer, by Lundberg. The exterior of the royal palace was restored, 1898–1901, and many ornamental details, planned by the architect, were executed by the munificence of King Oscar II.; what was formerly the royal library in the north-east wing of the palace is now the royal armoury, containing among other objects the relics of Sweden's most famous kings, Gustavus Adolphus and Charles XII. The principal modern edifices in the Norrmalm quarter are the opera house (1891–98), the academy of fine arts (1897), and the church of St John's (1890). In this quarter two parks have been opened—Vanadis Park in 1886–96 and Tegnér Park in 1891–93; and a statue to Nils Ericsson, the railway engineer, by Börjeson, was unveiled in 1893. To the east of Norrmalm stretches the handsome residential quarter of Östermalm, with fine promenades and broad boulevards, where have been built large barracks (1888, 1890, and 1897) for the Swedish Guards Corps. Monuments to Linnæus (1885) and Schéele (1892) have been set up in Humlegården (the Hop Garden). In 1897 the royal library possessed some 300,000 volumes, 10,000 MSS., and 14,000 portfolios of pamphlets, &c. The peninsula of Blasieholm, which juts out south-east from Norrmalm, contains

several palace-like private houses. Various hospitals, asylums, and barracks have been erected on Kungsholm (King's Island) to the west of Norrmalm. The Caroline medical institute (1815), which (since 1874) has the same rights as the universities to hold medical examinations and to confer the degree of M.D., had about 40 instructors and 282 students in 1899. In Södermalm, which rises to 184 feet above sea-level, there are, it should be mentioned, St Catherine's church (1656; restored 1891). In the same quarter there are the Roman Catholic chapel of St Erik (1892) and two parks—Tanto (1885–96) and White Hill (1895–96). On Djurgården (the Deer Park), the playground and favourite summer resort of the Stockholm people, great alterations have been made. In 1893 a biological museum was built; in 1897 a bridge to connect the island with Östermalm; and in 1898–99 a beginning was made with an imposing pile destined to contain the northern (Scandinavian) museum, collected mainly through the instrumentality of Dr A. Hazelius. In 1891 there was organized within the enclosure of Skansen (the Redoubt) the open-air historical museum of Swedish life, which serves to illustrate the collections of the northern museum. On this same island (Djurgården) are a deaf and dumb asylum, several restaurants and theatres, and a bust of Bellman, whose day (26th July) is celebrated annually with great festivities. Education stands at a high level in Stockholm, the city being exceptionally well endowed with academies, museums, and other adjuncts of higher culture. In 1897 there were 61·8 telephones for every 1000 inhabitants, as compared with 40·1 in Christiania, 37·1 at Helsingfors, and 2·3 in London. The industries of Stockholm are, generally speaking, of a miscellaneous character. It has no staples, like Norrköping or Jönköping. The most important are those producing commodities for human consumption, and next after them, iron and steel industries. Altogether, in point of value of output, Stockholm is accredited with 25 per cent. of the industry of all Sweden. In 1896 she had a total of 606 factories, employing 21,400 workpeople, with output valued at £4,711,000; as compared with 275 factories, 9810 workpeople, and £1,797,500 output in 1884. Stockholm is the first import town in Sweden, but with regard to exports she is surpassed by both Gothenburg and Malmö. During 1891–94 inclusive her imports averaged £5,821,600 and her exports £1,342,300 per annum; but in 1897 the imports were £6,805,600, or 30 per cent. of the total imports of the kingdom, and the exports £1,783,300, or only about 9 per cent. In 1900 the port was entered by 2255 vessels of 964,367 tons, of which 459 of 428,292 tons were British, as compared with 1746 vessels of 611,650 tons (241 of 178,500 tons British) in 1888. In 1899 Stockholm owned a mercantile navy of 205 vessels of 70,870 tons, ranking in this respect next after Gothenburg. There are three navigable approaches to the city through the Skärgård—(i.) the northern, *viâ* Furusund, 75 miles from the Baltic; (ii.) the eastern, *viâ* Sandhamn, 40 miles; and (iii.) the southern, *viâ* Landsort, 87 miles. From 1885 to 1890 inclusive the port was closed by ice on an average 81 days in the year, but during the period 1890–95 the average was only 25 days. Since 1896 an ice-breaker of 1000 horse-power has been employed to keep the approaches and the harbour open in winter. With the view of still further facilitating the commerce of the port, large quantities of iron, timber, and coal have since 1879–86 been shipped and unshipped at the new out-port of Värtan, immediately north-east of the city, where there is a harbour, 14 acres in extent, with 6340 feet length of quayage. In Stockholm itself the depth beside the larger quays is 20 feet at low water, beside the smaller quays, 12 feet; the general depth of the harbour and waterways being elsewhere 100 to 105 feet, except in Norrström (the connexion with Lake Mälar), where it is only $7\frac{1}{3}$ feet. Mean temperature of Stockholm (1859–94), 41·7° Fahr.; January, 26·6°; July, 61·5°. Rainfall (1860–94), 17 inches; snow falls on an average on 58 days in the year.

AUTHORITIES.—Of the more recent books upon Stockholm, the first place belongs to the profusely illustrated work, written by a number of authorities, edited by E. W. Dahlgren, and published under the auspices of the city executive, *Stockholm, Sveriges Hufvudstad*, 3 vols. (1897). See also A. STRINDBERG and C. J. LUNDIN, *Gamla Stockholm* (1882); and C. J. LUNDIN, *Nya Stockholm* (1887–90); G. NORDENSVAN, *Mälarens Drottning* (1896–97); *Urkunder till Stockholms historia*, ed. by Karl Hildebrand (1900); *Berättelser angående Stockholms kommunal-förvaltning* (annual reports since 1868); and K. KEY-ÅBERG, *Af Stockholms Stadsfullmäktige beslutad Undersökning af Arbetarnes Bostadsforhållanden i Stockholm* (1897). (J. T. BE.)

Stock Markets.—Since the ninth edition of the *Encyclopædia Britannica* was published the volume of transactions in interest-bearing securities has grown enormously in all the great cities of the world. In London the membership of the Stock Exchange, the number of securities quoted in the Official List, and the number of securities dealt in, have expanded greatly, and the markets in New York and Paris, especially the former, have acquired enhanced importance. The Berlin Bourse, the business of which was steadily growing during the 'eighties and early 'nineties, was checked in its expansion after 1896 by drastic legislation passed in July of that year against bargains for future delivery, and the business of German speculators was being done (1896–1902) in other exchanges, especially London, Amsterdam, and Brussels. Telegraphic communication between the various great cities of the world is much closer than it was in 1885, what is known as arbitrage business having attained very large proportions. This class of business consists in watching closely the fluctuations in certain securities which are dealt in in two big markets, and simultaneously selling in one and buying in the other when opportunity offers. Previous to 1884 and 1885 it was chiefly confined to operations between London and Paris, the difference in the times of London and New York having up till then prevented the growth of a similar business between those cities, as New York morning prices do not reach London till about 3.30 P.M., and the London Stock Exchange is shut at 4 P.M. But in London, about the middle of the 'eighties, the practice of staying in "the street," after the Stock Exchange was shut, to deal in "Americans" began to become common, though many old-fashioned brokers who were rich enough not to be eager to make more money set their faces against it. It is worth noting that in most of the foreign cities there has always been more disposition to stay late than in London, where it was formerly the rule to cease business definitely at a more or less fixed hour. Since 1885 there has been more laxity in this respect, but it is not even yet the practice to do business in the evening. In Paris, dealing "on the Boulevard" goes on intermittently in summer as late as 9 P.M. when trade is active.

Growth of Stock Exchange business in London.

London.—The value of the securities quoted in the Official List of the Stock Exchange, deducting foreign stocks (coupons payable abroad), the exact amounts of which are not ascertainable, was on 31st December 1891 £4,562,438,154; at the end of 1901 it was £6,795,548,291. The List itself has been increased in size several times. It formerly consisted of four pages, and in 1902 sixteen. The first great expansion in the number of

securities took place in the years 1888–90, when, following the example of Messrs Guinness, many brewery and other firms turned themselves into limited liability companies. During the 'nineties the conversion of private concerns into companies proceeded at an ever-increasing pace, attaining its maximum in the year 1896, when 309 millions of capital of all kinds were registered. The greatest single year on record was, however, 1888, when 353 millions of capital was registered.

The mining market.

The market for mining shares had, up to about 1888, held a very small place in the business of the Stock Exchange, but the discovery of an extensive gold-field on the Witwatersrand in the Transvaal produced a great change. At first, although the transactions in the new group of securities were very large, and enormous sums of money were won and lost in them, the "Kaffre circus," as it was called, was regarded with contempt by the older *habitués* of the Stock Exchange, and it was not until the winter of 1894–1895, when the number of brokers engaged in the new market had become greater than those in any other, that special recognition was given to the mining department, by a rule that the arrangements for carrying over bargains in mining shares should begin the day before the regular settlement commenced (see ACCOUNT). Even with these new facilities the Stock Exchange Clearing House found it difficult to cope with the huge mass of work thrown on it in 1895, and once or twice it broke down temporarily. Much of the trouble to all concerned arose from the fact that mining shares, like nearly all securities dealt in in London, were "registered" and not "to bearer." The offices of the companies were naturally not equipped with the staffs that would have enabled them to furnish certificates promptly in the enormous quantities unexpectedly required: it must be remembered that the preparation of a certificate for 50 or 100 shares of £1 each is just as troublesome as the preparation of one for 500 or 1000. The new feature, which upset all calculations, was the extraordinary number of small speculative investors who bought and paid for their shares, very often to their subsequent regret. If the shares had been "to bearer," the work could have been done with comparative ease.

Mining shares not quoted officially.

Another remarkable feature of the "boom," to use the slang which came into general use during the great speculative mania for South African shares in 1895, was the fact that of the 200 or 300 shares dealt in, less than a dozen were officially quoted. As a rule no quotation was asked for, though a "special settlement" was obtained. Most of the companies concerned had been registered under the laws of the then existing South African Republic. After the Jameson Raid business in the South African market slackened somewhat, and there were few new "Kaffre" companies introduced; but the volume of mining transactions was kept up by the discovery of the Coolgardie gold-fields of West Australia, which led to the creation of a great number of companies, whose shares were "introduced" in London from 1895 onwards. Very few of these also were, or are, quoted in the Official List. A minor "boom" occurred in the winter of 1900–1901 in West African shares, but although it created a good deal of noise, it was not to be compared in magnitude to the South African and West Australian movements. The West African gold-fields are expected by the best authorities to be very productive eventually, but are at present at an early stage of development and receive little attention, partly because the market was "manipulated" and a certain number of people lost money when they expected to gain it.

American securities.

The American department of the Stock Exchange has diminished considerably in importance since 1885, owing chiefly to the great distrust which the silver policy of the United States, not finally abandoned until 1893, created. This policy and the Venezuela Message of President Cleveland in December 1895 caused British holders to sell steadily. On the other hand, the United States continued to grow in wealth, and the American people bought back from Europe enormous masses of American railway bonds and shares. The London Stock Exchange took comparatively little part in the wonderful upward movement in American prices which began in 1897 and, after two partial checks, was still proceeding in 1902. The second check took place in May 1901, when two great groups of American railroad magnates unintentionally produced a "corner" (see MARKETS) in Northern Pacific Railroad shares. The American public took fright at this apparent evidence of the recommencement of hostilities between great financiers who were believed to have "buried the hatchet"; the dispute, however, was soon arranged, as the two parties had no desire to fight, but the public was only beginning to recover its confidence more than a year afterwards. The "corner" in Northern Pacific common shares produced one remarkable result in London, namely, the suspension for two or three weeks of the "buying in" rule: if that rule had been enforced against people who were, in most cases, involuntary "bears" of Northern Pacific, several leading firms of brokers would have been ruined.

Government securities.

Since the conversion of the British 3 per cents. in 1888, and creation of local loans stock (to provide money to be lent by the Public Works Loan Commissioners to local authorities), no important addition to the list of high-class investment securities was made until 1900, when the Boer war necessitated special finance, consisting in the creation and issue of the national war loan for 30 millions (1900), 92 millions of Consols, in two issues, of 60 millions (April 1901) and 32 millions (April 1902); there were also minor issues of three and five year Exchequer bonds and Treasury bills. These issues of Consols greatly broadened the market for them, which for many years after the conversion of 1888 had been very narrow, owing to a large proportion of the total being in the hands of Government departments. The Government's borrowing operations were sufficiently big to reduce the value of the whole mass of Stock Exchange securities, except Canadian and American railway issues, which increased in value owing to causes peculiarly affecting them, and certain securities which were also influenced by special forces, such as Argentine, Spanish, and other foreign bonds. The interest taken by British investors and speculators in foreign Government bonds generally has decreased considerably, and, on the other hand, foreign speculators, and to some extent foreign investors, have operated more freely on the London Stock Exchange. The smooth working of the finance of the Boer war was greatly facilitated by the employment of the funds of French financial institutions in British Treasury bills and Exchequer bonds, and to some extent in Consols.

Minor changes.

Various minor alterations in the working of the Stock Exchange occurred between 1888 and 1902. Telephonic communication has become much more general, and extends over longer distances; for instance, conversations between men in Paris and London are daily incidents of the business of many firms. The relations between the Stock Exchange and the money market have become closer: banks lend more freely than they used to, on a wider range of securities; but they also

lend more often direct to the holder of the securities borrowed on, and not through a member of the Stock Exchange. Formerly the usual practice of those banks which had considerable business with the Stock Exchange was to lend large sums on high-class stocks to wealthy brokers, who employed the money inside the "House" in carrying over the accounts of their clients, or to other brokers whom they trusted. This class of business is still very large, but wealthy clients are not now always satisfied to borrow through their brokers; they not unfrequently go direct to banks and borrow from them. This practice has its inconveniences: formerly it was possible for the jobbers in all important markets on the Stock Exchange to form a good idea, by comparing notes in each settlement, of what the condition of the speculative account really was, but it is less easy to do so now, because so much stock is "pawned" with banks that the conclusions arrived at by the jobbers from examining only what they are carrying over themselves are liable to be falsified through finding (*a*) that the account is either lighter than they expected, stock having been taken off the market temporarily by banks; or (*b*) that it is much heavier than they were prepared for, the banks having suddenly refused to lend any longer on a mass of stock they had hitherto been carrying. Banks are apt to be more capricious in their action as regards this class of business than the big "money-brokers"; they cannot so well feel the pulse of the market, and are therefore liable to sudden fits of alarm, and also to hurried changes of policy on the part of their boards, which may be, and usually are, based on sound principles, but are not unfrequently carried out without sufficient regard to the circumstances existing at the moment chosen for putting them in practice.

Paris.—The Paris Bourse is an institution of enormous strength, but it plays a smaller part in international business than might be expected, owing to the deep-rooted conservatism and caution of the French people in money matters. It is true that they are liable to occasional outbursts of imprudence, such as led to the loss of great sums in the Panama Canal Company; but, as a rule, it is difficult to induce the average Frenchman to place his money in anything which he does not think a safe interest-yielding security under French law: he almost always wants to invest, not to speculate. In Great Britain and America the distinction between the two is too frequently forgotten. Since the Panama collapse in 1894 the French investor—that is, the bulk of the French nation—has been very prudent. The French have gone on saving money, and have been very difficult to satisfy in the matter of the securities offered to them. Appeals to patriotism have drawn from some French capitalists a considerable amount of money from time to time for Russian Government loans, but these appeals were backed by assurances given by large banking institutions like the Crédit Lyonnais, the Comptoir d'Escompte, and the Société Générale, in addition to the Bank of France, that the interest was secure. As a rule, however, investments outside France are not popular with the French peasantry and middle classes; but there has always been a minority who were ready to speculate from time to time, besides the body of professional operators on the Bourse. The dimensions of this minority increased during the last eight or ten years of the 19th century, owing to the attractions presented by the South African gold-fields. Operators and speculative investors in France were large holders of South African mining shares when the Boer war broke out in 1899, and though they sold them freely in consequence of the war, they did so with the intention of "coming in" again, and on more than one occasion made tentative purchases. The great banking firms and institutions of Paris have been occupied a good deal with the finances of Spain, Portugal, Turkey, and other minor countries, and last, but not least, they were large purchasers of British Treasury bills, which during the first two years of the war afforded an extraordinary opportunity to the investor, it being possible to buy them at prices yielding a rate equal to $3\frac{3}{4}$ per cent. per annum during the currency of the bills.

New York.—The movements on the New York Stock Exchange during the last ten or twelve years of the 19th century were so gigantic and surprising, that it is difficult to realize their meaning. Naturally the earlier events of the period are comprehensible to some extent: the collapse of prices in 1893, owing chiefly to the prolonged resistance of the Senate to the repeal of the Sherman Silver Act of 1890; the semi-panic of December 1895, caused by the Venezuela Message of President Cleveland; the partial revival in 1897 and relapse in 1898, owing to the war with Spain. Opinions as to the real character of the colossal upward movement which began in the autumn of 1900 differ. Certain things, however, are worth mentioning: (*a*) that the United States is now the largest holder of its own shares as well as bonds; (*b*) that the position is much complicated by the growth of gigantic industrial combinations (see TRUSTS), which, according to some of the best judges, are over-capitalized; (*c*) that although the United States has bought back such huge quantities of American shares and bonds from Europe, and has "participated" in various loan operations in Europe, including the issues of Consols, there is very strong evidence that this has been done in part by borrowing largely in Europe "on short term," and by selling the securities taken up in Europe soon after their issue, or "pawning" them. It was difficult to account in any other way for the movements of gold from New York to Europe which took place from time to time in 1901–02. (W. HO.)

Stockport, a market town, municipal, county (1888), and parliamentary borough, mainly in Cheshire but partly in Lancashire, where is part of the suburb of Heaton Norris, 6 miles from Manchester, with which it is connected by railway and tramway. The site of the town is hilly, and it stands on the Mersey where the Tame and Goyt join. The area of the county borough is 2200 acres; its rateable value is £286,655; and the population at the census of 1891 was 70,263, and at that of 1901, 78,871. Stockport is a town of varied industries, but the most important are the woollen manufacture and hat making. It was enfranchised under the Reform Act of 1832, and its most distinguished representative was Richard Cobden, of whom the town has a statue. As a municipal borough it dates from 1835, and the corporation control the gas and water supply. From the gas-works there is an annual profit of about £10,000. The penny-in-the-slot system is increasingly used. The market rights were bought from Lord Vernon in 1847 for £22,500. By this arrangement the corporation secured the site of the present Vernon Park, in which stands a museum presented by Mr James Kershaw, M.P., and Mr John Benjamin Smith, M.P. There are six other parks and recreation grounds. A free library was opened in 1875. In 1889 Stockport became a county borough. The municipal authorities maintain a technical and art school. The architect was Mr G. Sedger, and the cost £20,000. Of this £5000 was given by the Whitworth legatees, who also gave £5000 for scholarships. There are also public baths, &c. A characteristic institution is the Stockport Sunday school, which dates from 1784, and is the largest in England. The mother church of St

Mary's was restored in 1882. The registers date from 1584. The borough contains various other Anglican, Roman Catholic, and Nonconformist places of worship. Stockport has a grammar school founded in 1487 by Sir Edmond Shaa, Lord Mayor of London. There are also many charitable and other public institutions.

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Stockton, a city of California, U.S.A., the capital of San Joaquin county. It is situated in 37° 57′ N. and 121° 15′ W., on the Stockton slough of the San Joaquin river, and on the San Francisco and San Joaquin Valley, and on branches of the Southern Pacific Railroad, in the central part of the state. It has a perfectly level site and a regular plan, with broad streets, a water-supply from artesian wells, good sewerage, and natural gas. It is in the midst of the great valley of California, the granary of the Pacific coast, and is one of the largest grain markets of the West. It has extensive manufactures of flour, lumber, agricultural implements, and other articles. Population (1890), 14,424; (1900), 17,506, of whom 4057 were foreign-born and 846 coloured, including 213 negroes.

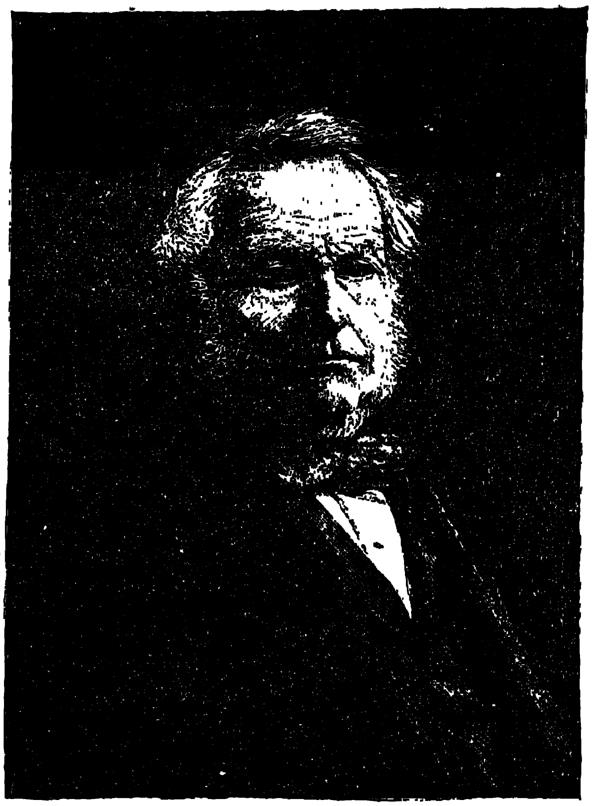
Stockton-on-Tees, a municipal and parliamentary borough, seaport, and market town, Durham, England, 20 miles south-south-east of Durham by rail. The iron bridge which spans the Tees and connects the town with Thornaby was erected at a cost of about £65,000. The corporation baths and wash-houses have been reconstructed. The improvement of the port of Stockton has cost over £200,000, of which the Government has advanced £80,000 on loan to the commissioners. The construction of the North Gare breakwater on the Durham side has been in progress about ten years. Vessels drawing 20 feet come up to the town at high-water spring tides. In 1901, 571 vessels entered with 208,131 tons, and 618 cleared with 231,048 tons. The registered shipping consisted of 30 vessels of 22,164 tons. In 1900 the total value of imports was £280,371, and of exports, £435,439. There is a well-known racecourse in the vicinity of the town. Ropner Park was opened in 1893. The population of the municipal borough was in 1891, 49,708; in 1901, 51,476: of the parliamentary borough (which includes Thornaby) in 1891, 68,875; in 1901, 71,812.

Stoke-on-Trent, a parish, municipal ana parliamentary borough, and market town of Staffordshire, England, 17 miles N. by E. of Stafford. Four large firms manufacturing every variety of art china and earthenware alone employ over 5000 hands. Coal mining and iron and machine manufactures are also carried on. Area of municipal borough, 1882 acres. Population (1891), 24,027; (1901), 30,458.

Stokes, Sir George Gabriel, BART. (1819–——), British mathematician and physicist, was the youngest son of the Rev. Gabriel Stokes, rector of Skreen, co. Sligo, where he was born on the 13th of August 1819. After attending Dr Wahl's school in Dublin and Bristol College, he matriculated in 1837 at Pembroke College, Cambridge, where four years later, on graduating as senior wrangler and first Smith's prizeman, he was elected to a fellowship. This he had to vacate by the statutes of that society when he married in 1857, but twelve years later, under new statutes, he was re-elected, and retained his place on the foundation until 1902, when, on the day before he entered on his eighty-fourth year, he was elected to the mastership. In 1849 he was appointed to the Lucasian professorship of mathematics in the University, and on the 1st of June 1899 the jubilee of his appointment was celebrated at Cambridge in a brilliant ceremonial, which was attended by numerous delegates from European and American universities. On that occasion a commemorative gold medal was presented to him by the Chancellor of the University, and marble busts of him by Hamo Thornycroft were formally offered to Pembroke College and to the University by Lord Kelvin. Sir George Stokes, who was created a baronet in 1889, further served his University by representing it in Parliament from 1887 to 1892. During a portion of this period (1885–90) he was president of the Royal Society, of which he had been one of the secretaries since 1854, and thus, being at the same time Lucasian professor, he united in himself three offices which had only once before been held by one man, Sir Isaac Newton, who, however, did not hold all three simultaneously.

Stokes was the oldest of the trio of natural philosophers, Clerk-Maxwell and Lord Kelvin being the other two, who especially contributed to the fame of the Cambridge school of mathematical physics in the latter part of the 19th century. His original work began about 1840, and from that date onwards the great extent of his output was only less remarkable than the brilliance of its quality. The Royal Society's catalogue of scientific papers, which does not extend beyond 1883, gives the titles of over a hundred memoirs by him published down to that year. Some of these are only brief notes, others are short controversial or corrective statements, but many are really long and elaborate treatises, as may be judged from the fact that his scientific writings for the eleven years 1842–52 (all that up to 1902 had appeared in a collected form) alone fill three volumes, the smallest of which contains 326 pages and the largest 413. In matter his work is distinguished by a certain definiteness and finality, and even of problems that when he attacked them were scarcely thought amenable to mathematical analysis, he has in many cases given solutions which once and for all settle the main principles. This result must be ascribed to his extraordinary combination of mathematical power with experimental skill, for with him, from the time when about 1840 he fitted up some simple physical apparatus in his rooms in Pembroke College, mathematics and experiment have ever gone hand in hand, aiding and checking each other. In scope his work covers a wide range of physical inquiry, but, as Cornu remarked in his Rede lecture of 1899, the greater part of it is concerned with waves and the transformations imposed on them during their passage through various media. His first published papers, which appeared in 1842 and 1843, were on the steady motion of incompressible fluids and some cases of fluid motion; this was followed in 1845 by one on the friction of fluids in motion and the equilibrium and motion of elastic solids, and in 1850 by another on the effects of the internal friction of fluids on the motion of pendulums. To the theory of sound he made several contributions, including a discussion of the effect of wind on the intensity of sound and an explanation of how the intensity is influenced by the nature of the gas in which the sound is produced. These inquiries together put the science of hydrodynamics on a new footing, and provided a key not only to the explanation of many natural phenomena, such as the suspension of clouds in air, and the subsidence of ripples and waves in water, but also to the solution of practical problems, such as the flow of water in rivers and channels, and the skin resistance of ships. But perhaps his best known researches are those which deal with the undulatory theory

of light. Their significance and importance may be gauged by a reference to the article WAVE THEORY in vol. xxiv. of this Encyclopædia, where Stokes's authority is repeatedly appealed to. His optical work began at an early period in his scientific career. His first papers, on the aberration of light, appeared in 1845 and 1846, and were followed in 1848 by one on the theory of certain bands seen in the spectrum. In 1849 he published a long paper on the dynamical theory of diffraction, in which he showed that the plane of polarization must be perpendicular to the direction of vibration. Two years later he discussed the colours of thick plates; and in 1852, in his famous paper on the change of refrangibility of light, he described the phenomenon of fluorescence, as exhibited by fluorspar and uranium glass, materials which he viewed as having the power to convert invisible ultra-violet rays into rays of lower periods which are visible. A mechanical model, illustrating the dynamical principle of Stokes's explanation, was shown in 1883, during a lecture at the Royal Institution, by Lord Kelvin, who said he had heard an account of it from Stokes many years before, and had repeatedly but vainly begged him to publish it. In the same year, 1852, there appeared the paper on the composition and resolution of streams of polarized light from different sources, and in 1853 an investigation of the metallic reflection exhibited by certain non-metallic substances. About 1860 he was engaged in an inquiry on the intensity of light reflected from, or transmitted through, a pile of plates; and in 1862 he prepared for the British Association a valuable report on double refraction, which marks a period in the history of the subject in England. A paper on the long spectrum of the electric light bears the same date, and was followed by an inquiry into the absorption spectrum of blood. The discrimination of organic bodies by their optical properties was treated in 1864; and later, in conjunction with the Rev. W. Vernon Harcourt, he investigated the relation between the chemical constitution and the optical properties of various glasses, with reference to the conditions of transparency and the improvement of achromatic telescopes. A still later paper connected with the construction of optical instruments discussed the theoretical limits to the aperture of microscopical objectives. In other departments of physics may be mentioned his paper on the conduction of heat in crystals (1851), and his inquiries in connexion with the radiometer; his explanation of the light border frequently noticed in photographs just outside the outline of a dark body seen against the sky (1883); and, still later, his theory of the Röntgen rays, which he suggested might be transverse waves travelling as innumerable solitary waves, not in regular trains. Two long papers published in 1849—one on attractions and Clairaut's theorem, and the other on the variation of gravity at the surface of the earth—also demand notice, as also do his mathematical memoirs on the critical values of the sums of periodic series (1847) and on the numerical calculation of a class of definite integrals and infinite series (1850), and his discussion of a differential equation relating to the breaking of railway bridges (1849).



SIR G. G. STOKES, BART.
(From a photograph by Elliott and Fry, London.)

But large as is the tale of Stokes's published work, it by no means represents the whole of his services in the advancement of science. Many of his discoveries have not been published, or at least have only been touched upon in the course of his oral lectures. An excellent instance is afforded by his work in the theory of spectrum analysis. In his presidential address to the British Association in 1871, Lord Kelvin (Sir William Thomson, as he was then) stated his belief that the application of the prismatic analysis of light to solar and stellar chemistry had never been suggested directly or indirectly by any other savant when Stokes taught it to him in Cambridge some time prior to the summer of 1852, and he set forth the conclusions, theoretical and practical, which he learnt from Stokes at that time, and which he afterwards gave regularly in his public lectures at Glasgow. These statements, containing as they do the physical basis on which spectrum analysis rests, and the mode in which it is applicable to the identification of substances existing in the sun and stars, make it appear that Stokes anticipated Kirchhoff by at least seven or eight years. Stokes, however, in a letter published some years after the delivery of this address, stated that he had failed to take one essential step in the argument (not perceiving that emission of light of definite refrangibility not merely permitted, but necessitated, absorption of light of the same refrangibility), and modestly disclaimed "any part of Kirchhoff's admirable discovery," adding that he felt some of his friends had been over-zealous in his cause. It must be said, however, that English men of science have not accepted this disclaimer in all its fulness, and still attribute to Stokes the credit of having first enunciated the fundamental principles of spectrum analysis. In another way, too, Stokes did much for the progress of mathematical physics. Soon after he was elected to the Lucasian chair he announced that he regarded it as part of his professorial duties to help any member of the University in difficulties he might encounter in his mathematical studies, and the assistance rendered was so real that pupils were glad to consult him, even after they had become colleagues, on mathematical and physical problems in which they found themselves at a loss. Then during the thirty years he acted as secretary of the Royal Society he exercised an enormous if inconspicuous influence on the advancement

of mathematical and physical science, not only directly by his own investigations, but indirectly by suggesting problems for inquiry and inciting men to attack them, and by his unfailing readiness to give encouragement and help.

Several of the honours enjoyed by Sir George Stokes have already been enumerated. In addition, it may be mentioned that from the Royal Society, of which he became a fellow in 1851, he received the Rumford medal in 1852 in recognition of his inquiries into the refrangibility of light, and later, in 1893, the Copley medal. In 1869 he presided over the Exeter meeting of the British Association. From 1883 to 1885 he was Burnett lecturer at Aberdeen, his lectures on *Light*, which were published in 1887, dealing with its nature, its use as a means of investigation, and its beneficial effects. In 1891, as Gifford lecturer, he published a volume on *Natural Theology*. His academical distinctions included honorary degrees from many universities, together with the knighthood of the Prussian Order Pour le Mérite.

Stone, Edward James (1831–1897), British astronomer, was born in London on 28th February 1831. He was educated at the City of London School and at King's College, London, and in 1856 he obtained a scholarship at Queen's College, Cambridge, where he graduated as fifth wrangler in 1859, and was immediately elected fellow of his college. The following year he succeeded the Rev. R. Main as chief assistant at the Royal Observatory, Greenwich. The question most prominently before the attention of astronomers at that time was the determination of the exact value of the sun's mean parallax. Up to about the year 1854 astronomers had been inclined to adopt as final the value (8·57″) found by Encke from the transits of Venus of 1761 and 1769. It had, however, been shown by Hansen in 1854 and Le Verrier in 1861 that this value was probably too small by about one-thirtieth part. From a discussion of the observations of Mars made in 1860 and 1862 at Greenwich and Williamstown (near Melbourne), Stone deduced a value of 8·932″ (*Mon. Not. of R.A.S.*, vol. xxiii. p. 183), and in a further investigation, in which he included the observations made in 1862 at the Cape of Good Hope, he obtained 8·945″ (*Mem. of R.A.S.*, vol. xxxiii.). The evidence thus afforded in favour of the larger value led him to undertake a fresh discussion of the observations of the transit of Venus of 1769, from which he deduced the value 8·91″ (*Mon. Not. of R.A.S.*, vol. xxviii. p. 255). In 1865 he contributed a memoir to the *R.A.S.* on the constant of lunar parallax. He also determined the mass of the moon, and from a discussion of the Greenwich transit circle observations between 1851 and 1865 he found for the constant of nutation the value 9·134″. Nor were his labours confined to one branch of astronomy only. From 1866 to 1870 he was secretary of the Royal Astronomical Society, and many important papers from his pen appeared in its publications during that period. On the resignation of Sir Thomas Maclear in 1870 he was appointed her Majesty's astronomer at the Cape. His first task on taking up this post was the reduction and publication of a large mass of observations left by his predecessor. Rejecting the earlier observations made before the transit circle had been brought into regular use, he reduced and published the observations for 1856–1860, and compiled a catalogue of 1159 stars from these observations, within the space of four years. His principal work at the Cape was, however, his great catalogue of 12,441 stars, containing all stars down to the 7th magnitude between the South Pole and 25° S. declination, which was practically finished by the end of 1878. Meanwhile the post of Radcliffe Observer at Oxford had become vacant by the death of Main on 9th May 1878, and Stone had been appointed to succeed him, with permission to remain a year longer at the Cape in order to complete his work there. The final reduction and preparation of the catalogue for the press occupied most of his time at Oxford until its publication in 1881, but in 1880 the Oxford transit circle was thoroughly examined and preparations made for extending the observations of stars to the 7th magnitude from 25° S. declination to the equator. The results of these observations were collected in the *Radcliffe Catalogue* for 1890, which contains the places of 6424 stars to the 7th magnitude. Shortly after his return to England, Stone was elected president of the Royal Astronomical Society (1882–84), and during his occupancy of the post of Radcliffe Observer he was a frequent contributor to its publications, several of his contributions being of a controversial character, and relating to his supposed explanation of the errors in the position of the moon as deduced from Hansen's Tables. He was the first to recognize the importance of the old observations accumulated at the Radcliffe Observatory by Hornsby, Robertson, and Rigaud, and in a paper (*Mon. Not. of R.A.S.*, vol. lv.) on Hornsby's zenith-sector observations of γ Draconis (1788–91) he showed the excellent quality of these old and hitherto unpublished observations. He also commenced shortly before his death a reduction of the immense mass of observations made between 1774 and 1839 with the transit instrument and fine mural quadrants of the Radcliffe Observatory.

Although not himself famous as an observer, he directed and supervised the observations of his assistants with eminent ability and success. He was indefatigable in the examination and discussion of the observations, and was never so happy as when dealing with great masses of figures. The number of his astronomical publications exceeds 150, but his reputation as an astronomer will rest mainly on his earlier work at Greenwich and his two great star catalogues—the *Cape Catalogue* for 1880 and the *Radcliffe Catalogue* for 1890. He died at the Radcliffe Observatory, after a few days' illness, on the 9th May 1897. (A. A. R*.)

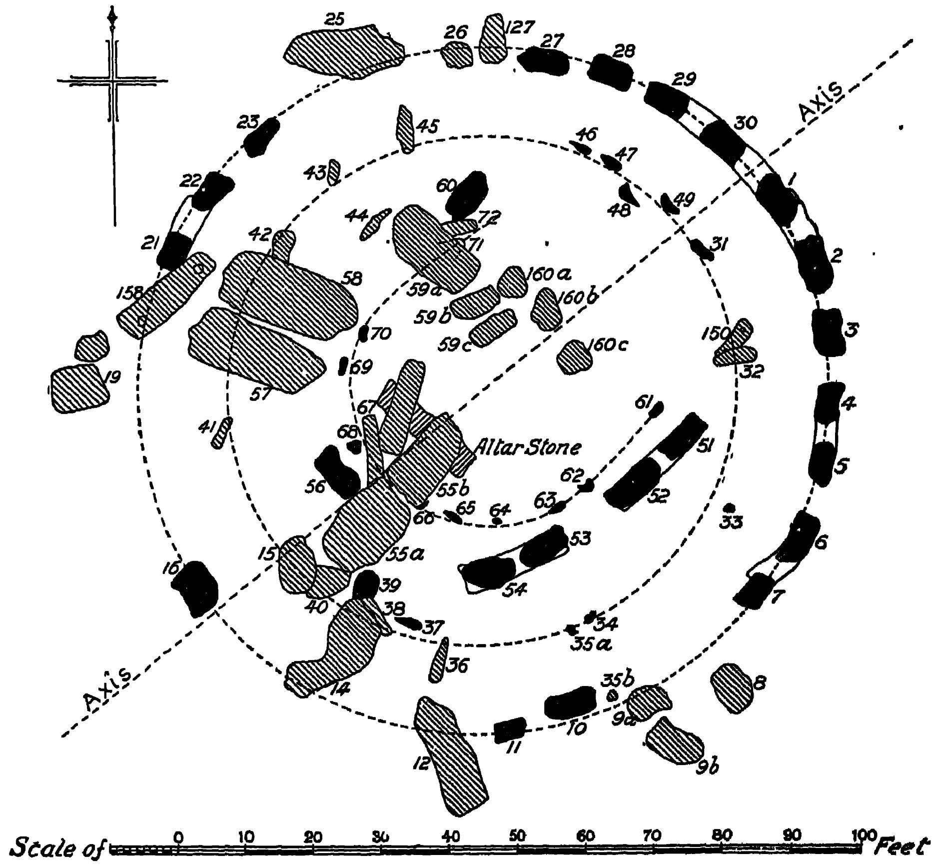
Stoneham, a town of Middlesex county, Massachusetts, U.S.A. It is in the north-eastern part of the state, 12 miles nearly north of Boston, on a line of the Boston and Maine Railroad. It has extensive manufactures of boots, shoes, and leather. Stoneham was incorporated as a town in 1725. Population (1880), 4890; (1890), 6155; (1900), 6197, of whom 1254 were foreign-born.

Stonehaven, a police burgh, seaport, favourite watering resort, and county town of Kincardineshire, Scotland, 16 miles south-south-west of Aberdeen by rail. There is a town hall, and a new railway station was built in 1900. A water-supply has been introduced and the drainage improved. The harbour is being extended; the town is an important centre of the fishing industry. Tanning and distilling are the principal industries. Population (1891), 4500; (1901), 4665.

Stonehenge.—On the evening of 31st December 1900 one of the outer trilithons (22 on Plan), with its lintel, was blown down in the course of a severe storm, this being the first collapse since 3rd January (*not* June) 1797, when one of the fine trilithons (57, 58) of the horseshoe fell. This catastrophe attracted renewed attention to the state of Stonehenge, and much discussion took place as to the taking of precautions against further decay.

The annexed Plan, which is that of Professor Flinders Petrie, shows the state of Stonehenge at the moment preceding the fall of the trilithon on 31st December 1900. Within a circular earthwork, 300 feet in diameter, is an outer circle of trilithons (100 feet in diameter) formed by great monoliths (sarsens), originally thirty in number, with large lintel stones. Within this circle is another formed of smaller "blue stones," only a few of which remain *in situ;* within that was a horse-shoe of five huge trilithons, with ten monoliths (sarsens); and within the horse-shoe was an inner horse-shoe of "blue-stones." The open part of the horse-shoe exactly faces the sunrise at the summer solstice. Beyond the outer circle (not shown on Plan), a great monolith—the Sun Stone—standing on the axis of the horse-shoe, marks the point where a spectator, centrally placed within the horse-shoe, would see the sun rise on the horizon at the solstice. On the circumference of the earlier circle (not shown on Plan), which is here intentionally broken, a great recumbent stone—the Slaughter Stone—lies along the axis; and across the axis, near the central curve of the inner horse-shoe, lies a fine recumbent stone, the Altar Stone.

Only half the outer circle sarsens now remained upright, three on the west, thirteen on the east; and this indicated the effect of the prevalent west wind. The fall of trilithon 22 and its lintel opened a larger path to the wind, and added to the danger of further destruction. Moreover, the narrow passages between the eastern monoliths had become worn by use into hollows which threatened their foundations. The acquisition of Salisbury Plain by the War Office for military purposes seemed likely, again, to add to the risk of harm from thoughtless visitors. For



Stones standing on 30th December 1900
Stones recumbent on same date.

all reasons, an attempt to preserve Stonehenge was desirable; and the owner, Sir Edmund Antrobus, was willing, on certain conditions as to limitations of access, to co-operate with the Society of Antiquaries, Wiltshire Archæological Society, and Society for the Preservation of Ancient Monuments, in taking such steps as might be necessary to prevent more stones from falling, and even (if possible) to set up some which had fallen. The societies advised that trilithon 6, 7, with lintel—which had slewed round—and trilithon 56, which was leaning at a dangerous angle, should be examined with a view to replacement with as little excavation as possible; that the monolith and lintel 22 be replaced, and its companion sarsen (21) secured; and that trilithons 57, 58, should be re-erected in its place, which was exactly known. Steps were taken to place the matter in the hands of engineering experts. On 19th September 1901 trilithon 56 was successfully raised to a perpendicular position. It then presented an imposing appearance, standing 21 feet above ground; its total length was found to be 29 feet 6 inches, and its weight about 30 tons. The excavations were carried to a depth of 8 feet 3 inches below the datum line, and many objects were found, including chippings and lumps of the stones, stone tools, bones, and (in the upper strata) coins and fragments of pottery. Nearly 100 implements belonging to the Neolithic age were excavated—axes, hammer axes, stone hammers and mauls—which, according to Dr W. Gowland, who superintended the work, had been used not only for breaking the rude blocks into regular forms, but also for working down their faces to a level or curved surface. No light was thrown, however, on the transport of the blocks.

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Stonehouse. See PLYMOUTH.

Stonington, a town of New London county, Connecticut, U.S.A. It contains an area of 42 square miles of rolling country, situated in the south-eastern part of the state. It contains Stonington borough, besides several villages and a rural population. Stonington borough is situated on the shore of Long Island Sound, on a good harbour, and has daily steamer connexion with New York. It is also on the main line of the New York, New Haven, and Hartford Railroad. Its manufactures are varied, and include machinery and textile goods. Population of the town (1890), 7184; (1900), 8540; of the borough (1900), 2278. Of the population of the town in 1900, 1968 were foreign-born and 141 negroes.

Stony Point, a town and village in Rockland county, New York, U.S.A. It is on a rocky promontory, on the west shore of the river Hudson, about 42 miles north of New York City, and is traversed by three railways—the New Jersey and New York; the New York, Ontario, and Western; and the West Shore. During the Revolutionary War it was fortified by the Americans, captured by the British, and retaken by the Americans. About six miles below the town, on the river, is the spot where the conspirators Arnold and André held their secret conference to arrange for the surrender of West Point. Population of the town (1880), 3308; (1890), 4614; (1900), 4161.

Stornoway, a burgh of barony, police burgh, and seaport of the island of Lewis, Ross-shire, Scotland. The sum of £75,000 has been spent in improving the harbour. There is regular steamer communication with the mainland. In 1888, 1268 vessels of 187,385 tons entered; in 1898, 1576 vessels of 269,943 tons. Exports (chiefly fish) were valued at £98,023 in 1888 and £150,669 in 1898. During the herring fishing season the population is increased to 10,000. Stornoway is one of the chief kippering districts in the United Kingdom. There is a court-house, a naval reserve station at which some 2200 men are trained annually, a public library, and a public school with a secondary department; also a female industrial school. Population (1891), 3386; (1901), 3711.

Story, William Wetmore (1819–1895), American poet and sculptor, the son of the jurist Joseph Story, was born at Salem, Massachusetts, 12th February 1819. He graduated at Harvard College in 1838, and two years later at the Harvard Law School, and was admitted to the bar, but followed the law only five years. In 1848 he went to Italy, made it his home for the rest of his life, and devoted himself entirely to art and literature. As a sculptor he is perhaps best known for his statues of Cleopatra, Josiah Quincy, Edward Everett, and George Peabody, the last of which was erected in London in 1869. Among his longer poems are "A Roman Lawyer in Jerusalem" (a "rehabilitation" of Judas Iscariot), "A Jewish Rabbi in Rome," "The Tragedy of Nero" (a separate volume), and "Ginevra di Siena." The last named poem and "Cleopatra"—one of the most striking of his shorter productions—are included in *Graffiti d' Italia*, a collection published in 1868, of which "all the poems are intended to be dramatic in their character." His collected poems were published in two volumes in 1885. His prose works comprise *The Life and Letters of Joseph Story; Roba di Roma; or, Walks and Talks about Rome; Vallombrosa; Fiammetta* (a novel); *Conversations in a Studio;* and *Excursions in Art and Letters.* Of these *Roba di Roma* is the most widely read and most likely to endure. Story was an intimate friend of the Brownings in Italy, and his treatment of certain themes often brings their works to mind. He died at Vallombrosa, 7th October 1895. A fragmentary account of his life is given in Mary E. Phillips's *Reminiscences of William Wetmore Story.*

Stourbridge, a market town of Worcestershire, England, in the Droitwich parliamentary division, 10 miles west of Birmingham by rail. Since 1894 it has been governed by an urban district council. Electric tramcars connect it with Brierley Hill and Dudley. A town hall was built in 1887, and the Corbett Hospital at Amblecote, founded in 1892, was enlarged in 1895. Population of the urban district (which includes the townships of Upper Swinford and Wollaston) in 1891, 14,891; in 1901, 16,302.

Stowe, Harriet Elizabeth (Beecher) (1811–1896), American writer and philanthropist, seventh child of Lyman and Roxana (Foote) Beecher, was born at Litchfield, Connecticut, U.S.A., 14th June 1811. Her father (the Congregational minister of the town) and her mother were both descended from members of the company that, under John Davenport, founded New

HARRIET BEECHER STOWE.
(From a photograph by Sarony, New York.)

Haven in 1638; and the community in which she spent her childhood was one of the most intellectual in New England. At her mother's death in 1815, she came most directly under the influence of her eldest sister Catherine, eleven years her senior, a woman of keen intellect, who a few years later set up a school in Hartford to which Harriet went, first as a pupil, afterwards as teacher. The society about her, both in Litchfield and Hartford, was one in which the supremacy of religion in the training of the young was fully recognized, and her ardent, imaginative nature was deeply stirred by the problems of personal religion. In 1832 her father, who had for six years

been the pastor of a church in Boston, accepted the presidency of the newly founded Lane Theological Seminary at Cincinnati. Catherine Beecher, who was eager to establish what should be in effect a pioneer college for women, accompanied him; and with her went Harriet as an assistant, taking an active part in the literary and school life, contributing stories and sketches to local journals, and compiling a school geography. She was married, 6th January 1836, to one of the professors in the seminary, Calvin Ellis Stowe. In the midst of privation and anxiety, due largely to her husband's precarious health, she wrote continually, and in 1843 published *The Mayflower*, a collection of tales and sketches. Mrs Stowe passed eighteen years in Cincinnati under conditions which constantly thrust the problem of human slavery upon her attention. A river only separated Ohio from a slave-holding community. Slaves were continually escaping from their masters, and were harboured, on their way to Canada, by the circle in which Mrs Stowe lived. In the practical questions which arose, and in the great debate which was political, economical, and moral, she took a very active part. When, therefore, in 1850, Mr Stowe was elected to a professorship in Bowdoin College, Brunswick, Maine, and removed his family thither, Mrs Stowe was prepared for the great work which came to her, bit by bit, as a religious message which she must deliver. In the quiet of a country town, far removed from actual contact with painful scenes, but on the edge of the whirlwind raised by the Fugitive Slave Bill, memory and imagination had full scope, and she wrote for serial publication in the *The National Era*, an anti-slavery paper of Washington, D.C., the story of *Uncle Tom's Cabin; or, Life among the Lowly*. The publication in book form, 20th March 1852, was a factor which must be reckoned in summing up the moving causes of the war for the Union. The book sprang into unexampled popularity, and was translated into at least twenty-three tongues. Mrs Stowe used the reputation thus won in promoting a moral and religious enmity to slavery. She reinforced her story with *A Key to Uncle Tom's Cabin*, in which she accumulated a large number of documents and testimonies against the great evil; and in 1853 she made a journey to Europe, devoting herself especially to creating an *entente cordiale* between Englishwomen and Americans on the question of the day. In 1856 she published *Dred; a Tale of the Dismal Swamp*, in which she threw the weight of her argument on the deterioration of a society resting on a slave basis. The establishment of *The Atlantic Monthly* in 1857 gave her a constant vehicle for her writings, as did also *The Independent* of New York, and later *The Christian Union*, of each of which papers successively her brother, Henry Ward Beecher, was one of the editors. From this time forth she led the life of a woman of letters, writing novels, of which *The Minister's Wooing* is best known, and many studies of social life in the form both of fiction and essay. She published also a small volume of religious poems, and towards the end of her career gave some public readings from her writings. In 1852 Professor Stowe accepted a professorship in the Theological Seminary at Andover, Massachusetts, and the family made its home there till 1863, when he retired wholly from professional life and removed to Hartford. After the close of the war for the Union, Mrs Stowe bought an estate in Florida, chiefly in hope of restoring the health of her son, Captain Frederick Beecher Stowe, who had been wounded in the war, and in this Southern home she spent many winters. After the death of her husband in 1886, she passed the rest of her life in the seclusion of her Hartford home, where she died 1st July 1896. She is buried by the side of her husband at Andover.

See *Life of Harriet Beecher Stowe*, compiled from her letters and journals by her son, CHARLES EDWARD STOWE (Boston, 1890). *Life and Letters of Harriet Beecher Stowe*, edited by ANNIE FIELDS (Boston, 1898). (H. E. S*.)

Stowmarket, a market town and urban district, Suffolk, England, in the Stowmarket parliamentary division of the county, 12 miles north-west of Ipswich by rail. The church of SS. Peter and Mary is in the Decorated and Early English styles. Its spire contains eight bells, re-hung in 1894. A fever hospital was opened in 1896. The town has an extensive chemical manufactory, iron foundry, and factories for the manufacture of gun-cotton, agricultural implements, and compressed leather. There is also considerable trade in corn, malt, coal, slate, and timber. Population (1891), 4339; (1901), 4162.

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